ENLIGHT'EM

European Training Network in Low-Energy Visible Light IoT Systems

Innovative Training Networks (ITN)

H2020-MSCA-ITN-2018

Deliverable D4.3

Third report on training activities, presentation of the results of past events and detailed planning of upcoming events

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Deliverable D4.3

Third report on training activities, presentation of the results of past events and detailed planning of upcoming events

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All beneficiaries.

Abstract

This document captures the third annual report on training activities, presentation of the results of past events and detailed planning of upcoming events of the ENLIGHT'EM project. The purpose of all these activities is the optimization of ESRs learning during their PhD programs, as well as the dissemination of knowledge in the project research field.

Revision History

Version	Editor	Date	Change
0.1	Borja Genovés	12/05/2022	First version of deliverable.
0.2	Domenico Giustiniano	17/05/2022	Editorial changes to the content.
1.0	Borja Genovés and Domenico Giustiniano	31/05/2022	Final editorial work.


European
Commission

Executive summary

This document captures the third annual report on training activities, presentation of the results of past events and detailed planning of upcoming events of the ENLIGHT'EM project. The purpose of all these activities is the optimization of ESRs learning during their PhD programs, as well as the dissemination of knowledge in the project research field.

Event 0, Training Event 1, 2 and 3 took place within the first and second years of the project, whose details were included in D4.1 and D4.2, respectively. This document focuses on Training Event 4, 5 and 6, which took place during the third year of the project. Besides, planning for Training Events 7, 8, 9 and 10 are included in this document, which will take place during the fourth year of the project.

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List of Abbreviations

ENLIGHT'EM: European Training Network in Low-Energy Visible Light IoT Systems

ESR: Early-stage researcher

EWSN: International conference on embedded wireless systems and networks

IoL: Internet of Lights

MSCA: Marie Skłodowska-Curie Actions

R&D: Research and Development

1. Introduction

1.1. Scope and objectives

This document contains the third annual report on training activities, results of past events and detailed planning of upcoming events, which constitutes the deliverable D4.3 of the H2020-MSCA-Innovative Training Network nº 814215 ENLIGHT'EM.

The purpose of this document is to report the training activities carried out in the project with the main objective of optimizing the training of the early-stage researchers (ESRs) that belong to the training network. Furthermore, a compendium of the results from the training events is detailed, as well as a brief description of the next training events and information about their organization.

1.2. Document structure

The remainder of this document includes a description of the training activities in the third year of the project (M25-M36) in Section 2, the results of these training events together with important additional results in Section 3, and finally details of next training events in Section 4.

1.3. Project situation

The project has reacted promptly to minimize the effects of the critical situation that the COVID-19 pandemic created. As can be seen in this deliverable, some Training Events have been affected by COVID-19 pandemic, mainly most of them are being organized in a remote mode, always guaranteeing the quality of the training events as well as the safety of all ENLIGHT'EM members. Fortunately, we have established a normal situation and, more recently, events are being organized in person.

2. Training activities to date

This Section presents the training events that took place during year 3, providing details of the organization and description of the contents.

2.1. Training Event 4

The objective of Event 4, based on the Annex I of Grant Agreement, was as follows:

Event 4: Training on VLC technology & Research commercialisation, and project meeting

The purpose of this event is two-fold and leverages the close-by location of UEDIN and PLF for improved efficiency. The first half will be led by UEDIN, one of the world's leading centers in VLC research, and has the purpose to train the ESR with the latest advancements in VLC technology, as well as in measurement and experimental technology in general. The second half will be led by PLF, a successful spin off from UEDIN, and will focus on the early-stage development of commercial products based on customer information, and on the technology transfer process from the research into the business world.

The Training Event 4 took place virtually on June 16th, 17th, 18th, 2021. The first day was dedicated to the Training on VLC Technology provided by UEDIN. Then the second day was dedicated to the Project Meeting #4 to which both supervisors and ESRs attended. Finally, the second part of the training called Training on Research Commercialization was given by PureLiFi Ltd on the 18th June, 2021.

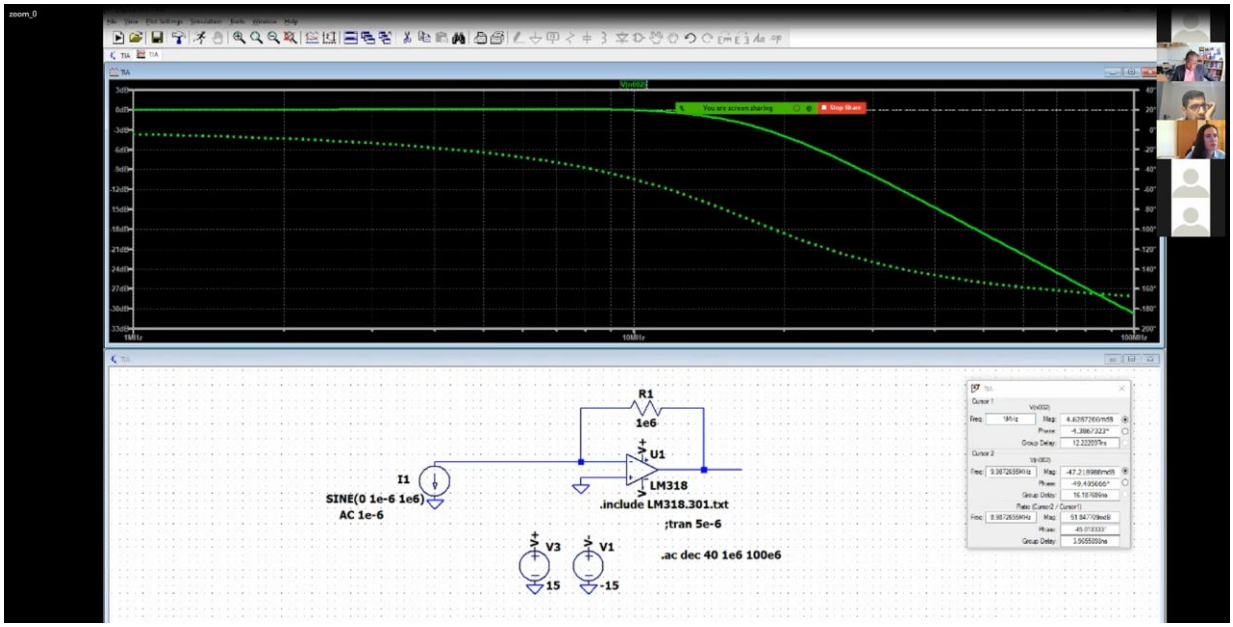

Figure 1: Picture of Prof. Popoola giving the online training to ESRs during Training Event 4

The agenda of the training event is reported below.

**

Day 1 (16th June 2021): Training on VLC Technology (UEDIN)

Location. Remotely via Zoom.

Table 1: Agenda of first half Training Event 4

Time (CEST)	Training module	Talk explain	Responsible
10:30- 10:40 – 11:10	Welcome Optical Wireless Communications	Talk on Optical Wireless Communications	Dr W. Popoola Dr M. Safari
Coffee break			
11:30-12:30	VLC Transceiver Design (Virtual Workshop)	Introduction to VLC transceiver design in LTSpice	UEDIN
LUNCH			
14:30-15:30	VLC Transceiver Design (Virtual Workshop)	Transceiver design in LTSpice	UEDIN
Coffee break			
16:00-17:00	VLC Transceiver Design (Virtual Workshop)	Design performance evaluation/presentation	UEDIN

Day 2 (17th June 2021): Project meeting #4

Day 3 (18th June 2021): Training on Research Commercialization (PLF)

Location. Remotely via Zoom.

Table 2: Agenda of second half Training Event 4

Time (CEST)	Training module	Talk explain	Responsible
9:30–9:40	Opening	Introduction	Rui Bian
9:40-10:40	Talk 1	LiFi ecosystem	Nikola Serafimovski
Coffee break			
11:00-12:00	Talk 2	Talk on agile project management; how to manage a team	Alan Kitching

LUNCH			
14:00-15:00	Talk 3	Talk on Research commercialization	Sarah Scace
Coffee break			
15:20-15:50	Talk 4	'The LiFi Journey and its Potential Toward Net-zero Wireless Networks'	Harald Haas
15:50 – 16:15	Information & Instruction	'How to make full use of your results' - introduction on the available services for a successful dissemination and exploitation (D&E)	Rui Bian

**

All speakers are experts in their respective topics, and all of them are employees of institutions involved in ENLIGHT'EM.

All the slides are available to all project partners in the internal GitLab repository of the project.

2.2. Training Event 5

The objective of Event 5, based on the Annex I of Grant Agreement, was as follows:

Event 5: Training on research exploitation, Presentation at IEEE standardization meeting

The activity will focus on fostering the entrepreneurial spirit. Our beneficiary TREL will provide an open training session on research exploitation. This session will cover topics of key relevance for successful startups and large organizations such as IPR generation, standardization and commercial exploitation of results. Alongside this event, we will take the opportunity offered by an IEEE standardization meeting, which usually occurs in Europe in the middle of the year. This meeting will give ESRs a chance to present their work in front of one of the Task/Study Groups (802.11 Light Communications; IEEE 802.15.7) and to understand the steps of a standardization process as it is happening live. This second activity will be led by our beneficiaries OZU and PLF, who are playing a leading role in VLC standardization.

The Training Event 5 took place virtually on July 8th, 9th, and the two weeks from 9th to 23rd, 2021 for IEEE Plenary session. We decided to split the event into two main blocks (8th – 9th and later on from 9th to 23rd) to avoid long online sessions. The first day (full day) was dedicated to the Training modules on research exploitation (morning) and on standardization (afternoon), whereas the second day morning was employed for the Project Meeting #5. There, we presented the main 2nd-year outcomes of the project and we received very valuable feedback from every component of the project.

We include the agenda of the first day of Training Event 5 in the following, as well as the description of each talk and a short biography of the speakers:

**

Training (1 day): 8th July, 2021

Table 3: Agenda of first day Training Event 5

IPR generation (TREL) Speaker: Thomas Prock	10:30 – 11:30 (1 hour)
Coffee break	11:30 – 11:45
From the lab to the market: How to test the commercial demand for your idea Speaker: Thomas Bierton	11:45 – 12:25 (40 min)
Commercial Exploitation of R&D Activities: A Case Study Approach Speaker: Dr Adnan Aijaz	12:25 – 12:45 (20 min)
Lunch break	12:45 – 14:15
Standardization (Part 1) Speaker: Dr. Tuncer Baykas Title: IEEE 802 Standardization for Scholars and Students (Part 1)	14:15 – 15:15 (1 hour)
Coffee break	15:15 – 15:30
Standardization (Part 2) Speaker: Dr. Tuncer Baykas Title: IEEE 802 Standardization for Scholars and Students (Part 2)	15:30 – 16:30 (1 hour)

IPR generation (TREL)

This session was conducted by a qualified attorney who covered theory behind IP and the journey from idea generation to different stages of protecting it. It discussed different types of mistakes (such as, public disclosures) that prevent companies from exploiting/monopolizing the idea.

Speaker biography: Thomas advises clients in the high-tech field, in particular, in the electronics sector on software, artificial intelligence and internet related subject matter. Thomas moreover has a large medical devices practice and is active in the Cleantech field.

Thomas leads the Marks & Clerk practice group for Additive Manufacturing / 3D Printing; a technology in which he is considered an expert. He has been invited more than once to join a panel of experts, as the only private practice patent attorney, to present at conferences organised by the European Patent Office (EPO) on the challenges 3D printing poses to IP.

He has worked on patent applications relating to non-volatile semiconductor storage devices, data processing and exchange, mobile telecommunications, smart grid related inventions, waste reduction and medical imaging, to name a few. Thomas also has experience in contentious related matters, including European oppositions, appeals and litigation.

Thomas graduated with a Diploma in Biomedical Engineering from the University of Applied Science in Ulm (Germany) and went on to obtain his PhD from the Institute of Cancer Research, where he investigated the interaction between radio frequency electromagnetic fields and conducting tissue, with particular emphasis on its application to the design of phased array resonators.

Having qualified as a Chartered (UK) and European Patent Attorney in 2007, in 2014 Thomas became one of the few professionals to also qualify as a Patentanwalt (German Patent Attorney).

In the LMG Life Sciences Guide 2014, Thomas is listed as a ‘Life Sciences Star’ for his work in the medical devices area. He is also commended in the inaugural Who's Who Legal - Patent Agents, which refers to him as a “definite inclusion on any list”.

Commercial Exploitation of R&D Activities

From the lab to the market: How to test the commercial demand for your idea

Abstract: Taking technology from concept to product is a difficult challenge to address. While I’m sure you will have tested your technology in a number of different ways to see whether it can be done, it is less likely that you have done some work around whether it should be done. Applying a rigorous and methodical approach to testing demand is as important as applying the same methods to testing the technology itself. In order to take an idea from the lab and towards a commercial product, you need to have explored the competitive landscape and customer demand for your idea. In this talk we discussed methods of exploring the market for your idea, followed by how to test the demand using a methodology called ‘the Startup Way’. This method sees you listing the key assumptions about your customers and market that must be true for your idea to succeed, followed by designing minimum viable products (read: experiments) that test as many of these assumptions as possible. Following the session, you are able to think of methods of testing the commercial assumptions to your ideas that will help you to more quickly identify potential customers for your R&D activities

Speaker biography: Thomas Bierton is a Research Analyst at Toshiba's Bristol Research and Innovation Laboratory. His principal activities include analyzing markets and developing strategies for commercializing technologies. He has a Master of Business Administration from the University of West of England where he focused on Strategy, Digital Transformation, and Operations. During this time, he completed a consultancy project for Toshiba looking into potential business models for autonomous mobile robot solutions for small and medium enterprises with warehouses. He has a diverse background in project management at a legal software company as well as a Bachelor of Science in Molecular Biology from Cardiff University. He is interested in disruptive technologies and taking business ideas from concept to product.

Commercial Exploitation of R&D Activities: A Case Study Approach

Abstract: Go-to-market strategy for R&D outputs in the Internet of Things domain requires meticulous planning, patience, and perseverance. As a brilliant idea goes from different maturity stages of intellectual property protection, proof of concept, standardization, manufacturing, and software development, there are hurdles all along the way. The talk touched on some of these hurdles and the strategies to make a success out of all these efforts. Preparing the market to uptake the latest technology often requires building a support ecosystem from major industry players. This is typically achieved by participation in standardization and building commercial alliances. We can't stress enough the importance of these activities that are easily ignored while working in an academic setting. We presented some of the successful case studies in recent years that have crossed the chasm between idea and market successfully. This enabled us to highlight some of the best and proven practices for commercial exploitation of R&D activities.

Speaker biography: Dr Adnan Aijaz studied telecommunications engineering at King's College London, UK, where he received a Ph.D. in 2014 for research in wireless networks. He has held various roles in industry, academia, and corporate research during his 8+ years of experience in the wireless domain. He joined the Bristol Research and Innovation Laboratory (BRIL) of Toshiba Corporation in 2015, where he currently holds the position of Innovation Programme Lead. His recent research areas include industrial communication systems and automation networks, next-generation mobile/cellular (5G and beyond) and Wi-Fi technologies, cyber-physical systems, and robotics and autonomous systems. He has several patents and publications in these areas. He has been contributing to various national and international research projects and standardization activities related to industrial communication.

IEEE 802 Standardization for Scholars and Students

The IEEE 802 LAN/MAN Standards Committee develops and maintains networking standards and recommended practices from body area to metropolitan area networks, using an open and accredited process, and advocates them on a global basis. Among its working groups 802.11, 802.15, 802.16, 802.19 and 802.22 focus on wireless communication. In this talk, we reviewed those task groups' current projects and activities, focusing on light communications. We provided suggestions on how researchers from academia can contribute and benefit from the 802 standardization process.

Speaker biography: Dr. Tuncer Baykas received his Ph.D. in Electrical Engineering from the University of Ottawa in 2007. Then, he joined National Institute of Information and Communication Technologies of Japan same year. During his tenure, he contributed to multiple standardization projects, including 802.15.3c, 802.11ad and 1900.7. He served as the chair of IEEE 802.19.1 Coexistence in TVWS Task Group. He joined Istanbul Medipol University as assistant professor in 2014, where he was the founding head of the Computer Engineering Department. Currently he is the vice chair of 802.19 Working Group and 802.11bb Light Communications Task Group. In addition, he is serving as liaison officer between 802.19 and 802.11 groups. His research interests include THz communications, spectrum sharing and radar signal processing. Dr. Baykas is one the recipients of Turkish Academy of Sciences Young Researcher Awards, IEEE-SA Standards Board Award and IEEE-SA certificate of appreciation. He served as guest editor for IEEE Communications Magazine and board member IEEE Comsoc MMTC E-Letters. He organized 2017 Istanbul IEEE 5G Summit and 2018 IEEE Standards Summits in Ankara and Istanbul. He is IEEE Turkey Board Member and IEEE Comsoc Turkey Chapter chair. Dr. Baykas has over 50 major journal and conference publications and 3 US, 34 Japanese Patents.

Project meeting #5: 1/2 day (Organized by Borja and Domenico)

9th July 2021 from 10h00 CEST.

Training: Meetings of IEEE Plenary session (several talks and meetings)

Spread over July 09-23.

These were the main instructions provided by the training event organizer (Prof. Murat Uysal):

1. The past and future meeting dates (including the current July meeting) are available here: https://www.ieee802.org/11/Meetings/Meeting_Plan.html
2. For registration, ESRs need to go to above link and click "registration is now open" to proceed with registration and payment.
3. Calendar of all IEEE standardization meetings for July meeting is available at https://www.ieee802.org/11/ (Check calendar on right hand side).
4. ENLIGHT'EM ESRs will be mainly interested in attending 802.11 TGbb. Please check the meeting times of 802.11 TGbb from this calendar and click on the zoom links provided. Most of them are in the week of July 12th. See calendar here: https://www.ieee802.org/11/adminCalendar.html
5. ESRs need to attend 75% of 802.11 TGbb meetings. ESRs must report which sessions they attended in a formal report, detailing a summary of each session (1 page

maximum). Once done, please submit it at the corresponding ENLIGHT'EM GitLab folder.

**

All speakers are experts in their respective fields. In the following image you can see a picture of ESRs attending the Training on Standardization and the IEEE Plenary Session on LiFi standard IEEE 802.11bb:

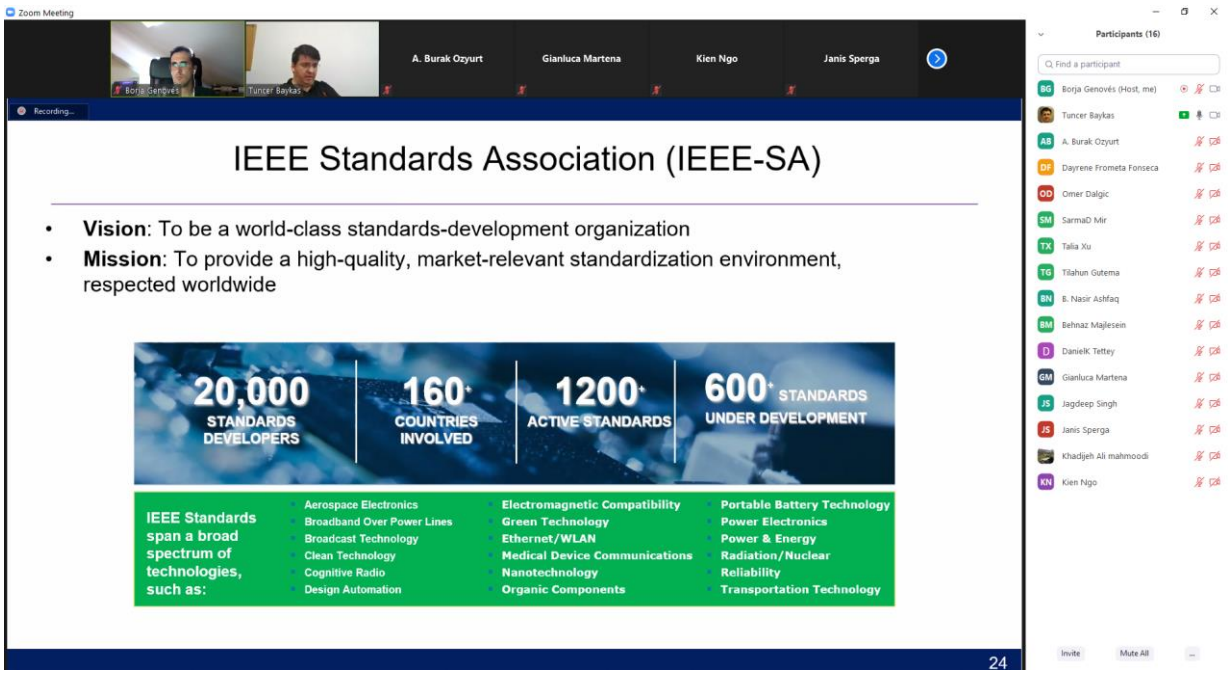

Figure 2: Picture of Dr. Tuncer Baykas giving a Training on IEEE 802 Standardization for Scholars and Students

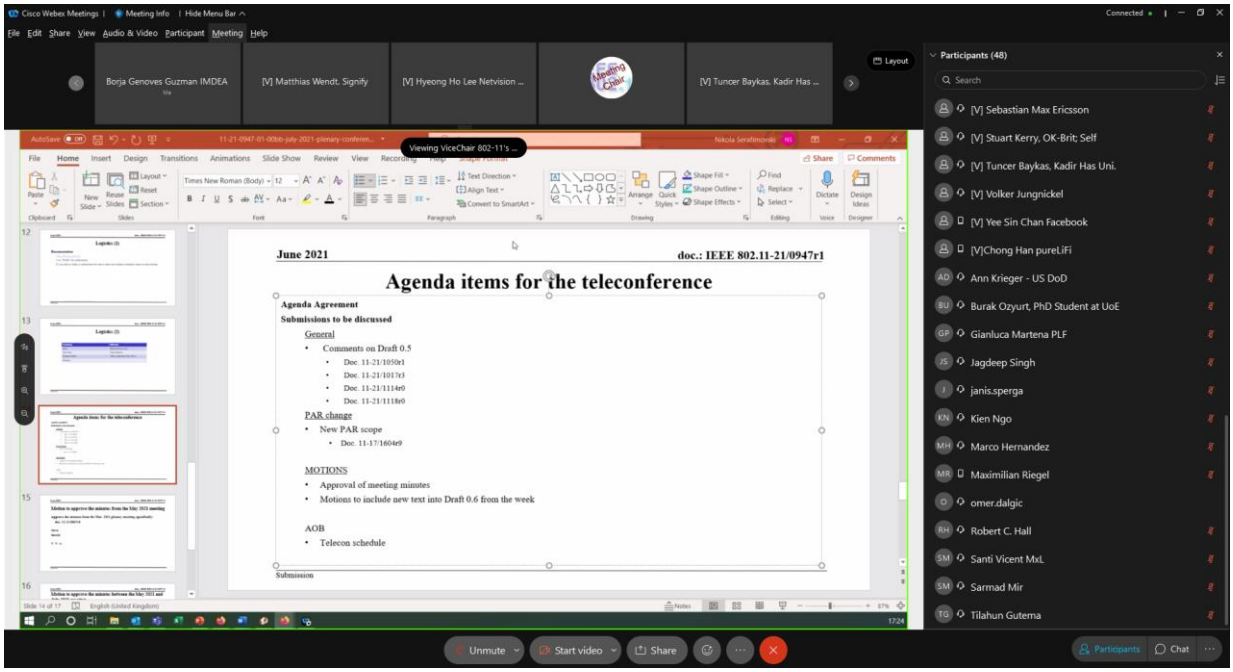

Figure 3: Picture on IEEE Plenary session where we can see some ESRs among the attendees

2.1. Training Event 6

The objective of Event 6, based on the Annex I of Grant Agreement, was as follows:

Event 6: Training on industrial careers, Workshop at conference, and project meeting

The first objective of this event is to train our ESRs in industrial careers. Two industry partners, TRI and ZII, will provide training on making a transition from academia to industry, technology roadmap (TRM) and innovation management, TRL process engineering, and building and leading teams. The second objective will involve organizing a second special workshop co-located with ACM Mobicom, giving ESRs a continuous opportunity to showcase their work and receive substantial feedback from an expert community.

The Training Event 6 was split in two parts. The first one was an online workshop titled 'Internet of Lights' organized by SUPSI, co-located with ACM Mobicom 2021 conference. It took place virtually on June 25th, 2021. The second part took place on May 26th, 2022, and it was dedicated to a Training on Research & Innovation and career opportunities after the PhD (including MSCA-PF). We originally planned a training on industrial careers in Tridonic facilities (Austria), but due to the unavailability of the company to find a timeslot to host the project members, we decided to organize a Training Event in person in Madrid. This was a priority, as many ESRs did not know each other in person yet, and this is key to leverage the training network. It is important to note that the training on industrial careers has been postponed and will be co-located with Training Event 8 organized by FORD in Turkey.

In the following we include the Call for Papers and the Program of the workshop:

**

Call for papers:

Title: Internet of Lights, workshop co-located with Mobisys 2021

Site: https://enlightem.eu/results/workshops/iol-workshop/

Date: 25 June 2021

The objective of this workshop is to provide a forum for researchers and practitioners to share early-stage ideas and results on how to leverage the potential of Li-Fi and the underlying Visible Light Communication technology in the Internet of Things.

Original papers addressing both theoretical and practical aspects of Li-Fi in the IoT are solicited. Papers describing prototype implementations and deployment of such applications and systems are particularly welcome. The submission of informative surveys of the state of the art as well as position papers on controversial issues is also encouraged. (An itemized list of topics has been omitted due to space constraints).

The topics of interest include, but are not limited to:

- Energy efficiency in LiFi
- Spectrum efficiency in LiFi
- Low-power VLC systems
- Simultaneous Data and Power Transfer
- Passive Communication and Sensing
- Resource-constrained VLC
- Resilient LiFi for IoT applications
- LiFi systems for home automation
- LiFi systems for smart buildings
- Interplay of LiFi and smart lighting
- Indoor Positioning Systems based on LiFi/VLC
- Integration of VLC/LiFi and mm-Wave technologies
- Power-efficient underwater optical communications
- Applications of LiFi to smart energy systems
- Applications of LiFi to smart vehicles and smart transportation

- Applications of LiFi to smart manufacturing

Program:

3:00 pm CEST / 2:00 pm BST / 9:00 am EDT

Opening remarks and keynote

Lecture by Prof. Harald Haas (LiFi Research and Development Centre, University of Strathclyde, UK)

Title: Multi-Gigabit/s LiFi Networking for 6G

Abstract: We will first review light sources, detectors, and transmission techniques for LiFi. Moving on we will present networking architectures based on a grid-of-beam approach to achieve 10s of gigabit/s user data rate in LiFi multiuser networks. We will discuss advantages of the proposed system such as enhanced physical layer security and moot existing challenges.

Speaker biography: Director of the LiFi Research and Development Centre (University of Strathclyde, UK). Born in Neustadt an der Aisch (Germany), Professor Harald Haas graduated as an electrical engineer in 1994 from Technische Hochschule Nürnberg (Germany). He subsequently received a Heinz-Nixdorf scholarship to gain experience in South-East Asia and lived in Mumbai for a year working for Siemens Mobile Communications then joined Siemens Semiconductor (now Infineon) as an application engineer for a GSM (2G cellular) chipset in Munich in 1995. He moved to Scotland to embark on a PhD programme at the University of Edinburgh and on completion in 2001, returned to Germany to work as a research manager on 4G cellular communication systems with Siemens in Munich. In 2002, he became an Associate Professor at the Jacobs University in Bremen then rejoined Edinburgh in 2007, where together with one of his former postdoctoral students, Mostafa Afgani, founded pureLiFi Ltd, in 2012. He remains its Chief Scientific Officer and a member of the Board of Directors. The company has two registered PhD students who are employed as part of an H2020 Marie Curie Initial training network, ENLIGHT'EM. Haas was elected a Fellow of the Royal Society of Edinburgh in 2017, Fellow of the IEEE in 2017 and Fellow of Royal Academy of Engineering in 2019. When he is not working, Professor Haas enjoys outdoor activities – canoeing, hiking and riding.

Session chair: Daniele Puccinelli, University of Applied Sciences and Arts of Southern Switzerland (SUPSI)

4:15 pm CEST / 3:15 pm BST / 10:15 am EDT

Session 1: Communication Protocols

Session chair: Daniele Puccinelli, University of Applied Sciences and Arts of Southern Switzerland (SUPSI)

"LED-to-LED based VLC Systems: Developments and Open Problems"

Muhammad Sarmad Mir (IMDEA Networks Institute, Madrid, Spain); Behnaz Majlesein (LightBee S.L., Las Palmas de Gran Canaria, Spain); Borja Genoves Guzman (IMDEA Networks Institute, Madrid, Spain); Julio Rufo (LightBee S.L., Las Palmas de Gran Canaria, Spain); Domenico Giustiniano (IMDEA Networks Institute, Madrid, Spain)

“Adaptive WDMA: improving the Data Rate of a densely deployed LiFi Network”

Giovanni Luca Martena (University of Strathclyde); Rui Bian (pureLiFi Ltd); Harald Haas (University of Strathclyde)

“Link Adaptive Protocol for V2LC”

Meysam Mayahi, Valeria Loscri (Inria Lille - Nord Europe); Antonio Costanzo (Inria Lille-Nord Europe)

5:15 pm CEST / 4:15 pm BST / 11:15 am EDT

Session 2: Deployments

Session chair: Frank Lochmann, Tridonics

“Position: Drone Camera Communication meets Robotic Soil Sensing”

Bhawana Chhaglani (UMass Amherst, USA); Harsh Gupta (Wheeler Magnet High School); Khadija Ashraf, Ashwin Ashok (Georgia State University, USA)

“Gbps Optical Underwater Wireless Communication in the Presence of Turbulence and Random Sea Surface”

Wasiu Popoola, Egecan Guler, Jianming Wang, Callum Geldard (The University of Edinburgh)

“Multi-cell Deployment for Experimental Research in Visible Light Communication-based Internet of Things”

Javier Talavante, Borja Genovés (IMDEA Networks Institute); Domenico Giustiniano (IMDEA)

6:15 pm CEST / 5:15 pm BST / 12:15 am EDT

Closing remarks

**

We include the agenda of the Training Event 6 in what follows:

**

DAY 1 (May 26, 2022):

Table 4: Agenda of Day 1 Training Event 6

Time	Topic	Title	Speaker
9:00 – 10:00	Registration at IMDEA Networks		
10:00 – 12:00	Research & Innovation	Building and communicating integral project ideas in R&I	Eva García (Research Technology Development and Innovation S.L. (RTDI)).
12:00 – 12:15	Coffee Break		
12:15 – 13:00	Research & Innovation	R&I in SMEs: how to raise EU fundings while working in new startups	Julio Rufo (LightBee)
13:00 – 15:00	Lunch		
15:00 – 15:45	MSCA-PF	Introduction to Marie Curie PostDoctoral fellowships	Javier Hervás (IMDEA) and Borja Genovés Guzmán (IMDEA)
15:45 – 16:00	Coffee Break		
16:00 – 17:00	MSCA-PF	How to write a successful Marie Curie PostDoc proposal	Jaya Prakash Varma Champati (IMDEA)

Social dinner.

DAY 2 (May 27, 2022): Project meeting

**

In the following we include a picture where the keynote speaker is providing his talk on ‘Multi-Gigabit/s LiFi Networking for 6G’:

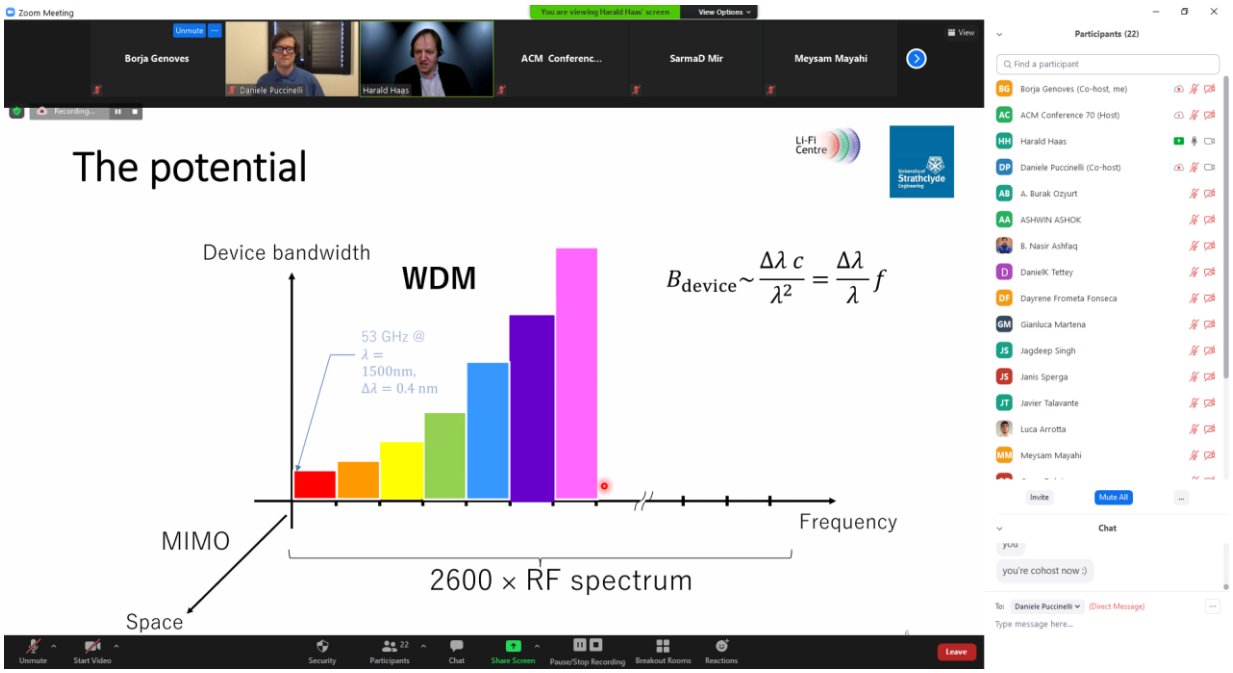

Figure 4: Picture of keynote speaker in 'Internet of Lights' workshop organized in ENLIGHT'EM Training Event 6

Figure 5: Picture of ESRs and coordination team at IMDEA during part 2 of training event 6 (May 26, 2022)

3. Results of past events

This section presents the results obtained from the events that took place during the third year of the project, in the form of slides, videos, etc.

3.1. Training Event 4

The material created for the Training Event 4 that can be re-used in the future within the project lifetime and beyond, are: slides from the training presenters, material of the tutorial on VLC technology provided by UEDIN, and some other outcomes for the sake of ESRs learning such as networking.

3.1.1. Slides

The slides created by the speakers of the training are uploaded to the internal GitLab of the project, where only people involved in the project can access them. It can be seen in the following image.

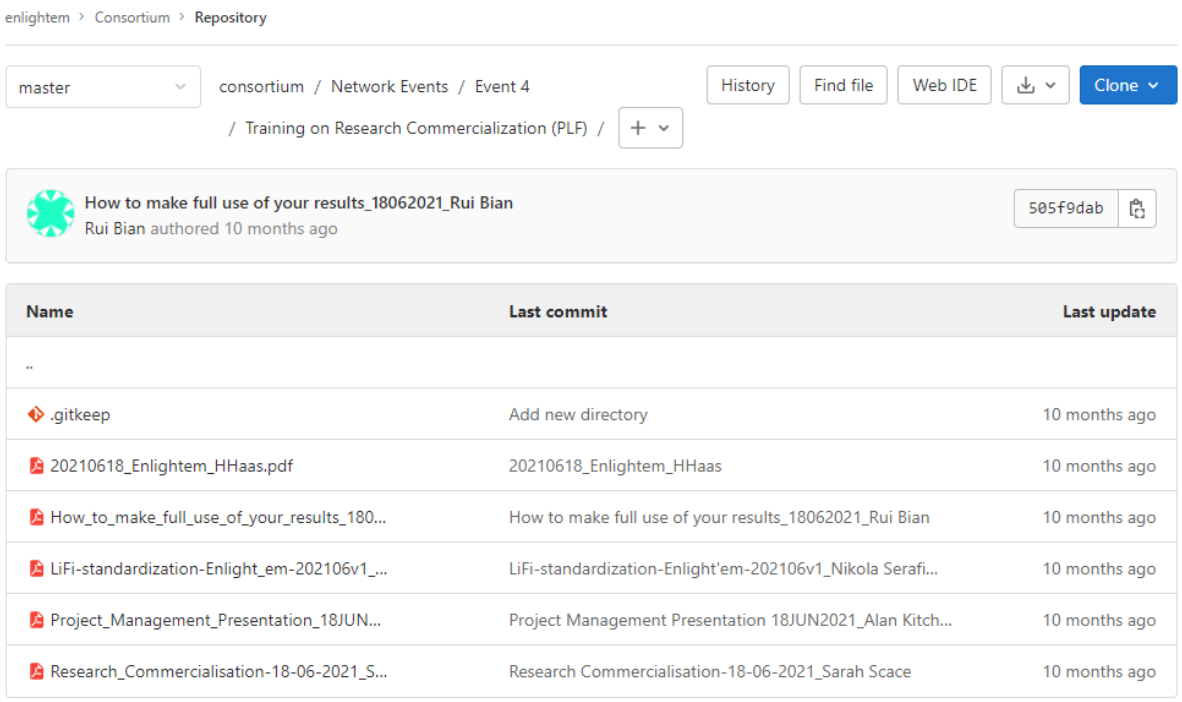

Figure 6: GitLab repository of ENLIGHT'EM where the slides of Training on Research Commercialization belonging to Training Event 4 are uploaded

Note that slides are private because companies and universities had some reservations about the potential replication of the slides' content without their consent.

3.1.2. Material

The training on VLC Technology was a collaborative exercise organized by Prof. Popoola, with the following short summary and outcomes:

Summary: This course is a training exercise in using discrete components and operational amplifiers to design an optical communication receiver for LiFi applications. That is, to design an electronic circuit to recover signals encoded on the intensity of an optical carrier.

Impact of COVID-19: Due to the COVID-19 restrictions, the design will be implemented and evaluate using an electronic circuit simulation software - LTSpice.

Training outcomes: On successful completion of this training, you will be able to:

- Use discrete components and operational amplifiers to implement analogue subsystems that include passive filters and multistage amplifiers among others. You will be able to mitigate any inter-stage loading effect between successive subsystems in your design.
- Design a simple current-to-voltage trans-impedance amplifier (TIA) to a written specification and balance the gain/bandwidth trade-off.
- Test your design and measure its performance in terms of bandwidth, rise/fall time etc.

The material is accessible by everybody involved in ENLIGHT'EM via the project Gitlab, as seen in next figure:

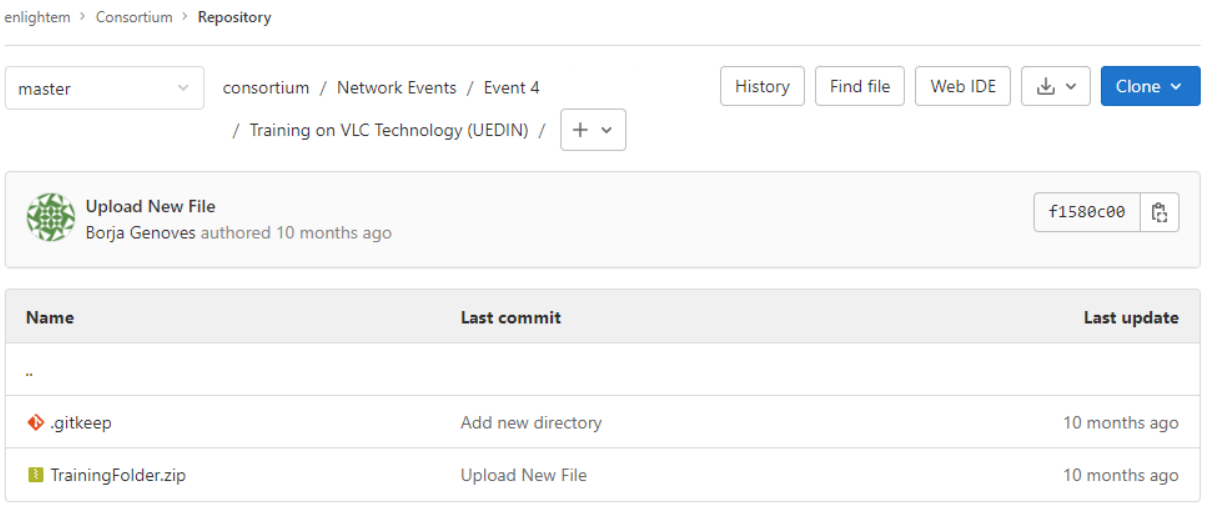

Figure 7: GitLab repository of ENLIGHT'EM where the material of Training on VLC Technology belonging to Training Event 4 is uploaded

3.1.3. Other results

On Thursday June 17th 2021 the Project meeting #4 took place together with Training Event #4. It was a virtual meeting organized via Zoom application, as the whole Training Event. It was

used to discuss the ESRs projects progress, deliverables to be submitted in following weeks, next Training Events, etc.

To summarize the issues addressed in Project meeting #4, its agenda is included in the following:

**

Project meeting #4

During morning: 9:30-12:30 CEST

Location. Remotely via Zoom

1. **Presentation of ERS: 3 minutes each – 3 slides (slide 1: Summary of research carried out in last year; slide 2: objectives and publications attained with respect to original plan; slide 3: ongoing research and further research for next 12 months)**

2. **Deliverables to be submitted in next weeks**

Borja will give a brief update about the state of such deliverables.

---------- Coffee Break (10 minutes) ----------

3. **Training Event 5**

Brief update and guidelines of organizers

4. **Training Event 6**

Brief update and guidelines of organizers

5. **MOOC**

Brief update and guidelines of organizers

6. **Notification of two new ESRs as SB members**

7. **Secondments**

Borja will remind secondments to be on 2021, and supervisors/ESRs will provide an update. The importance of joint paper between secondment and host institution during secondment.

8. Lack of communication activities

9. Feedback given by Advisory Members on 2020 (check if they were addressed)

10. Amendment

Decision on how many months to ask for extension.

Resume discussion of last GA meeting.

11. Next meeting

12. Free discussion

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3.2. Training Event 5

The material created for the Training Event 5 that can be re-used in the future within the project lifetime and beyond, are: slides from the training speakers, ESRs reports on the IEEE Plenary Sessions, and some other outcomes for the sake of ESR learning such as networking.

3.2.1. Slides

The slides created by the speakers of the tutorials are uploaded to the internal GitLab of the project: https://git2.networks.imdea.org/enlightem/consortium where only people involved in the project can access them. It can be seen in the following images.

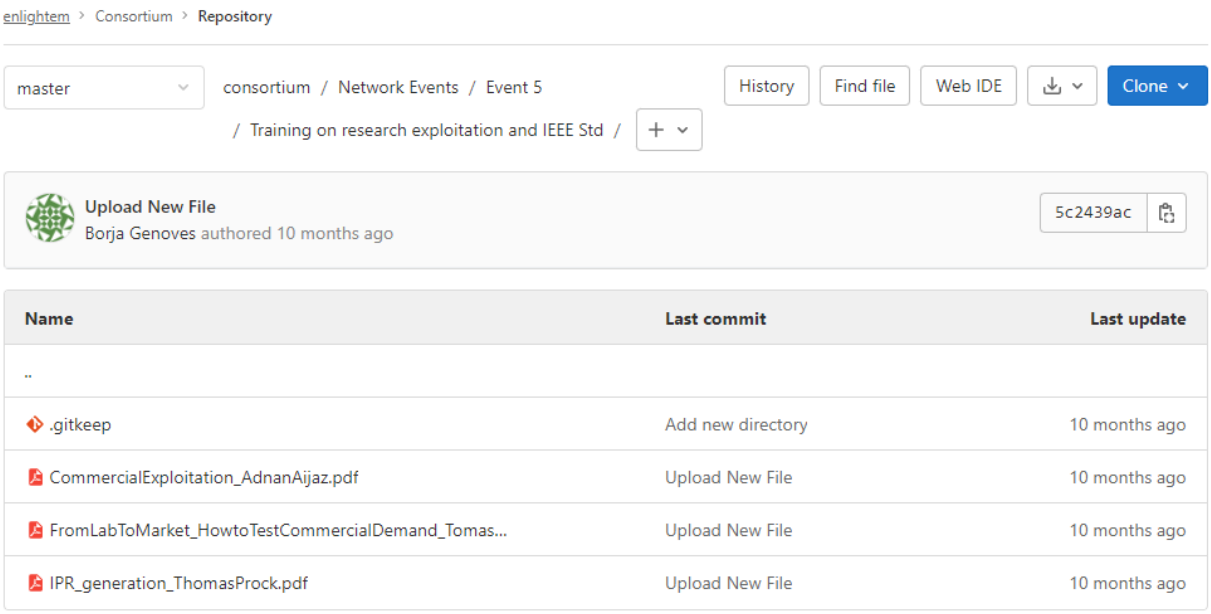

Figure 8: GitLab repository of ENLIGHT'EM where the Training Event 5 slides are uploaded

3.2.2. ESR reports

All knowledge learned from the IEEE Plenary Sessions was written in short reports by ESRs. This was the first contact point for ESRs with Standardization bodies. They were attendees, but now that they know how they perform, they will be able to contribute actively on next Plenary Sessions. In the next figure we can see all reports submitted to the GitLab repository of the project:

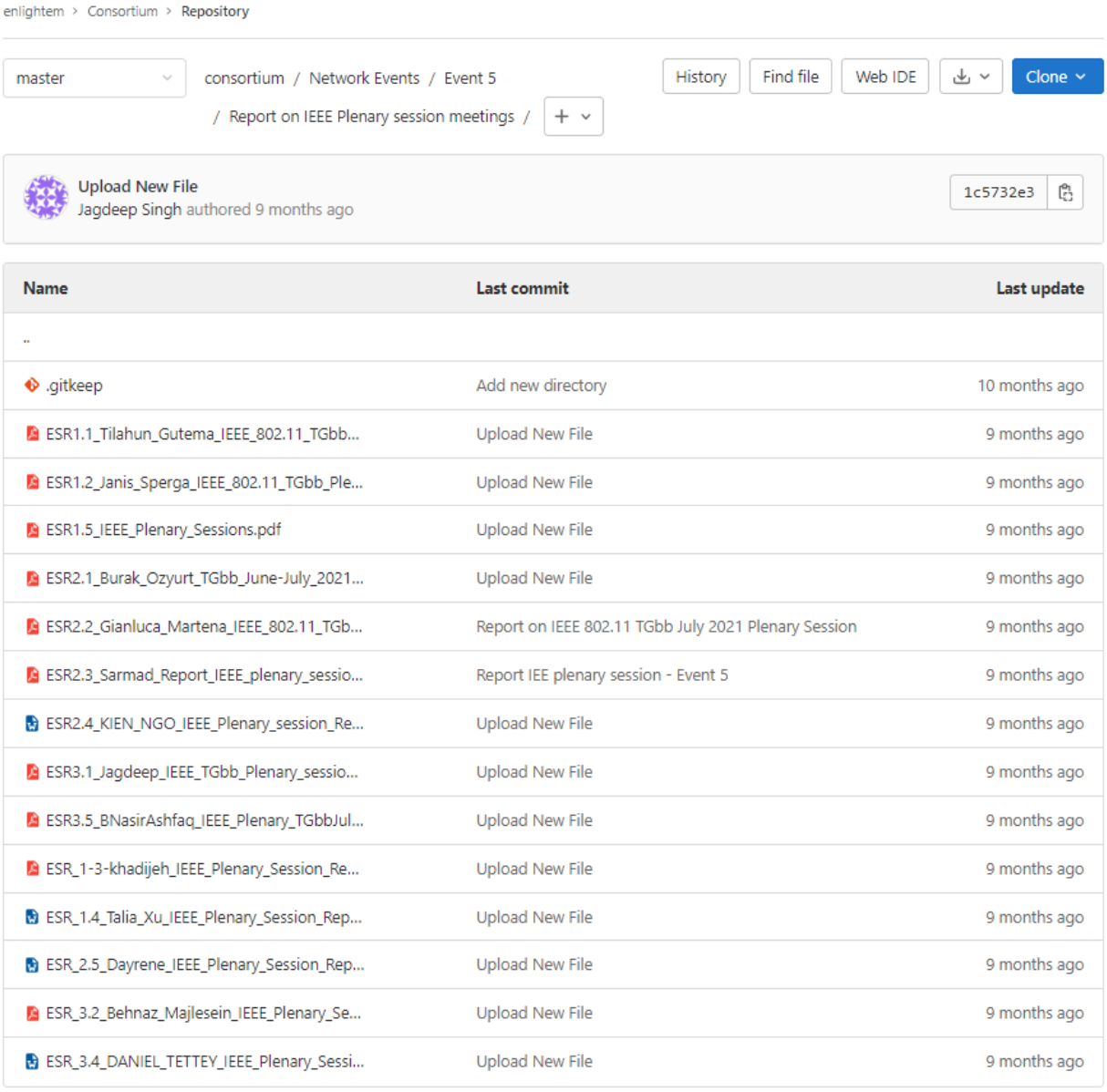

Figure 9: ESR Reports on IEEE Plenary Session activyties of Training Event 5

3.2.3. Other results

On July 9th the Project meeting #5 took place. It was a virtual meeting organized by Zoom application.

To summarize the issues addressed in Project meeting #5, its agenda is included in the following:

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Project meeting: 1/2 day (Organized by Borja and Domenico)

9th July 2021 from 10h00 CEST.

1. **Progress on WP1. Presentation of D1.2 Mid-term research progress reports on Low-energy Technologies; overview of research activities and the status of the results.**

10’ presentation. Rui Bian

2. **Progress on WP2. Presentation of D2.2 Mid-term research progress reports on Intelligent Algorithms and RF Integration; overview of research activities and the status of the results.**

10’ presentation. Wasiu Popoola

3. **Progress on WP3. Presentation of D3.2 Mid-term research progress reports on Applications and Services; overview of research activities and the status of the results.**

10’ presentation. Marco Zuñiga / Przemysław Pawełczak

4. **Progress on WP4 (Training).**

10’ presentation. Domenico Giustiniano

5. **Feedback of ESRs about Training Events 1-5.**

5’ presentation. What skills have you learnt? Were the trainings useful? What other skills you would like to learn?

6. **Progress on WP5 (Dissemination and Outreach)**

10’ presentation. Sercan

---------- Coffee Break (10 minutes) ----------

7. **Periodic Report**

Borja will give a brief update about its state.

8. Training Event 6

Brief update and guidelines of organizers (TRI and ZII)

9. MOOC

Brief update and guidelines of organizers

10. Secondments

Borja will remind secondments to be on 2021, and supervisors/ESRs will provide an update.

11. Balance of year 2 and things to improve for year 3.

Borja will give a brief update of milestones and state of project objectives.

12. Next meeting

SB Meeting in September or October.

13. Free discussion

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In the next figure, we show a picture of the Project meeting #5:

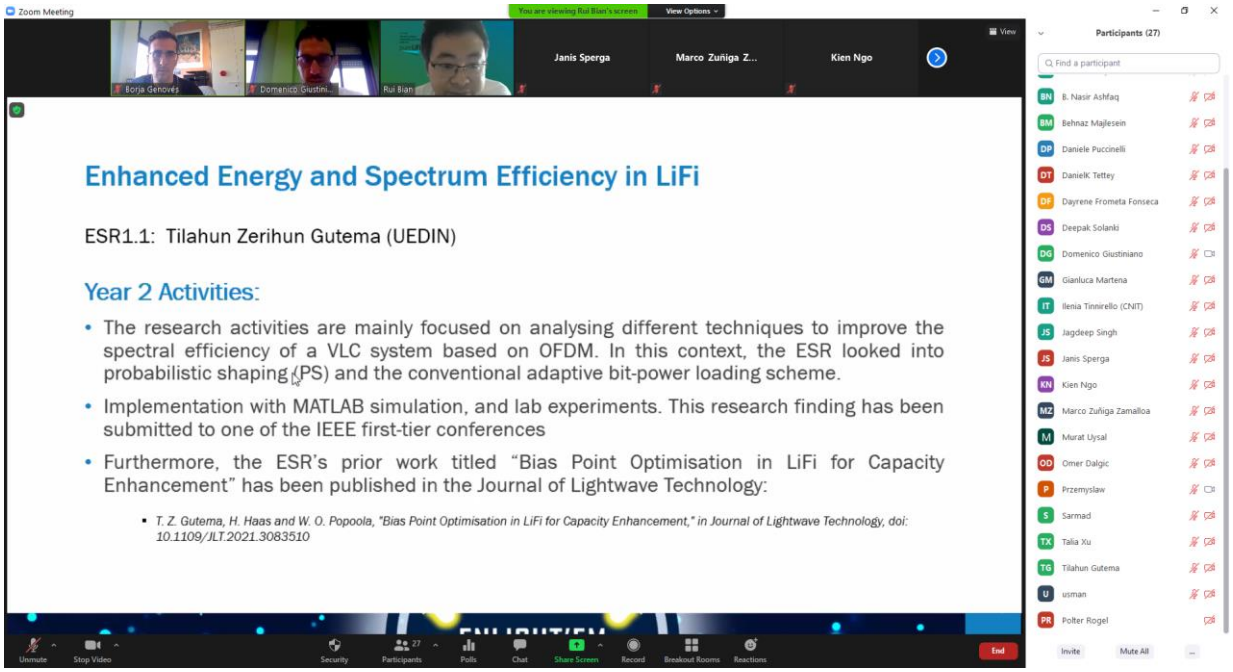

Figure 10: Picture of the Project meeting #5

3.3. Training Event 6

The material created for the Training Event 6 that can be re-used in the future within the project lifetime and beyond, are slides from the training speakers that will be uploaded in the GitLab of the project. Due to the submission date of this deliverable, we couldn't collect all slides of speakers yet, but they will be uploaded to our internal GitLab soon so that all ESRs can access, following the same procedure as in previous training events. Besides, on May 27th the Project meeting #6 took place. It was a meeting in person organized at IMDEA facilities in Madrid.

To summarize the issues addressed in Project meeting #6, its agenda is included in the following:

Table 5: Agenda for Project meeting #6

Time	Topic	Title	Speakers
10:00 – 11:30	Project meeting: Updates on ESRs projects	Analyze the progress of the project and next steps	ESRs. 3 minutes each presentation + Q&A (2 min) = 3 slides: 1) Project objectives + Current state of project (including secondments); 2) Results obtained so

			far; 3) Foreseen research
11:30 – 12:00	Coffee break		
12:00 - 13:00	Project meeting: Updates on overall ENLIGHT'EM	Analyze the progress of ENLIGHT'EM and next steps	Agenda will be announced later (moderated by Borja)

4. Planning of upcoming events

This section details the plan for the next upcoming events that will take place from the submission date of this deliverable up to the next annual report D4.4.

4.1. Training Event 7

According to the Annex 1 of the Grant Agreement, the Training Event 7 (*Training on advanced research skills, tutorials at conference*) was expected to take place in February 2022 (M33) with the following description:

The event will be co-located with the EWSN conference. The purpose of this event is two-fold: tutorial sessions will be organized to showcase the results of the ESRs to a broad global audience (activity led by UEDIN); and ESRs will be trained on advanced transferable skills (activity led by TUD). The training will include modules on thesis completion (effective writing, preparing for the thesis defense); continuing education and career development (career planning, skill development and professional development planning, CV writing, applications and interviews in the academic and non-academic domains); impact (advanced presentation skills, advanced communication skills, knowledge transfer).

However, due to COVID-19 restrictions the conference to which we aim to co-locate the event (2022 International Conference on Embedded Wireless Systems and Networks (EWSN)) was postponed till October 2022. We decided to postpone Training Event 7 too for the sake of the ESRs training, as we strongly think that it will be more fruitful for ESRs to attend a flagship conference in person, and because we thought it was beneficial to wait until such that the results of ESRs were more mature.

The tutorial proposal was submitted and it was successfully accepted, so the Training Event 7 is confirmed that it will take place together with EWSN 2022 conference in Austria on the dates 3rd – 5th October 2022. The agenda of the Project Meeting is still to be defined, but the draft Tutorial and the Training information can be found in the following:

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Title:

Fundamentals of LiFi Design and Applications

Abstract:

Wireless connectivity has instigated phenomenal advancements in our society with monumental socio-economic benefits. From commerce to healthcare and emerging paradigms such as internet of things (IoT), smart home/city, industry 4.0 and many more, wireless connectivity continues to enable new services, applications, products and developments.

To meet our ever-increasing demand for ubiquitous wireless connectivity and sustain future socio-economic growth, communication technology is rapidly advancing with wireless

connectivity with lightwave. This idea of wireless connectivity with light is termed LiFi (it is a networked version of the optical wireless communication technology). The LiFi technology will undoubtedly play an increasingly significant role in the global communication network and infrastructure. This has already been happening in space with the use of laser beams to deliver unprecedented amount of data exchange between satellites and to ground stations.

Thus, this tutorial is pertinent and it is designed to educate and introduce the fundamentals of LiFi technology through lively discussions. Attendees will learn what designing a LiFi system entails. The tutorial promises to stimulate ideas for future application of LiFi beyond those currently envisaged.

Our approach in this tutorial will be a mix of discussions and presentation of LiFi to a much broader audience beyond those researching it. The tutorial is organised by the EU funded project ENLIGTH'EM (https://enlightem.eu/) – a training network dedicated to low power LiFi technology for IoT applications.

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Description of the topics that the tutorial will address, emphasizing their timeliness:

Progress in LiFi research has accelerated considerably in the past decade resulting in several high profile demonstrations, patents and numerous scholarly publications. The field has now progressed to the stage where professional and international bodies (particularly IEEE and ITU) are currently intensifying efforts to develop industry standards for it. This is in readiness for mass-market penetration.

Furthermore, several companies across the globe including, Signify (formerly Philips lighting) in the Netherlands, PureLiFi in the UK, Lightbee in Spain, Oledcomm in France, and many more now have early products in the market.

The foregoing buttresses the timeliness of this tutorial that aims to illuminate this nascent field of light-based wireless connectivity.

Finally, as part of our commitment to the development of future researchers, we will have a training session for early career researchers on career options. The entire tutorial is open to the general audience attending EWSN conference and not restricted to only ENLIGHT'EM members.

The topics that will be covered are as follows:

- LiFi Physical Layer Design
- Network Design in LiFi
- LiFi System Design
- LiFi Applications
- Training event for early career researchers.

Table 6: Outline of the tutorial, including a tentative time schedule

	Time	**Activity**
	09:00 – 09:10	**Introduction**
Session 1	09:10 – 10:20	**LiFi Physical Layer Design** Presentations/demos. + Q&A
Break 1	10:20 – 10:40	Coffee/Tea Break
Session 2	10:40 – 11:50	**Network and LiFi System Design** Presentations/demos. + Q&A
Break 2	11:50 – 14:00	Lunch
Session 3	14:00 –15:10	**LiFi Applications** Presentations/demos. + Q&A

Break 3	15:10 – 15:30	Coffee/Tea Break
Training 1	15:30 –16:10	Topic: Career Paths/Options for Early Career Researchers
Break 4	16:10 – 16:30	Coffee/Tea Break
Training 2	16:30 – 17:10	Panel Discussion

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4.2. Training Event 8

According to the Annex 1 of the Grant Agreement, the Training Event 8 (*Industry day*) is expected to take place in Istanbul (Turkey) in June 2022 at FORD facilities, with the following description:

In this training event, all industrial beneficiaries and partners will form a panel to provide substantial insight and feedback on potential applications and use cases for the ESR's work and on optical technologies in general. The event will feature demonstrations and poster sessions to showcase the project technologies.

It will finally be taken at FORD facilities on the 26th-27th July, 2022. The agenda is still to be decided. It will include Training on industrial careers that could not be taught at Training Event 6.

4.3. Training Event 9

According to the Annex 1 of the Grant Agreement, the Training Event 9 (*Final workshop at conference and project meeting #9*) is expected to take place in February 2023 together with EWSN 2023, a top conference in the domain. The original details of the event are as follows:

A workshop on the topics of ENLIGHT'EM will be organized as a co-located event of the EWSN 2023 conference, presenting the main innovation of projects led by ESRs when approaching the completion of their programs. A project meeting will be held alongside the event.

The organizers are UNIPA and IMDEA. However, the venue and date may change according to the interest of the Consortium. The decision may depend on the resolution of the Amendment where we asked for a project extension of 7 months due to COVID-19 impact.

4.4. Training Event 10

According to the Annex 1 of the Grant Agreement, the Training Event 10 (*Open day and final project meeting #10*) is expected to take place in May 2023 with the following description:

Invited talks from VLC experts, research talks and practical demonstration of ENLIGHT'EM will be blended together into the final open day of ENLIGHT'EM. The event will be organized at TUD premises. The event will be advertised in order to reach out to a wide spectrum of audience, with technology demonstrations for practitioners, industry and government representative, as well as more engaging technology displays for the general public. The final project meeting will be held alongside this event.

The organizers are IMDEA and TUD. However, it is still soon to give a detailed plan of the event. The date of the event may vary depending on the project status at that time.

5. Conclusion

This document presented the training activities during the third year of the project, as well as the results obtained from those past events. Finally, a detailed planning of upcoming events was described.

Training events 0, 1, 2 and 3 took place in the first and second years, whereas Training Events 4, 5 and 6 took place in this third year, as planned in the Annex 1 of Grant Agreement (GA). Although the project has been affected by COVID-19 outbreak, and as it is demonstrated in this deliverable, measures have been taken to alleviate this situation. Furthermore, all ENLIGHT'EM members are committed to guarantee the highest impact and visibility to the training events, and we have uploaded the materials of the Events until the present day to the repositories of the project.