

ENLIGHT'EM

European Training Network in Low-Energy Visible Light IoT Systems

Innovative Training Networks (ITN)
H2020-MSCA-ITN-2018

Deliverable D5.4

Third report on dissemination and exploitation results



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Contributors

All beneficiaries and partners.

Abstract

Results of dissemination and outreach activities completed during the third year of the project by the partners and beneficiaries within the scope of ENLIGHT'EM project.

Revision History

Version	Editor	Date	Change
0.0	Borja Genovés	12/05/2022	Created initial template.
0.1	Sercan Karaağaç	27/06/2022	Updated the document per beneficiary inputs
1.0	Borja Genovés and Domenico Giustiniano	12/07/2022	Final revision

Executive summary

This document captures Dissemination and Exploitation Results for the third year of the project of the ENLIGHT'EM project partners. The present Third Annual Report on Dissemination and Exploitation Results – prepared within the Dissemination and Outreach Work Package (WP5) – will ensure that dissemination activities from various WPs and the project in general are captured, and well presented.

The document includes all the dissemination, communication and outreach efforts. Results of the tasks such as the review and mapping of stakeholders at European, national and local levels, timing of communication and dissemination activities, media channels, and division of tasks between partners are detailed.

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List of Abbreviations

ENLIGHT'EM	European Training Network in Low-energy Visible Light IoT Systems Project
MSCA	Marie Skłodowska-Curie Action
ITN	Innovative Training Networks
ETN	European Training Networks
ESR	Early Stage Researcher
SB	Supervisory Board
IPR	Intellectual Property Rights
IP	Intellectual Property
IoT	Internet of Things
VLC	Visible Light Communication
LiFi	Light Fidelity

1. Introduction

ENLIGHT'EM is training the next generation of researchers in energy efficient IoT systems based on VLC. This project consolidates pan-European collaborations among leading groups in the field, and it is fostering its contribution into the 5G ecosystem by developing low-energy VLC systems and also plans to feed into standardization activities. Disseminating the results of such research and explaining its impact on the design of IoT systems that leverage the low baseline energy consumption of LEDs is an important objective of the ENLIGHT'EM project.

In this report, all research, dissemination, and exploitation activities, carried out during the third year of the project are provided as a summary as reported by the project partners.

1.1. Responsibilities and Points of Contact

The following table lists the main network wide bodies responsible for the dissemination and outreach activities tasks of ENLIGHT'EM and the updated list of responsible project participants constituting the respective bodies.

Table 1: Contact persons details

Contact person	Role	Institution
Sercan Karaağaç, skaraag1@ford.com.tr	WP5 - Dissemination and Outreach lead	FORD
Ilenia Tinnirello, ilenia.tinnirello@unipa.it	T5.1 – Academic Dissemination Lead	UNIPA
Daniele Puccinelli, daniele.puccinelli@supsi.ch	T5.2 – Communication and Outreach Lead	SUPSI
Rui Bian, rui.bian@purelifi.com	T5.3 – Exploitation and Impact Plan Lead	PLF

2. Dissemination Results

This section presents dissemination activities in which ENLIGHT'EM participants have been involved during the third year of the project (from June 2021 to May 2022). These activities have been used by ESRs to disseminate the ENLIGHT'EM outcomes.

2.1 TU Delft

TU Delft researchers involved in the ENLIGHT'EM got the following accepted paper related to the project:

Xu, Talia; Chávez Tapia, Miguel; Zúñiga, Marco (April 2022): “Exploiting Digital Micro-Mirror Devices for Ambient Light Communication” on April 4, 2022 at NSDI '22 – USENIX. (Link to the presentation: <https://www.usenix.org/conference/nsdi22/presentation/xu-talia>)

James Scott Broadhead, and Przemysław Pawełczak, “Data Freshness in Mixed-Memory Intermittently-Powered Systems” at the IEEE International Symposium on Information Theory (ISIT 2021), Melbourne, Australia (held virtual) held on 12-20 July 2021. (Link: <https://zenodo.org/record/4756047#.YJzVsLUzaUk>)

Liu, Hao; Ye, Hanting; Yang, Jie; Wang, Qing (November 2021) “Through-Screen Visible Light Sensing Empowered by Embedded Deep Learning” Workshop on Workshop on Challenges in Artificial Intelligence and Machine Learning for Internet of Things in conjunction with ACM SenSys 2021, Coimbra, Portugal 15-17 November 2021 (Link: <https://zenodo.org/record/5646942#.YsWlfHZByUl>)

2.2 University of Applied Sciences and Arts of Italian Switzerland (SUPSI)

As planned, SUPSI has taken the lead of the organization of the “Internet of Lights” - Workshop Co-Located With Mobisys 2021, and successfully completed the event. The workshop event was designed as a forum for researchers to share research results. The general chair was Daniele Puccinelli (SUPSI).

Results of the training events can be reached from the link: <https://enlightem.eu/results/workshops/iol-workshop/>

SUPSI researchers involved in the ENLIGHT'EM recently got the following accepted paper related to the project:

Dalgic, Omer; Puccinelli, Daniele; Zuñiga, Marco “Enabling Body-Centric Computing Applications with LED-to-Camera Communication”, at ACM BodySys'22, (Portland, ORE, USA) on 1 July 2022. <https://dl.acm.org/doi/abs/10.1145/3539489.3539588> We are currently working to upload it in our Zenodo repository.

2.3 LightBee Corp (LBEE)

LBEE researchers involved in the ENLIGHT'EM recently got the following accepted paper related to the project:

B.Majlesein, V.Matus, C.Juradu-Verdu, V.Guerra, J.Rabadan and J.Rufo, “Experimental Characterization of Sub-Pixel Underwater Optical Camera Communications” at the 13th IEEE/IET International Symposium on Communication Systems, Networks & Digital Signal Processing (CSNDSP) on 20-22 July 2022 at Porto/Portugal. We are currently working to upload the author version of the paper to our Zenodo repository.

2.4 IMDEA Networks (IMDEA)

IMDEA ESRs involved in the ENLIGHT'EM carried out the following research dissemination activities during year 3 of the project:

Muhammad Sarmad Mir, Behnaz Majlesein, Borja Genovés, Julio Rufo, Domenico Giustiniano, “RGB LED bulbs for communication, harvesting and sensing” at the 20th International Conference on Pervasive Computing and Communications (PerCom 2022) at Pisa/Italy on 21-25 March 2022. (Link: <https://zenodo.org/record/6319844#.Yh34x-jMK5c>)

Muhammad Sarmad Mir, Borja Genovés, Ambuj Varshney, Domenico Giustiniano, “PassiveLiFi: Rethinking LiFi for Low-Power and Long Range RF Backscatter” at the Annual International Conference On Mobile Computing And Networking (MobiCom 2021) at New Orleans/United States on 31 January – 4 February. (Link: https://zenodo.org/record/5644705#.YYOb_mDMKUK)

Muhammad Sarmad Mir, Behnaz Majlesein, Borja Genovés, Julio Rufo, Domenico Giustiniano, “LED-to-LED based VLC systems: developments and open problems” at the Workshop on Internet of Lights – Colocated with ACM MobiSys 2021 (IoL21), Virtual Conference held on 25 June 2021 (Link: <https://zenodo.org/record/5090682#.YsWJEHZByUI>)

2.5 The University of Edinburgh (UEDIN)

UEDIN has contributed to dissemination with the following activities:

Burak Özyurt, Ilenia Tinnirello, and Wasiu Popoola, “Modelling of Multi-Tier Handover in LiFi Networks”, “2021 IEEE Global Communications Conference (GLOBECOM)”. (Link to the paper: <https://zenodo.org/record/5646990#.YsWJfHZByUI>)

Burak Özyurt, Wasiu O. Popoola, “LiFi-based D2D Communication in Industrial IoT”, IEEE Systems Journal, 2022. <https://ieeexplore.ieee.org/document/9797286> We are currently working to upload the author version of the paper to our Zenodo repository.

Burak Özyurt has been recently appreciated with the Peter Grant award for the best student-led paper for “Mobility management in multi-tier LiFi networks”, published in IEEE/OSA Journal of

Optical Communications and Networking. (Link to the details: <https://enlightem.eu/peter-grant-annual-award-burak-ozyurt/>)

Burak Özyurt has been recently appreciated with the Best Poster Prize at the 2022 School Research Conference by the University of Edinburgh School of Engineering for “Resilient LiFi for Internet-of-Things”. (Link to details: <https://enlightem.eu/best-poster-prize-burak-ozyurt/>)

Tilahun Gutema has submitted, and presented a conference paper, “Single LED Gbps Visible Light Communication with Probabilistic Shaping” at the IEEE Global Communications Conference on 7 - 11 December 2021. (Link to the presented paper: <https://doi.org/10.1109/GLOBECOM46510.2021.9685753>) Zenodo link: <https://zenodo.org/record/5646960#.Ys0r03ZByUl>

Tilahun Gutema, Harald Haas; Wasio O. Popoola, “WDM Based 10.8 Gbps Visible Light Communication with Probabilistic Shaping” at Journal of Lightwave Technology, 2022. (Link to the paper: <https://ieeexplore.ieee.org/document/9779112>) Zenodo link: <https://zenodo.org/record/6606074#.Ys0r73ZByUl>

2.6 PureLiFi (PLF)

PureLiFi has contributed to dissemination with the following activities:

Janis Sperga, Rui Bian, and Harald Haas, “Beam Selection in Angle Diversity MIMO Systems for Optical Wireless Systems” at the IEEE International Conference on Communications (ICC) that is held in Seoul/ South Korea on 16-20 May. (Link to the conference presentation: <https://zenodo.org/record/6602077#.Ypch1nZBy5c>)

Giovanni Luca Martena, Rui Bian, and Harald Harald has submitted, and presented a paper with the subject “Impact of Passband Shift in Optical Wireless Communication Systems based on Wavelength Division” at the IEEE International Conference on Communications (ICC), Seoul, South Korea, 16-20 May. (Link: <https://zenodo.org/record/6541962#.YnzMLOhBy5c>)

Giovanni Luca Martena, Rui Bian, and Harald Harald “Adaptive WDMA: improving the data rate of a densely deployed LiFi network” at the Workshop on Internet of Lights – Colocated with ACM MobiSys 2021 (IoL21), Virtual Conference in 25 June 2021. (Link: <https://zenodo.org/record/5090686#.YOyWouqzY2wzY2w>)

2.7 Ozyegin University (OZU)

Khadijeh did not present dissemination results in this year.

2.8 University of Palermo (UNIPA)

Kien Trung Ngo, Kien, Stefano Mangione, Ilenia Tinnirello, “Exploiting EDCA for Feedback Channels in Hybrid VLC/WiFi Architectures” at the 19th Mediterranean Communication and Computer Networking Conference (MedComNet 2021), Virtual Conference held on 15-17 June 2021. (Link: <https://zenodo.org/record/5090694#.YOyXCegzY2w>)

2.9 Toshiba Research Europe Ltd. (TREL)

TREL has not reported a public dissemination activity specifically for this reporting period.

2.10 Ford Otosan (FORD)

Daniel Tettey, Bismillah Nasir Ashfaq have not reported dissemination activities during this third year.

3. Communication and Outreach

3.1 Communication through open electronic media

IMDEA has been in charge of promoting and disseminating the results of the events organized within the ENLIGHT'EM project.

IMDEA is updating the [website of the project](#) with every new event and result obtained from the project.

The following table shows the activity of ENLIGHT'EM in open electronic media, with the aim of disseminating outcomes and drawing the attention of the general public.

Table 2: Activity in open electronic media during the second year of the project

Social Network Channel	Activity
YouTube	Current content: 76 Videos, 8 Playlists Views: 2.700 times, 82,4 hours, 32.900 impressions
Twitter	32 Tweets, 13.871 Impressions 561 Following, 155 Followers
LinkedIn	374 Views, 76 Followers

All ESRs have introduced their projects through individual short videos. They are being disseminated through ENLIGHT'EM social media channels. We are releasing one video every Friday. All these videos can be found at ENLIGHT'EM social media channel, but they are redirecting to the Youtube ENLIGHT'EM channel where videos are uploaded:

<https://www.youtube.com/playlist?list=PLGH-oHXjzcdERRfqdayxF94zQiB9gSm3I>

3.2 Communication through the formal press

Muhammad Sarmad Mir, Borja Genovés Guzmán, Domenico Giustiniano, Ambuj Varshney have had their studies on VLC based IoT application, “battery-free communication for a green planet” published on the top Spanish national newspaper El Mundo. <https://www.elmundo.es/madrid/2022/01/19/61e460d1fdddfff07b8b45a5.html>

Besides, another top national press (ABC) released a news about IMDEA research results:

https://www.abc.es/natural/abci-presente-futuro-sostenible-comunicacion-inalambrica-202205251842_noticia.html

Finally, Telemundo visited IMDEA Networks to learn more about ENLIGHT'EM project and our latest results with the participation of Sarmad Mir and Dayrene Frometa. We introduced them a method to communicate on mobile devices without batteries. Telemundo is a premier media company, an industry leader in the production and distribution of high-quality Spanish-language content across multiple platforms for Hispanics in the United States and around the world. Link of video report: <https://youtu.be/mVk00t85kJc>

3.3 Communication through public events

The following communication activities to the public at large have taken place to disseminate the project implications on the possibility to provide affordable, low-cost and low-energy technologies for Internet access.

In what follows, we list the activities for communication by the single beneficiaries:

TU Delft:

Talia Xu, and Hanting Ye have not presented yet their results in communication activities, however work is in progress for the next upcoming months.

LightBee:

Behnaz Majlesein has attended the “Canary Island Science Fair 2022”, “Mujer y Niña en la Ciencia: Conoce a nuestras científicas y tecnólogas” on April 2022, on the role women in science, and presented her studies on Underwater VLC Communications.

Link to the event: <https://www.cienciacanaria.es/miniferias2022/charlas-conferencias/549-mujer-y-nina-en-la-ciencia-conoce-y-pregunta-a-nuestras-cientificas-y-tecnologas>

IMDEA:

ESRs at IMDEA have participated in the “Madrid is Science” Fair 2022 on 4-5 March 2022.

<https://networks.imdea.org/imdea-networks-participates-in-the-11th-madrid-is-science-fair/>

UEDIN:

Neither Tilahun nor Burak have participated in communication activities during this third year.

OZU:

Khadijeh Ali Mahmoodi has made a presentation on European Researcher's night took place on 21 September 2021 with the subject: “LiFi: A Green Technology for Wireless Access”.

UNIPA:

Ngo Trung Kien, Ilenia Tinnirello, Stefano Mangione have demonstrated “VLC video streaming application” during the public event, Internet of Lights - SHARPER Night (sharper-night.it) on September 2021. (Link to the event: [Internet of Lights - SHARPER Night \(sharper-night.it\)](http://sharper-night.it))

Moreover, Ngo Trung Kien (UNIPA), Sarmad Mir (IMDEA) have attended the Sintec Summer School in 2022, and have presented a poster to talk about Visible Light Communication application, and their research. (Link to the summer school: <https://www.sintec-project.eu/smart-bioelectronic-and-wearable-systems-summer-school/>)

FORD:

Daniel Tetey and Bismillah Nasir Ashfaq have attended the Green Night 2021 (MSCA European Researchers' Night) seminar, and presented their research results on "LiFi – A Green Technology for Wireless Access".

4. Exploitation of results and intellectual property

ESRs Dayrene (IMDEA) and Sarmad (IMDEA) have been selected as team members for a proposal submitted to the “EIT Jumpstarter 2022” to get support to turn their ideas into business. The researchers have already passed the first two rounds of evaluation and are now in the 15 teams that will receive additional training. More information can be found in the following link: <https://networks.imdea.org/route-to-the-eit-jumpstarter-grand-final-congrats-for-your-work/>

Dayrene (IMDEA) was selected and completed a national pre-seed training program organized by Santander Group (<https://explorerbyx.org/>) in Spain.

Sarmad (IMDEA) and researchers at IMDEA have submitted a European patent, and it has passed the first check: Extended European Search Report (EESR) issued by the European Patent Office.

Jagdeep Singh, Usman Raza has submitted the patent application to US authorities. In the previous step, Jagdeep and Usman had filed the patent internally within TREL, and in this reporting period, they filed the patent application to US for international IP protection.

All ESRs have received training on Intellectual properties and patents issues between June and July 2021:

- Event 4: **Training on VLC technology & Research commercialization**, and project meeting #4
- Event 5: **Training on research exploitation**, Presentation at IEEE standardization meeting, and project meeting #5

The ESRs did not contribute to standardization bodies or creation of startups yet, although first initiatives are growing up (e.g., participation at EIT Jumpstarter 2022 mentioned above). Besides, ESRs attended Meetings of IEEE Plenary session, all of them spread over July 09-23 2021. This activity is part of Training Event 5:

- Event 5: Training on research exploitation, **Presentation at IEEE standardization meeting**, and project meeting #5

Besides, ESRs received training on entrepreneurship on Event 3:

- Event 3: **Training on entrepreneurship**, Workshop at conference, and project meeting #3

Finally, beneficiary pureLiFi is founding member of the Light Communication Alliance (LCA) whose mission is to lead the global adoption of light communication technologies, offer

unprecedented wireless communications and to build a far-reaching, coherent & sustainable ecosystem. PureLiFi plans to use the LCA platform to disseminate ENLIGHT'EM outcomes.

5. Conclusion

This document has summarized the dissemination activities of the third year of the ENLIGHTEM project. In particular, we have presented the summary of industrial and academic contributions. As can be seen from the report, dissemination activities through publications and conference presentations are progressing. Furthermore, the project partners have built a community through presentations to a broader public, and planning further dissemination initiatives, included specific workshops on the project themes.

Annex

Annex A: Official project event during third year of ENLIGHT'EM project

The following official project Events have been accomplished during the third year of the project:

Table 3: Main network-wide Training Events organized along the third year of the project

Main Training Events & Conferences		ECTS	Lead Institution	Completion Status
Event 4	Training on VLC technology & Research commercialisation, and project meeting #4	2.4	PLF/UEDIN Held virtually	Completed – June 2021 (M25)
Event 5	Training on research exploitation, Presentation at IEEE standardization meeting, and project meeting #5	1.6	TREL/PLF/OZU Held virtually	Completed – July 2021 (M26)
Event 6	Training on industrial careers, Workshop at conference, and project meeting #6	2.4	IMDEA/SUPSI Held virtually (workshop co-located with ACM Mobicom 2021) and in person (Training offered at IMDEA facilities)	Completed – June 2021 and May 2022