European Commission

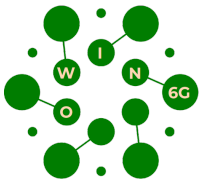
Marie Skłodowska-Curie Actions

HORIZON-MSCA-2022-DN-01

(Marie Skłodowska-Curie Actions Doctoral Networks)

Project Number: 101119624

Acronym: OWIN6G



Project title: Optical and WIreless sensors Networks for 6G scenarios

Work Package 4: Doctoral Training

Deliverable D4.1 (D14): Initial report on training activities and programme evaluation

Czech Technical University in Prague (CTU), Prague, Czechia

July 2024

Funded by the European Union

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Executive Summary

In this report, the progress of doctoral training activities is presented.

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1. Objectives of Work Package 4 – Doctoral Training

The objectives are (i) coordination of the training activities of OWIN6G; (ii) continuous monitoring of the progress of Doctoral Candidates (DCs); and (iii) liaising with the European Committee on all aspects of OWIN6G. To achieve these goals WP4 is divided into two main tasks:

Task 4.1. Coordinating training activities: Coordinating training activities and To provide high-quality training-by-research program on Wireless Sensor Network (WSN) from devices to systems (RF and optical technologies) to DCs, this task includes (i) training in a structured manner (theory, simulation and experiments) in the chosen research areas with significant inputs from industry in order to prepare DCs for future employment in European industry and academia; (ii) inviting external distinguished researchers (four per year) to deliver lectures, give presentations and participate in open technical discussions with DCs; (iii) offering training in research and innovation, research bid writings, teamwork, negotiation and management of research projects; and (iv) enhancing awareness on research integrity and ethics, starting from research design through to publications and beyond.

Task 4.2. Assessment and evaluation of DC's progress: This includes (i) monitoring, assessment and evaluation of DCs' research projects as well as over-seeing their professional career development; and (ii) ensuring successful implementation of the specific measures outlined in subsections 1.3 & 1.4 including a rigorous reporting and feedback system as well as a process for the internal evaluation of OWIN6G at regular intervals.

2. Training Activities Plan

This targets training of DCs in using the followings:

I. **Open Learning Platform** (OLP): This is created to cover details of training programme (e.g., events, news, calendar, etc.), technical and educational materials (e.g., lecture notes, presentations, audio, video, etc.) and interactive content (e.g., discussion forums, evaluation platforms, etc.) that will be updated regularly. There will be a private section for each DC project, which will allow DCs and supervisors/advisors to see work done, progress made and meeting minutes of meetings with tasks, etc. Trough OLP, research contents can be shared and a collaborative research environment can be created.

II. **Local Training:** The DCs will join the existing research groups within academic institutions. There will be weekly meetings between DCs and supervisors to discuss research progress, issues and what to do next as well as monthly online meetings with the other DCs within the cluster formed around each WP. There will be minutes of these meetings together with actions and dates, which will be shared under OLP. This process has already been started. Each DC will conduct an extensive State-of-the Art (SotA) review on the research topic in the first 12 months to know about the technical background, identify what has been done so far, who is working in the field, what the remining issues are, what needs doing and why as well as writing their research proposals. In addition, DCs within each WP will share information, discuss technical contents that are relevant to their WP and their own projects, highlight technical issues and how they could be addressed as well as identify who is doing what in order to ensure smooth progressing of the research. In years two and three, DCs will continue focus on their research activities while continuing to monitor SotA and work within clusters. As part of their secondments, the experts in host institutions will provide the required supervision and technical/non-technical assistance to DCs. The local training program also involves attending research presentations by the Graduate School, the language classes to help integration and relevant courses at their host institutions (physics, optics, information theory, communication and network technologies, Internet of Things (IoT), and Machine Learning (ML)). All presentations and teaching materials will be available in OLP.

III. **Network-wide Training:** OWIN6G will offer network-wide on-line courses and presentations in order to improve the technical knowledge and skills of DCs in subjects related to the

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research topics. This includes (i) two training schools (years 1 and 2) on “Photonics for IoE” (M12, 3 days) and “Design and Optimization of 6G WSNs” (M23, 3 days) focusing on both technical courses/demonstrations and soft skills with speakers from within and outside the consortium; (ii) two workshops on WSN for IoT/IoE with papers from DCs and others outside of OWIN6G (years 1 and 2); (iii) two industrial dissemination days to observe facilities in industries and how they function; and (iv) a final conference, where DCs will present their results. During the planned PM, network-wide training will be delivered by both academic and industry experts, as well as invited experts. This will minimize costs and travel. Although there is one lead institution for each network-wide event, several partners will participate in the courses. The lead organizer will also arrange the invited talks that may take place.

IV. **Training in Secondments:** Most DC will spend at least three months of their eight-month fellowship with industry partners in order to complement the expertise acquired during placement in academic institutions. To ensure that DCs receive the best possible experience and knowhow, secondment activities and the resources needed will be agreed by the DC supervisors and ultimately by the Supervisory Board (SB) in coordination with the host institutions. In addition, supervisors will monitor the progress of DC and, if required, short visits will be made to partner institution in agreement with the project coordinator.

V. **Role-playing Training in Secondments**: It is expected that DCs will (i) participate in the activities of their home/host research groups; (ii) be invited to co-supervise BSc/MSc projects/internships in order to acquire some experience in supervision, which will be useful for their future careers; and (iii) be involved in the organization of various meetings and workshops related to their project. Participation will include local arrangements, publicity and the funding that OWIN6G will reserve for such activities.

Regarding network training activities, there are seven planned activities of 2 training schools, 2 Industrial dissemination days and 3 OWIN6G workshops/conferences, see Table 1.

Table 1. Planned network training activities.

	Events	ECTS (if any)	Lead Institution	Action month (estimated)
1	1st Training school (3 days)	N/A	CTU	M12
2	2nd Training school (3 days)	N/A	NU	M23
3	1st Workshop (1 day)	N/A	IT	M22
4	2nd Workshop (1 day)	N/A	UV	M32
5	1st Industrial dissemination day (2 days)	N/A	IST	M20
6	2nd Industrial dissemination day (2 days)	N/A	MXL	M26
7	Final Conference / Symposium (2 days)	N/A	HUA	M42

3. Progress Assessment and Evaluation Plan

This is for continuous monitoring of training activities within OWIN6G, which will be assessed by means of surveys and individual progress reports as outlined in the followings:

Surveys: DCs will be asked to provide feedback and suggestions on the training activities, focusing mainly on relevance, mode of delivery, overall quality (balance between technical and non-technical materials) and expectation insights. These surveys will be conducted online using platforms available at the Czech Technical University in Prague. The survey will be implemented in conjunction with the OWIN6G training activities.

Individual Progress Reports: DCs will provide progress reports on their research activities via (i) monthly online meetings with SB - a firm schedule has been established for online meetings with

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presentations by DCs, which started in January 2024 when the first group of DCs were registered; and (ii) research group meeting at their hosting institutions. The purpose of these short technical reports is to (i) highlight research activities conducted during the reporting period, alignment of these activities with the individual CDPs and the objectives of OWIN6G, research results and outputs (i.e., publications, seminars, etc.); (ii) concerning issues with DC's projects that needs resolving, which include possible delays in deliverables; and (iii) resolving any risk issues. A template created for the online reporting of DCs is added in the appendix.

4. Reporting on Training Activities

1st Training School – 18th-20th Sept 2024

The event is organized at Czech Technical University in Prague (Dr Shivani Rajendra Teli, Prof. Stanislav Zvanovec) together with a mid-term meeting. The main objectives of the training school are to (i) coordinate the training activities of OWIN6G; (ii) continuously monitoring the progress of DCs research activities; and (iii) liaise with European Committee on all aspects of OWIN6G to ensure its smooth running. There was a selection of topics from SB and in parallel between DCs, see Table 2.

Table 2. Suggested topics for training school

Suggested topics by SB and DC's	**Actions taken**
OCC - Optical camera communications (OCC)	**Invited Dr. Vicente Matus; OCC Devkit – OCC for IoT**
Machine learning algorithms for data driven system models	**Invited Dr. Vicenc Almenar Terre;** **Matlab: Modulation and data processing; and machine learning algorithms**
Applied machine learning in optical wireless communications	**Invited Prof. Petia Georgieva; Application of ML&DL for management of complex (i.e., 5G) wireless sensor networks**
Optical fiber sensing	**Invited Prof. Yulia Semenova; fiber optical sensors and distributed sensing**
WSN, software defined networking (SDN), physical layer	Will be considered for next training school
Backhaul solution for Li-Fi (Power line communication Vs. WiFi for LiFi (Low-Fi))	Will be considered for next training school
Drone to drone optical communications	Will be considered for next training school
Distributed Optical Sensor Systems	Will be considered for next training school

In total, SB and DC's suggested eight topics for the upcoming training school. Thus, we have invited four speakers to cover the first four topics of OCC, ML and optical fiber sensing, see Table 3. The training school will consist of both technical presentations and then practices of students in laboratory tasks and seminars (data processing). The 1st training School (in green) and the mid-term check (in blue) have the following schedule:

Table 3. Training school programme.

Day 1: Wed.	**18th Sep. 2024**
9.00 - 11.00	**1st Lecture: Model development** *Dr. Vicente Matus; Optical camera communication (OCC) Devkit – OCC for IoT*
11.00 - 11.30	**Coffee break**

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11.30 – 13.30	**Labs:** Group 1 (5 students) – **Free space optical (FSO) systems/mmW RF technology,** *Mr. Carlos Guerra Yanez and Dr. Jan Bohata* Group 2 (5 students) - **VLC/OCC systems** *Dr. Shivani Rajendra Teli and Mr. Carlos Guerra Yanez*
13.30 - 14.30	**Lunch break**
14.30 - 16.30	**Labs:** Group 1 (5 students) - **FSO systems/mmW RF technology** *Mr. Carlos Guerra Yanez and Dr. Jan Bohata* Group 2 (5 students) - **VLC/OCC systems** *Dr. Shivani Rajendra Teli and Mr. Carlos Guerra Yanez*
16.30 – 17.15	Report writing by DCs based on lab sessions

Day 2: Thurs.	**19th Sep. 2024**
9.00 - 11.00	**2nd Lecture: Fiber optical sensors and distributed sensing** *Prof. Yulia Semenova*
11.00 - 11.15	**Coffee break**
11.15 – 13.15	**3rd Lecture: Matlab: Modulation and data processing; ML algorithms** *Dr. Vicenc Almenar Terre, Universitat Politecnica de Valencia*
13.15 - 14.00	**Lunch break**
14.00 - 17:15	Mid-term check with **Project officer (PO),** *Nina Poumpalova*

Day 3: Fri.	**20th Sep. 2024**
09.00 – 13.00	Mid-term check with PO
13.00 - 14.00	**Lunch break**
14.00 – 16.00	**4th Lecture: Application of ML&DL for management of complex (i.e.5G) wireless sensor networks** *Prof. Petia Georgieva*
16.00 - 17.00	**Lab visit: Demonstration of RF over FSO for 5G systems** *Dr. Jan Bohata, Czech Technical University in Prague, Czech Republic*
17.00 – 17.15	Closing and feedback session: *Prof. Stanislav Zvanovec*

5. Reporting on Progress Assessment and Evaluation

As a result of numerous delays during the recruitment phase, the development stage of each CDP varies greatly. Note the followings:

- The DC from ISTL will not be able to participate in the first training school because of the long VISA process in UK, but the DC will be able to join online to benefit from technical presentations). This of course will delay his assessment.
- Individual career plans of 9 CDs have been submitted and evaluated by external members from SB. More details are reported in deliverable D28 Career Development Plan.
- All reports from students during monthly online meetings are discussed with members of SB and recorded in the shared OWIN6G folder.

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- A survey on the training activities will take place following the first training school, which will include feedback from all DCs. For this reason, we will create a Google form to collect feedback from all the DC's as well as SB in terms of suggestions for next training school activities, improvement in the arrangements, particular technical requirements, etc.
- Individual reports received from DCs will be assessed during October 2024, which will be included in the next deliverable report in 2025.

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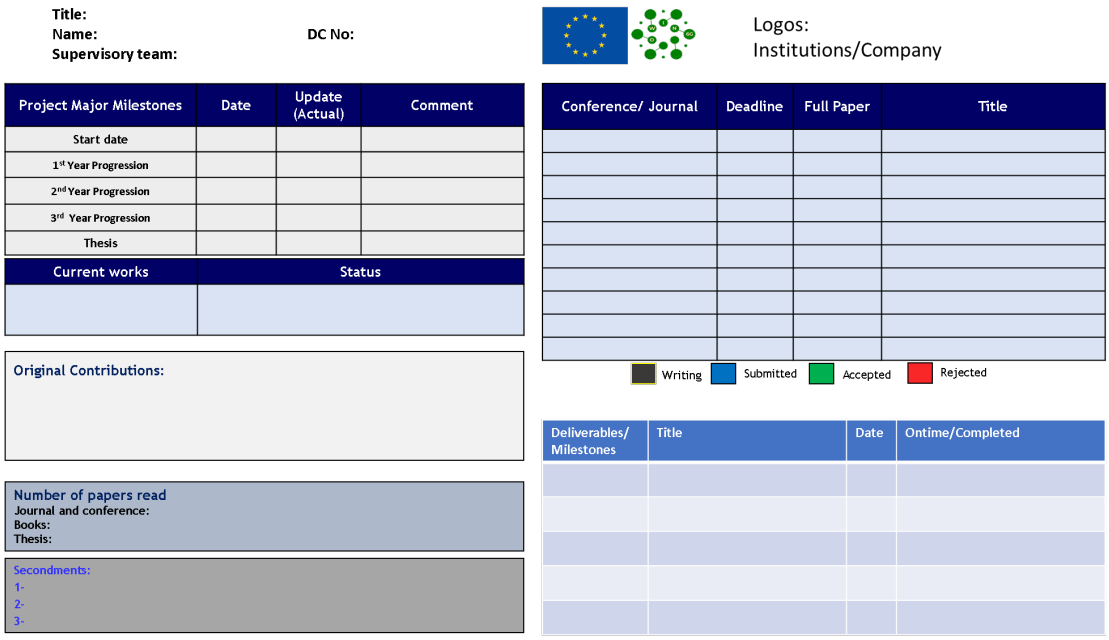
Annex A. Template for DC progress reporting

As part of their monthly report, DCs are divided into three groups, each of whom will present on their progress. In order to facilitate this activity, we use a standard template to report on:

- System block diagram (1 slide)
- Problem statement and literature review (1 slide)
- What is being proposed, why and how? (1 slide)
- Methodology (1 slide)
- Results (1-3 slides)
- Link with other DCs (1 slide)
- Feeding to specific deliverables and milestones (1 slide)
- Questions from the last meeting and DC's responses (1 slide)
- Future work (1 slide).

The front page of the presentation slides is shown below.



Title:
Name: **DC No:**
Supervisory team:

Logos:
Institutions/Company

Project Major Milestones	Date	Update (Actual)	Comment
Start date			
1st Year Progression			
2nd Year Progression			
3rd Year Progression			
Thesis			

Current works	Status

Original Contributions:

Number of papers read
Journal and conference:
Books:
Thesis:

Secondments:
1-
2-
3-

Conference/ Journal	Deadline	Full Paper	Title

Writing Submitted Accepted Rejected

Deliverables/ Milestones	Title	Date	Ontime/Completed

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Annex B. ACRONYMS

CTU	Czech Technical University in Prague
NU	Northumbria University
IT	Instituto de Telecomunicações
MXL	MaxLinear
UV	Universitat de Valencia
IST	Integrated System Technologies
HUA	Harokopio University
CDP	Career development plan
DC	Doctoral candidate
FSO	Free space optics
IoE	Internet of Everything
IoT	Internet of Things
ML	Machine learning
OLP	Open Learning Platform
OCC	Optical camera communication
PO	Project officer
SB	Supervisory board
SotA	State of the Art
VLC	Visible light communication
WSN	Wireless Sensor Network
WP	Work Package

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