MIRELAI

MIcroelectornics RELiability driven by Artificial Intelligence
Project no. 101072491

# Deliverable 2.1

# First annual network meeting

WP 2 – Innovative training

Version 1

| | |
|---|---|
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# Revision history

| Author(s) | Description | Date |
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| Jacqueline Strehler (accelCH) | Draft deliverable | 21.08.2024 |
| Willem van Driel (TU Delft) | Updated draft deliverable | 22.08.2024 |
| Jacqueline Strehler (accelCH) | Revision | 02.10.2024 |
| Peter Fuchs (PCCL) | Final version | 02.10.2024 |

# Executive summary

**Background**

Deliverable D2.1, as part of work package 2, is dedicated to the implementation of the first annual network meeting of MIRELAI.

**Objectives**

The annual network meetings are a key network-wide training activity and aim to provide the MIRELAI doctoral candidates with a comprehensive training programme that covers scientific, transferable, and industry skills.

**Outcome**

The first annual MIRELAI network meeting was hosted by TU Delft in Delft, Netherlands, from 11 to 14 September 2023. It brought together 12 doctoral candidates and 23 supervisors in a hybrid meeting. The programme included foundational scientific lectures, workshops on transferable skills and important industry perspectives, covering all three tracks of the MIRELAI training programme as planned.

I**mpact**

The four-day event provided comprehensive training across scientific, industrial, and transferable skills. The meeting set a strong foundation for the DCs' research activities and professional development, enhancing their technical proficiency, practical industry insight, and collaborative spirit.

**Next Step**

The first annual meeting is completed, and no further steps will be taken. However, the meeting will inform future training activities, specifically the remaining planned annual meetings.

# Contents

# Partner short names

| Short name | Partner name |
|---|---|
| accelCH | Accelopment Schweiz AG |
| TU Delft | Technische Universiteit Delft |
| Nexperia | Nexperia BV |
| NXP | NXP Semiconductors Netherlands BV |
| EKL | Else Kooi Laboratory |

# Abbreviations

| Acronym | Full name |
|---|---|
| **D** | Deliverable |
| **DC** | Doctoral Candidate |
| **EKL** | Else Kooi Laboratory |
| **EU** | European Union |
| **ML** | Machine Learning |
| **FMEA** | Failure Mode and Effect Analysis |
| **8D** | 8 Dimensions |
| **EKL** | Else Kooij Lab |

# 1 Introduction

The annual network meetings of MIRELAI are a key network-wide training activity of our research and training programme. They are conceived to include training along three tracks: scientific, industry and transferable skills, as described in the EU Grant Agreement Annex 1 (DoA).

- **Science track:** Dedicated to training on scientific topics relevant to MIRELAI, including oral presentations and lectures under the overarching theme "from theory to expectations".
- **Industry track**: Providing business and industry skills such as IP and entrepreneurship through talks, lab tours, etc.
- **Transferable track**: Equipping the doctoral candidates (DCs) with the interdisciplinary, intersectoral and interpersonal skills necessary for successful careers in academia and industry through lectures and workshops with hands-on activities.

The annual network meetings are further an important networking opportunity and allow the consortium to monitor the progress of the action, more specifically, the progress of the DCs' individual research projects through presentations and meetings of the MIRELAI governance boards.

The first annual network meeting marked a significant milestone of the MIRELAI project, as it was the first network-wide training activity and the first opportunity for the DCs to meet their fellow PhD candidates in person. The meeting was hosted by TU Delft in Delft, Netherlands, from 11 to 14 September 2023.

# 2 Programme

The first annual network meeting of MIRELAI was held over four days. The event included a session to introduce the DCs to the overall project, and the DCs had the first opportunity to present their individual research project to the other DCs and the rest of the consortium. The programme also included scientific presentations on important foundational knowledge related to MIRELAI, as well as industry perspectives and transferable skills training.

**Day 1: Project introduction and DC presentations – 11/09/2023**

| Time | Topic | Responsibility |
|---|---|---|
| *12:00* | *Registration* | *All participants* |
| 13:00 | Welcome & Who is Who | Willem van Driel (TU Delft) |
| 13:30 | Overview of MIRELAI - MIcroelectronics RELiability driven by Artificial Intelligence | Peter Fuchs (PCCL) |
| 14:00 | Interactive workshop – DC Projects' interrelations | All WP leaders |
| *15:00* | *Coffee break* | *All participants* |
| 15:15 | DC presentations (15 minutes for each DC = 6 x 15`) | DCs 1, 6, 10, 11, 12, 13 |
| 16:45 | Wrap up day 1 | Peter Fuchs (PCCL), Jeanette Müller (accelCH) |
| 17:00 | Supervisory and Executive Board meetings | All + 2 DC representatives |
| 18:00 | End of meeting – day 1 | |

### Day 2: Project management, Open Science, DC Presentations and Microelectronics reliability - 12/09/2023

| Time | Topic | Responsibility |
|---|---|---|
| 08:45 | Welcome back and overview | Peter Fuchs (PCCL) |
| 09:00 | EU project requirements in a nutshell | Jeanette Müller (accelCH) |
| 09:15 | DC presentations (15 minutes for each DC = 7 x 15`) | DCs 2, 3, 4, 5, 7, 8, 9 |
| *11:00* | *Coffee break* | *All participants* |
| 11:30 | Open science– the Dos and Don`ts in dissemination and communication | Mario Ceccarelli (accelCH) |
| *12:30* | *Lunch* | *All participants* |
| 13:30 | Introduction to Reliability - 1 | Willem van Driel (TU Delft) |
| *15:00* | *Coffee break* | *All participants* |
| 15:30 | Introduction to Reliability - 2 | Willem van Driel (TU Delft) |
| 16:30 | Wrap up of day 2 | Peter Fuchs (PCCL) |
| 17:00 | End of meeting – day 2 | |

### Day 3: Microelectronics reliability – 13/09/2023

| Time | Topic | Responsibility |
|---|---|---|
| 08:45 | Welcome back and overview | Willem van Driel (TU Delft) |
| 09:00 | Failure modes, mechanisms & data analysis Chip/Package/BoardLevel | |
| *11:00* | *Coffee break* | *All participants* |
| 11:30 | Industry perspective on semiconductor reliability: NXP | Romuald Roucou (NXP) |
| *13:00* | *Lunch* | *All participants* |
| 14:00 | Design for Reliability & Physics-of-Failure | Willem van Driel (TU Delft) |
| 15:00 | *Coffee break* | *All participants* |
| 15:30 | Industry perspective on semiconductor reliability: Nexperia | Rene Poelma (Nexperia) |
| 17:00 | Evaluation methods FMEA & 8D | Willem van Driel (TU Delft) |
| 18:00 | End of meeting – day 3 | Peter Fuchs (PCCL) |

### Day 4: Getting to know each other – 14/09/2024 (optional)

| Time | Topic | Responsibility |
|---|---|---|
| 10:00 | EKL – Lab tour | TU Delft |
| *12:30* | *Lunch* | All participants |
| 14:00 | Delft guided tour (Open to DCs only) | TU Delft |
| 16:00 | End of meeting | |

# 3 Report

The first annual network meeting of MIRELAI was a success, providing an enriching and multifaceted experience for the participants. The meeting was attended by eight DCs and 17 partner representatives in person, as well as four DCs and six partner representatives online.

## 3.1 Day 1

On the first day, the participants got to know each other through a tour de table and an interactive workshop to understand the interrelations between the individual DC projects. This session encouraged a collaborative spirit among the DCs and their supervisory teams, fostering strong relationships and effective communication. The first six DCs presented their individual research projects for the first time to the entire group, providing an overview of their backgrounds, objectives, methodologies and planned timelines.


***Figure 1.*** *Interactive workshop for the MIRELAI DCs and supervisors.*

After that, a joint meeting between the Supervisory and Steering Board and the Executive Board was held.

The evening of day 1 was planned with a joint dinner. A vegitarion sharing dinner was selected as to promote the DC's to work as one team.

***Figure 2.*** *Joined sharing dinner.*

## 3.2 Day 2

The second day started with an important introduction to the EU MSCA DN requirements by Jeanette Müller of associated partner accelCH. This session was crucial to ensure that all DCs and supervisors are well aware of the expectations, timelines and rules to follow to ensure the appropriate implementation and monitoring of the MIRELAI project. After, the remaining six DCs presented their individual projects.

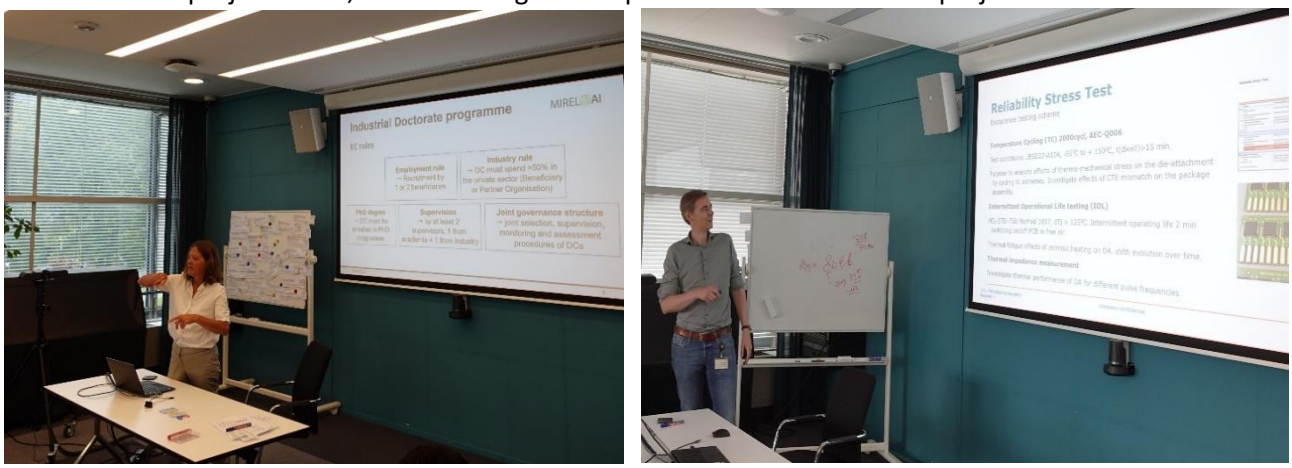


***Figure 3**. Jeanette Müller (accelCH, left) and Rene Poelma (Nexperia, right) giving their respective workshops.*

The rest of the day was dedicated to transferable and scientific skills. Mario Ceccarelli of accelCH introduced the DCs to the open science concept, sharing relevant dos and don'ts for communication and dissemination in EU-funded projects. Willem van Driel for TU Delf further gave an introduction to reliability. The full program of this lecture is shown in the below figure. After dealing with the basics of statistical distribution, the lecture continued with detailed descriptions of the possible failure modes and mechanisms in semiconductor devices. This included failure modes seen in chips, package and systems. At the end of the lecture, system reliability techniques were presented.

Classified

# Full Program of the course

MIRELAI

TimeEdit
ET4277_rooster
01-02-2023 - 27-06-2023

| Nr | Day | Date | Location | Topic |
|---|---|---|---|---|
| 1 | Tuesday | 14/02/2023 | 36.LH.01.440.EEMCS-HallK | Introduction: Problems and impact, definitions |
| 2 | Friday | 17/02/2023 | 35.1.160.Drebbelweg-InstructionRoom3 | Distributions & Dataanalysis |
| 3 | Tuesday | 21/02/2023 | 36.LH.01.440.EEMCS-HallK | Reliability Models |
| 4 | Friday | 24/02/2023 | 35.1.160.Drebbelweg-InstructionRoom3 | System reliability – 1 non-maintained systems |
| 5 | Tuesday | 28/02/2023 | 36.LH.01.440.EEMCS-HallK | System reliability – 2 maintained systems |
| 6 | Friday | 03/03/2023 | 35.1.160.Drebbelweg-InstructionRoom3 | Failure modes, mechanisms & data analysis Chip/Package/BoardLevel |
| 7 | Tuesday | 07/03/2023 | 36.LH.01.440.EEMCS-HallK | Failure modes, mechanisms & data analysis Chip/Package/BoardLevel |
| 8 | Friday | 10/03/2023 | 35.1.160.Drebbelweg-InstructionRoom3 | Failure modes, mechanisms & data analysis Chip/Package/BoardLevel |
| | Tuesday | 14/03/2023 | 36.LH.01.440.EEMCS-HallK | Design for Reliability & Physics-of-Failure |
| | Friday | 17/03/2023 | 35.1.160.Drebbelweg-InstructionRoom3 | AI methods for reliability |
| 9 | Tuesday | 21/03/2023 | 36.LH.01.440.EEMCS-HallK | Evaluationmethods FMEA |
| | Friday | 24/03/2023 | 35.1.160.Drebbelweg-InstructionRoom3 | Digital twin concepts for reliability |
| 10 | Tuesday | 28/03/2023 | 36.LH.01.440.EEMCS-HallK | Evaluationmethods 8D |
| | Friday | 31/03/2023 | 35.1.160.Drebbelweg-InstructionRoom3 | Faulttree analysis |
| 11 | Tuesday | 04/04/2023 | 36.LH.01.440.EEMCS-HallK | Exam/Mini-projects |
| exam | Wednesday | 12/04/2023 | 62.0.21.AE-HallE | Exam |
| exam | Tuesday | 27/06/2024 | 62.0.21.AE-HallE | Resit |

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***Figure 4.** Full program of the reliability course.*

## 3.3 Day 3

On the third day, the focus shifted to scientific skills, specifically microelectronics reliability. Under the expert guidance of Willem van Driel of TU Delft, the DCs delved into the concepts of reliability designs, failure mechanisms, testing methodologies, and industry perspectives. This segment equipped the DCs with critical knowledge on ensuring the durability and performance of electronic components, which is essential for advancing their research in microelectronics. The DCs got trained in industry methods like Failure mode and Effect analysis (FMEA) and 8 Dimensions (8D). These techniques enable the DC's to understand the common practice in industry, making it easier for them to discuss their research with the associated industrial partner.

***Figure 5.*** *Hands-on experience on chips and semiconductors.*

The day was further enriched by Romuald Roucou of NXP and René Poelma of Nexperia sharing their industry perspective on semiconductor reliability. The DCs gained valuable insights into the semiconductor industry. Both Romuald and Rene presented the reliability principles used in their companies and the common problems they face. At NXP, being a supplier to the automotive industry, reliability problems arrive due to the high quality demand in that industry. At Nexperia, a supplier of standard components, reliability problems arrive due to the high volume production. Rigorous testing with a trial and error mindset is the common practice. They both mentioned the lack of fundamental understanding of failure mechanisms.

## 3.4 Day 4

The final day of the meeting started with an Else Kooij Lab (EKL) tour. EKL is one of the biggest cleanrooms in The Netherlands with over 600 m2 of cleanroom class 100 (ISO 5) and 400 m2 of cleanroom class 10'000 (ISO 7). EKL allows full fabrication and characterisation of any active or passive nanostructure starting from a silicon wafer. The laboratory offers sub-micrometer resolution lithography, thin film deposition and etching, bulk and surface micromachining, packaging, and assembly of the final device. Moreover, polymer based, biocompatible and biodegradable devices can be fully fabricated and synthesized in EKL. EKL cannot be visited without taking any measures as to prevent dust coming into the cleanroom. So, all DC's had to be dressed as if they would be walking on the moon (see below left picture).

***Figure 6****.Participants in the EKL lab tour (left) and during the Delft city tour (right).*

The event ended with a guided tour of the beautiful city of Delft, known for its channels and the central market.

***Figure 7****.The city of Delft is well-known for its channels (left) and the central market (right).*

# 4 Impact

The first annual meeting of MIRELAI was a success. The event provided the DCs with foundational scientific, industry, and transferable skills for a successful start in their MIRELAI PhD journey. Meeting their fellow students and the supervisors within the consortium will have been useful in establishing collaboration between the different groups. All DCs are now also aware of the objectives of the entire project and the other DC projects. The scientific lectures ensured that the DCs have a common knowledge basis on the most relevant technical topics related to MIRELAI. The industry perspective talks broadened the DCs' horizons' and will be valuable for the planning of their individual research projects and in the future when they work at their industry placement if they aren't already doing so. The transferable skills training ensured that the DCs are aware of important rules to follow within the framework of an MSCA Doctoral Network. Overall, the first annual network event delivered a comprehensive programme to set the DCs up for a successful implementation of MIRELAI.

# 5 Next steps

The first annual network meeting is now considered complete, and no further steps are necessary. However, experiences from the first network meeting will inform the organisation of the second network meeting and other training activities. Furthermore, the DCs will use the knowledge gained to further their individual research projects.