

Seven years of committed Nordic IIoT cooperation

Five Nordic universities incorporating eight departments with a strong focus on Industrial Internet of Things have spent seven years on integrating their capacities when it comes to:

- Graduate school with 62 PhD students
- Sharing state-of-the-art laboratories
- Offering more than 80 joint high level courses
- Developing a Nordic Roadmap on IIoT.

- Joint participation in EU's research programmes
- Organization of five high class Summer Schools
- Paving the way for a more sustainable green transition

We gratefully acknowledge the long-term commitment from Nordforsk for the provision of funding facilitating the development of a world-class Nordic IIoT research environment.

The Hub students

62 PhD students have been associated with the Hub, from which 46 have graduated. They were divided into four thematic groups:

- Networking (19 students)
- Fog/Edge computing (17 students)
- Cloud computing (12 students)
- Data Analytics & Machine Learning (14 students)

- Fog computing and Industry 4.0
- The Summer School on Cyber Physical Systems
- Nordic IoT Summer School: Edge and Fog Computing
- Robotics
- Advanced Computer Architecture and Compilation

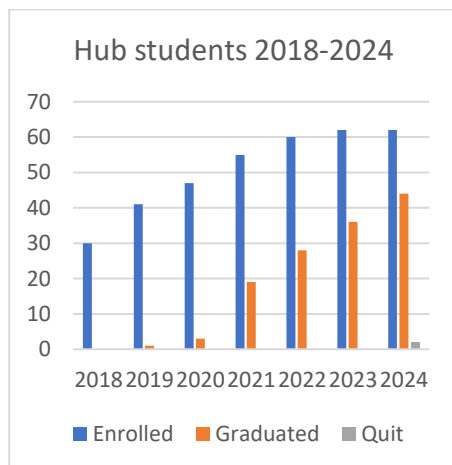
Further three events were organized by the students:

- Hackathon "IoT on Mars"
- LinkedIn training
- IoT product development workshop

The students have also benefitted from access to joint labs, i.e. nearly 40 lab set-ups are shared between the partners.

Throughout the project a Yearly meeting was organized on a rotational basis to discuss progress and new initiatives:

- Copenhagen (2018, 2021)
- Helsingborg (2018)
- Espoo (2019)
- Trondheim (2022)
- Stockholm (2023)
- Lund (2024)

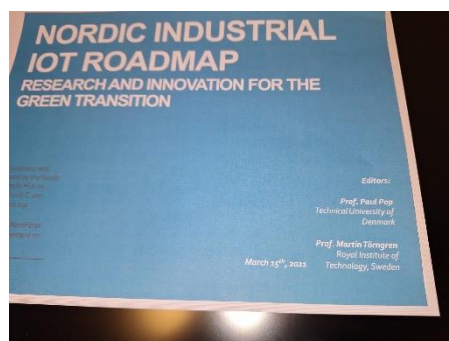


More than 80 courses were offered to the students, among them five Summer Schools:

Creating a Nordic Industrial IoT roadmap

In November 2019, the Hub organized an IoT roadmapping workshop in Stockholm. The theme and purpose of the workshop was talks and overviews of existing roadmaps to come up with a synthesis based on the views of our staff and the invited people.

The roadmap has been very instrumental in managing the future directions of the Hub partner's research work, i.e. to support sustainability and the green transition



The aim of the Nordic IoT Roadmap was to complement existing roadmaps and research agendas, such as the European initiatives on Green Deal, Smart Everything Anywhere, and Autonomous systems. A long-term focus on sustainability has provided the Nordic countries with significant advantages. For example, the CO₂ intensity (gCO₂/kWh) of power and district heating production amounts to only 14% of the EU25 average and transport's total energy use decreased by over 20% compared with year 2000, despite a 70% increase in overall passenger and freight activity. Many of these results have been achieved by a long-term focus on digitalization—in fact the four Nordic countries are ranked on the top four places in EU's 2020 "Digital Economy and Society Index". Thus, the Nordic countries are good at both sustainability and digitalization!

Student mobilities

As part of the Hub activities the PhD students were encouraged to visit each other to strengthen co-operation and to pursue synergies. A vast number of students have been travelling to e.g. the student events and Summer Schools as well as visiting leading global universities.

Yearly, more than twenty students made use of the mobility programme.



Sharing of IoT Laboratories

Early in the project the partners agreed to offer access to selected parts of their laboratories. Nearly 40 such test set-ups were made available to the Hub students including user instructions and access information.

Lately the 5G Lab hosted at NTNU was made available for remote Hub users. An internal network is running at the NTNU Lab with several 5G-connected devices and this set-up was documented in a recent joint NTNU-DTU paper.

Nordforsk position paper

In 2023 Nordforsk made a call for Fast Track publications from ongoing projects to capitalize on the research results and knowledge that has been built during the first years of Vision 2030. The aim of Vision 2030 is that the Nordic region will become the most sustainable and integrated region in the world by 2030.

The Hub results as summarized in the Nordic IIoT road map demonstrate that digital technologies, if harnessed properly, can drive the Nordic region towards a sustainable future. But this requires targeted policies and innovations that can solve the challenges with digital tech.

Our Hub position paper, entitled Digital Technologies for a Sustainable Nordic Future - Challenges, Opportunities, and Policy Implications came up with the following recommendations:

- Foster trustworthy digitalization and multidisciplinary collaboration
- Encourage the use of renewable energy sources, improve energy efficiency, and reduce e-waste of digital systems
- Establish 'Sustainability Innovation and Competence Hubs' to drive the digital transformation.

A proposal for a Nordic IIoT Master program

Educating the next generation of engineers to be able to design and develop the rapidly increasing need for Industrial Internet of Things (IIoT) devices is imperative. Beside the joint PhD education, the overall goal of the Nordic IIoT Hub was to determine the preferred content of a Nordic Industrial IoT MSc curriculum.

By the end of 2022, the Hub presented a report with a proposal for a joint Nordic IIoT Master program. The report starts with a review of CPS/IoT-related courses currently being offered at the eight university departments involved in the Nordic IIoT project. Next it defines which courses should be included in a Nordic IoT curriculum.

Lasting Hub impact

At the final meeting in Lund the partners discussed how to maintain a lasting impact of the Hub. The discussion ended up with a long list of joint activities that may be pursued in the future.

Just to mention some of the lowest hanging fruits:

- Joint involvement in EU proposals (COST and MSCA-DN proposals already submitted)
- Joint mailing list/shared Google calendar with events/news
- Maintain the access to joint infrastructure (Labs)
- Maintain a bi-monthly on-line meeting among the partners
- To create value from the IIoT Roadmap, i.e. the Green transition, circularity, etc.

