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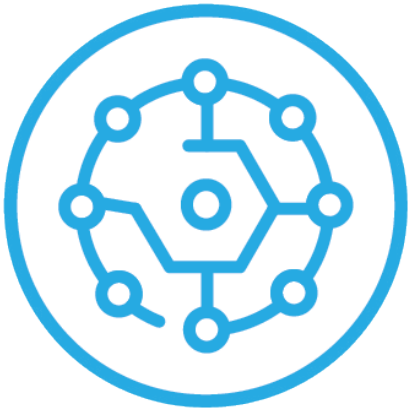
European Association on
Smart Systems Integration



Joint workshop by EPoSS and
INSIDE Industry Associations

The Future of Innovation in Edge AI

Online, April 04, 2025

Notes from the Workshop

Part IV: DAIS: Lessons from Building Distributed AI Systems in Europe

Presented by Anders Lindgren, RISE

1. A Vision for Distributed AI Across Europe

The DAIS (Distributed Artificial Intelligent Systems) project set out with an ambitious goal: to design and deploy distributed AI across the full value chain – from semiconductors to real-world applications. Coordinated by RISE (Sweden's National Research Institute), the project brought together 47 partners from 11 countries and spanned nearly four years.

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This large-scale collaboration aimed to enable intelligent systems that are not only powerful and connected but also **energy-efficient, self-organizing, and privacy-preserving by design**. In doing so, DAIS directly addressed the evolving needs of industries increasingly reliant on smart, decentralized computing at the edge.

2. Structure: From Modular Contributions to Integrated Systems

The project was structured around **eight supply chains**, each focusing on specific technology clusters or application areas. These were:

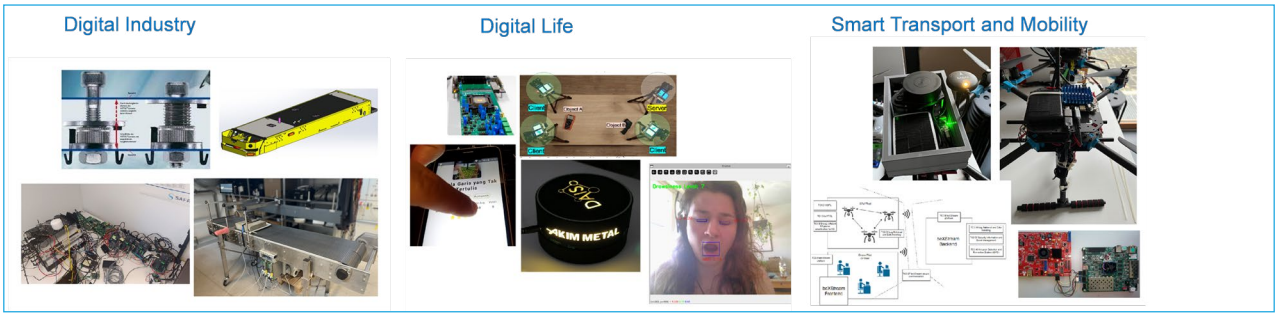
- **SC1–SC5**: Enabling technologies such as semiconductors, sensors, hardware/software integration, and edge frameworks.
- **SC6–SC8**: Real-world applications across digital industry, digital life, and smart mobility.

Work was driven by a combination of:

- **13 Proof-of-Concepts (PoCs)**: Smaller, focused efforts by individual or small groups of partners.
- **14 Demonstrators**: Larger integrations showing real-world use.
- **Consolidated Demonstrators**: Evolved projects that brought together multiple technologies into unified platforms.

This modular yet collaborative setup allowed partners to innovate independently while still feeding into broader system-level goals.

3. Application Areas: Where Distributed AI Meets Reality



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Digital Industry

In the industrial domain, DAIS contributed to smarter, more adaptive manufacturing processes through:

- Smart mechatronic systems for cost-saving and reliability in automotive applications.
- Real-time anomaly detection to improve production line efficiency.
- FPGA-based AGVs (Autonomous Guided Vehicles) for warehouse automation.
- Edge AI systems that enabled smarter energy usage and predictive maintenance.

Digital Life

Focusing on human-centered innovation, this area explored how AI can enhance user experiences while maintaining data privacy:

- Emotion recognition using sound and neuromorphic processors.
- Federated learning for privacy-aware recommendations in smart TVs.
- Driver drowsiness detection and personalized feedback systems.
- AI-enhanced multipath communication for immersive XR (Extended Reality) experiences.

Smart Transport and Mobility

The third pillar dealt with mobility challenges, especially for drone technology:

- Autonomous drone navigation, obstacle avoidance, and accident reconstruction.
- Fleet self-provisioning and AI-based route optimization.
- Aerial fire detection systems that deploy sensors in remote forest areas.
- Resilient multi-channel communication (Wi-Fi, LTE, SATCOM) to ensure seamless operations.

4. Technological Foundations: Hardware and Software Breakthroughs

DAIS delivered impactful innovations in both hardware and software.

On the hardware side:

- Development of energy-efficient microcontrollers with advanced sensing (e.g., PCS chips).
- Integration of **SPAD-Memristor imaging devices** for ultra-low-power visual sensing.
- Communication systems enabling end-to-end AI data flow across 5G and satellite links.

In software:

- Robust federated learning algorithms that are both **noise-tolerant and data-efficient**.
- Sensor fusion for environmental classification using edge AI.
- Middleware frameworks to manage AI workflows and ensure system interoperability.

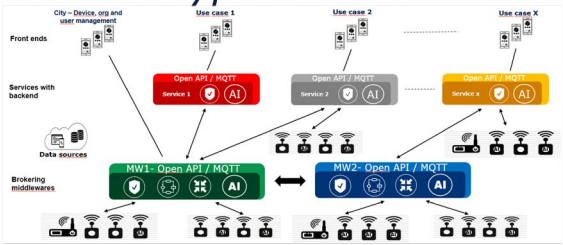
These technologies enabled scalable edge AI solutions that were modular and adaptable to various use cases.

5. Integration: Overcoming Fragmentation Through Federation

One of the major challenges in distributed AI – and IoT in general – **is fragmentation**. DAIS tackled this head-on using **broker-based middleware architectures** that facilitated smooth integration between different platforms, data formats, and hardware.

Integration prove that the DAIS SW framework, except creating exceptional research, innovations and products also successfully overcome one of the major issues within modern IoT by using brokering middleware platforms:

Fragmentation and incompatibility between vertical systems because of different type of dataformat and interfaces.



Does it establish even larger values than the sum of the individual solutions? Absolutely !

Copyright: RISE

Each consolidated demonstrator followed a **top-down and bottom-up strategy**:

- **Top-down**: Define goals such as privacy compliance, security, and end-user value.
- **Bottom-up**: Leverage available communication protocols, middleware options, and technical capabilities.

Standard protocols like HTTP and MQTT were employed to ensure a **shared data ecosystem**, allowing vertical integration across domains – whether in a smart factory, a smart city, or a connected vehicle platform.

6. Collaboration and Agility: Navigating Complexities and Crises

With such a large consortium, collaboration was both a strength and a logistical challenge. Effective coordination was essential – especially when facing unexpected external events like the **COVID-19 pandemic** and **global hardware supply chain disruptions**.

Despite these hurdles, DAIS remained agile:

- The project was extended by eight months, allowing time for deeper integration.
- Hackathons and integration workshops proved instrumental in driving synergy.
- Spontaneous innovations, such as a new demonstrator born during a hackathon, highlighted the project's flexible spirit.

This adaptability ensured that DAIS could respond to shifts in the technological landscape, such as the mid-project rise of **large language models (LLMs)**, which were integrated into several updated demonstrators.

7. Lessons Learned: Building Resilient, Scalable Edge AI

The DAIS journey offers key takeaways for future projects in AI and edge computing:

- **Flexible system architecture** is vital for cross-domain scalability.
- **Middleware platforms** do more than connect – they accelerate modular innovation.
- **Early planning for KPIs and validation** enables smoother cross-demonstrator evaluation.
- **Access to high-quality data early on** boosts model training and real-world relevance.
- **Agility in the face of change** – whether technical or global – is essential for long-term project success.

8. What Comes Next: Beyond DAIS

While the DAIS project formally concluded in late 2024, its legacy continues. Multiple spin-off proposals have already been submitted under **Chips JU, Horizon Europe**, and national research programs. Many of the original partners remain open to **continued collaboration**, both through formal projects and bilateral efforts.

The core message of DAIS is clear: **distributed, federated, and privacy-preserving AI systems are no longer a future ambition – they are a present-day imperative**.

And as we move forward, the ecosystems built and the technologies developed under DAIS will continue to power Europe's leadership in trustworthy, efficient, and secure edge AI.