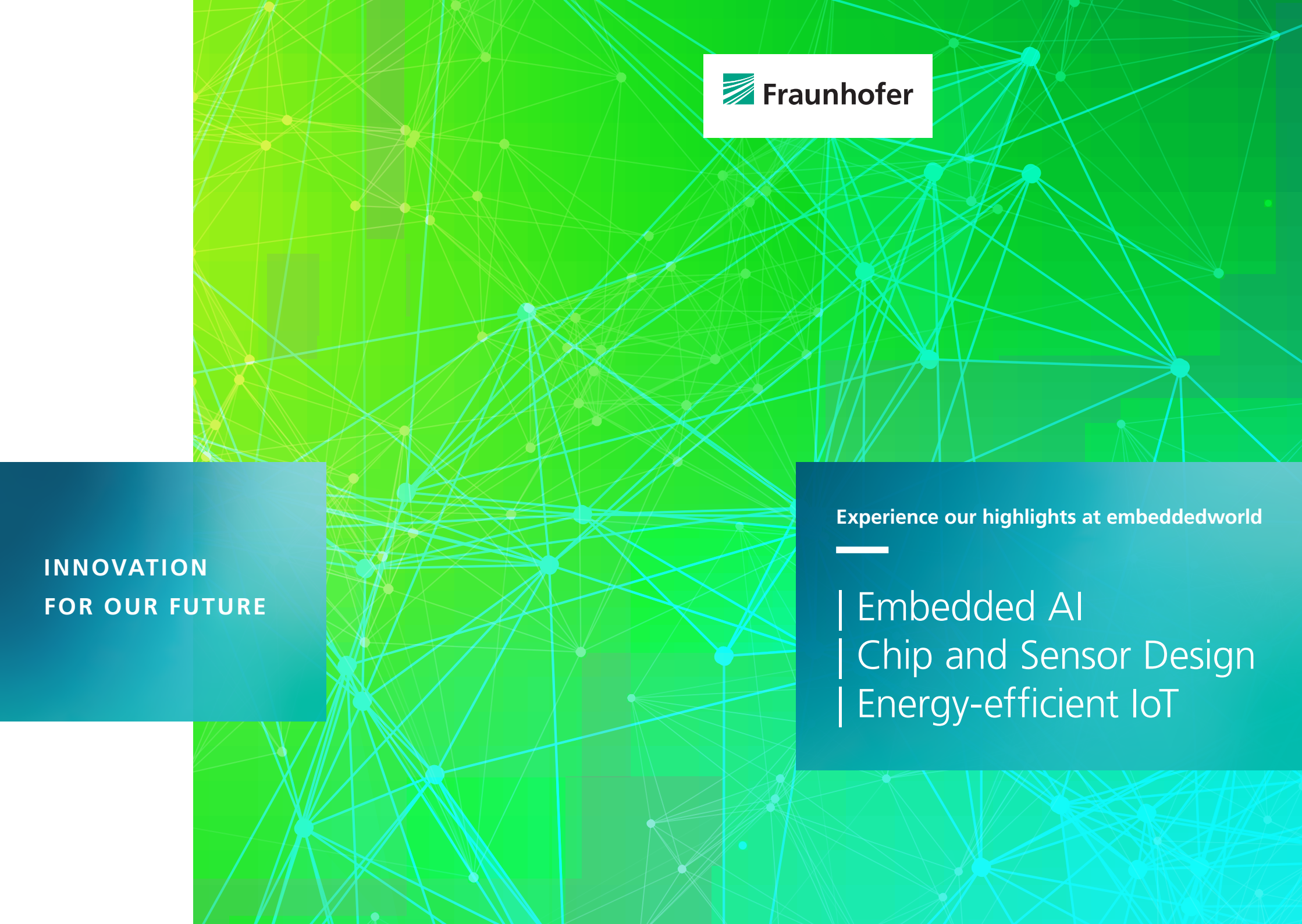

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| Embedded AI
| Chip and Sensor Design
| Energy-efficient IoT

Topics

Preface 3

Agentic Neural Architecture Search is the Enabling Technology for Edge AI 4

Intelligent Edge AI: When Even Bolts Think for Themselves 6

The Edge AI Store: Shaping the Future of Intelligent Edge Devices 8

Connected Rescuers: Mesh Communication for Drone Swarms 10

mioty®: The Allrounder LPWAN Technology for IoT Communication 12

A Case Study in Chip System Engineering:
Spexclip at the Bavarian Chip-Design-Center. 20

System-Technology Co-Optimization (STCO)
for Advanced Heterogeneous Prototypes 22

Maximum Energy Efficiency and Service Life for IIoT Systems 24

Making Integrated Microchips Possible:
How the Design Enablement Team Accelerates Innovation 26

Failure and Reliability Analysis and Testing for Networked Systems 28

Save Energy, Gain Control – That's how Smart a Home can be. 30

Fraunhofer Booth Plan Hall 4-422 32

Imprint 34

Fraunhofer@ew26: Innovation for our Future

Chip and Sensor Design – Embedded AI and Energy-efficient IoT Sensors and Systems ...

these Fraunhofer highlight topics stand for the perfect triad of innovation in embedded system technologies that push the boundaries of new implementations and furthermore new IoT applications.
Our institutes provide cutting-edge Edge AI and Agentic AI technologies that pave the way for high performance, efficiency and at the same level sustainability for industrial, medical and automotive applications. They bring new possibilities to Edge AI design, allow for neuromorphic computing in the component and assist to design Edge AI models first-hand. With the Edge AI Store we are shaping the future and open up access to rapid deployment of pre-trained AI models for a wide range of use cases that can be easily run on resource-constrained devices, enabling powerful AI directly at the edge.

And important role also plays the sovereignty of technologies to secure supply chains and technological processes.

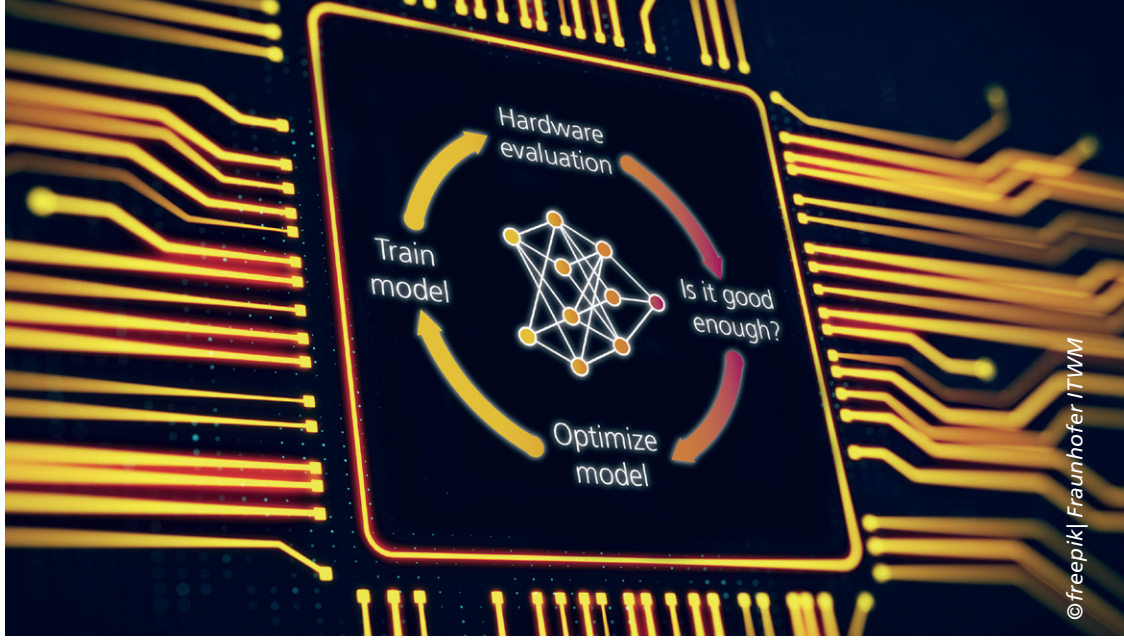
With the Bavarian Chip-Design-Center e.g. we provide an important milestone for these issues: Chiplet technologies and implementation, ASIC and IC design that are focused on customer- and application-oriented requirements as well as energy-efficiency and sustainability on top.

With our future-proof Low Power Wide Area Network LPWAN mioty® e.g. we set new standards in the field of wireless data transmission in terms of scalability, cost efficiency, range, transmission security and battery life.

Keen to learn more about all this?
No problem – we are looking forward to your visit and your questions at our booth and during our workshop events and for now – enjoy reading!

Fraunhofer Joint Booth
Hall 4-422

Agentic Neural Architecture Search is the Enabling Technology for Edge AI



The data produced at the edge brings many opportunities for novel AI applications. Since the volume of produced data is increasing steadily, we observe a shift away from the cloud and towards the edge for AI processing. But implementing AI on the edge is challenging, since computational resources are limited. Common manual finetuning of the models is not able to keep up with the demand. Human experts become the bottleneck for edge AI adoption. AI Agents combined with Neural Architecture Search automatize AI design and make AI adoption widely applicable and scalable.

Data produced at the edge often is send to the cloud for processing. This approach is running into two major bottlenecks:

1) The energy bottleneck, since the energy consumption of datacenter grade hardware is high.
2) The communication bottleneck, since moving all generated data into datacenters for processing is hitting a bandwidth limit.

Edge AI is a smart way to process data efficiently at the source, so that both the energy and the communication bottleneck can be resolved. However, doing so is challenging, since designing edge AI applications requires to consider both the application performance and the hardware limitations. Human experts are needed to design edge AI models, but these manual design processes become the bottleneck for edge AI adoption.

Agentic Neural Architecture Search makes edge AI design scalable

Agentic Neural Architecture Search (ANAS) is a method to automatically find optimized AI models. More specifically, given a set of optimization targets such as accuracy, latency and energy consumption, the AI agent can find an AI model structure that meets all requirements. The ANAS does so by applying changes to the model structure and determining if the resulting model is better or not. By repeatedly applying beneficial changes to the model, the quality improves and the optimization targets are met. This AI driven AI design is fully automatic and can outperform human experts in both development time and the quality of the results.

Agentic Neural Architecture Search with hardware in the loop

At Fraunhofer ITWM, we work on intelligent ANAS algorithms that can directly optimize AI models for any hardware platform. By treating the hardware as a black box, our ANAS algorithms can infer from hardware measurements what the best design choices are. The ANAS learns from the hardware feedback and improves its decision making. Since often there is no single best solution, our tool investigates several model design veins at once.

All of this is automatic, yet transparent to the developer, since all design decisions are traced and can be reviewed. This helps to understand why our ANAS reached the designs it is suggesting. The AI developer stays fully in control of the search, but receives a productivity boost that reduces development time from potentially months to weeks.

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Intelligent Edge AI: When Even Bolts Think for Themselves

Our infrastructure often ages faster than maintenance teams can respond. Bridges, wind turbines, and industrial plants consist of thousands of critical connecting elements, the condition of which has previously been checked manually. Neuromorphic computing opens up new possibilities here: With a NeuroQ-Bolt, an intelligent bolt with an integrated ADELIA AI chip, continuous self-monitoring directly on the component becomes a reality. This allows damage to be detected even before it becomes visible.

Bolts carry enormous loads and are crucial for the safety of large structures. However, the large number and inaccessibility of these locations make regular inspections costly. A NeuroQ-Bolt fundamentally changes this process. It combines sensor technology, AI processing, and energy-autonomous communication in a compact unit that remains permanently in the component.

Neuromorphic computing in the component

Neuromorphic computing refers to brain-inspired AI hardware that executes neural networks directly and extremely energy-efficiently in the hardware itself. The neuromorphic AI chip ADELIA, a dedicated low-power processor for edge-based neural signal analysis, is built on precisely this principle and forms the heart of a NeuroQ-Bolt:

Its analog in-memory computing enables the execution of complex neural networks with less than 1 mW of power consumption. This efficiency allows the complete analysis to be performed directly in the bolt – without the cloud, without external computers, and powered exclusively by energy harvesting. Even slight temperature differences or small ambient light levels are sufficient to power a whole NeuroQ-Bolt.

ADELIA processes the signals from several integrated sensors: the piezoresistive DiaForce® thin-film system measures the preload force, while other sensors detect vibrations and acoustic events. Neuromorphic algorithms classify these signals in real time, detecting anomalies, incipient cracking, and atypical load curves, even in noisy or vibration-intensive environments.



A future scenario at sea: edge-AI driven predictive maintenance with self-monitoring bolts instead of manual inspections

© Fabian – stock.adobe.com /Fraunhofer IIS

Self-sufficient monitor with a wide radio range

If the bolt detects any abnormalities, it sends an energy-efficient warning via the LPWAN system mioty®. A base station can connect up to 30,000 bolts over distances of up to 10 km. Each message requires only 54 mWs – ideal for years of autonomous operation.

Greater efficiency and sustainability

With its local AI processing, a NeuroQ-Bolt enables true predictive maintenance. Inspections only occur where necessary, rather than at fixed intervals. This drastically reduces material, energy, travel, and costs. Areas that are particularly difficult to access, such as offshore wind farms, bolted motorway or railway bridges or large industrial plants, benefit greatly from this technology.

Pioneering for infrastructure and industry

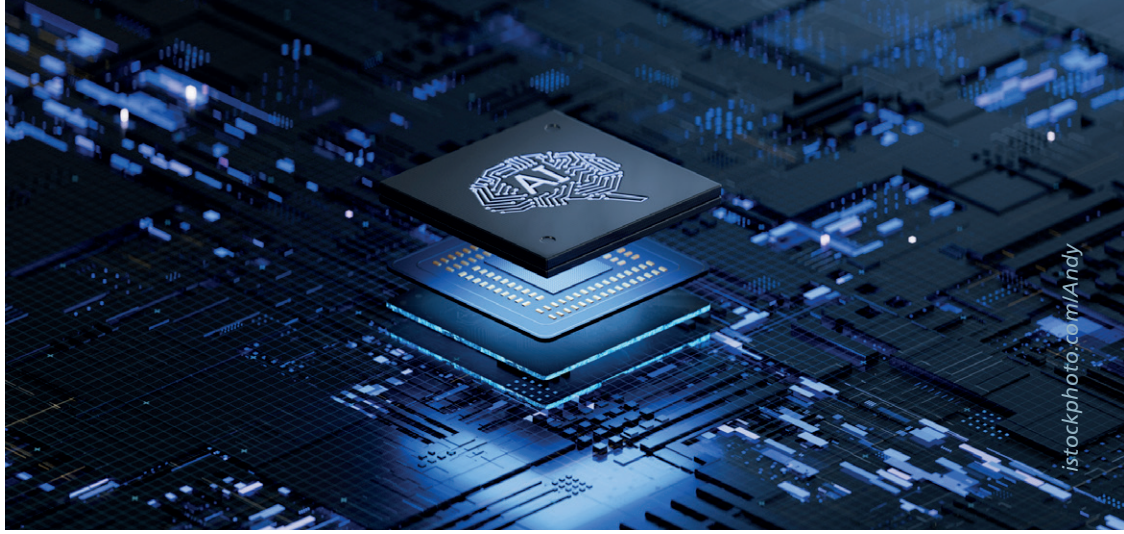
A NeuroQ-Bolt could be a solution for edge-AI driven predictive maintenance of critical infrastructure. Yet the underlying technologies – ADELIA, energy harvesting, mioty®, Q-Bo® and DiaForce® – already exist and can also be deployed as modular add-ons for existing bolts, for example. They impressively demonstrate how neuromorphic computing is making the leap from research to real-world applications. A bolt that thinks and reports for itself: small in size, big in potential for a more sustainable and secure infrastructure.

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The Edge AI Store: Shaping the Future of Intelligent Edge Devices



Artificial intelligence is increasingly moving from data centers directly to edge devices. This enables local data processing, faster response times, and better data privacy. Our Edge AI Store offers optimized AI models that can be easily deployed on resource-constrained devices, supporting developers and businesses with powerful, and easily upgradable AI solutions right at the edge. The result: faster innovation cycles, lower energy use and a clear path from idea to product.

Breaking barriers for a new era of Edge AI

Imagine a world where AI capabilities are as easy to integrate as installing an app. Where developers can browse ready-to-use intelligence, test it directly on their hardware, and deploy it without months of engineering overhead.

Built on a mission to bring large AI capabilities to small devices, the Edge AI Model is powered by a technology foundation: a hardware-agnostic inference engine that makes AI portable across platforms from ARM Cortex-A and Cortex-M to Raspberry Pi and emerging IoT chipsets. It breaks down silos. It removes platform barriers and most importantly: it accelerates innovation.

From months to days

With the Edge AI Store, development cycles that once stretched over months now compress into days.

Immediate access to ready-to-use intelligence enables companies to evaluate computer vision, gesture recognition, person tracking or anomaly detection directly on their target hardware without delays, cloud detours or complex toolchains.

Why Edge AI matters

Designed for energy-efficient devices, on device inference reduces bandwidth consumption, strengthens data privacy and significantly lowers energy use, making AI not only faster but also more sustainable.

Edge AI models can require up to a thousand times less power than standard GPU based ML applications, because data is processed locally rather than transferred to the cloud. This extreme efficiency enables devices to operate for years on minimal battery resources, reducing both energy demand and the use of valuable materials. Local inference also delivers true real time performance: raw data no longer has to be transmitted and processed externally, which eliminates network latency and dramatically improves responsiveness.

At the same time, independence from cloud providers ensures that sensitive information stays on the device, making AI retrofittable even in environments where connectivity is unstable or not allowed. The result is a combination of efficiency, speed, privacy and resilience that only decentralized intelligence can deliver.

Experience the Edge AI Store first-hand

Are you ready to transform your embedded systems? Join us at embeddedworld 2026 to experience the Edge AI Store in action. Unlock the potential for next-generation applications in industrial automation, predictive maintenance, IoT, and beyond. Discover how you can future-proof your products with efficient, reliable, and easily upgradable AI right at the edge. Let's take the next step towards smarter, autonomous devices together.

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Connected Rescuers: Mesh Communication for Drone Swarms

Where communication must stay reliable under tough conditions, autonomous drone swarms with mesh technology unfold their potential. Within minutes, they establish a self-organizing, resilient network independent of cellular service or satellite links. This robust system delivers situational awareness, supports search and supply, and stays stable even during failures. Fraunhofer IIS develops flexible and energy-efficient, European-built mesh solutions for real-world emergencies.

A powerful earthquake has reduced a wide region to rubble, cellular networks have collapsed, power is down, and roads are blocked. While first responders are still trying to gain orientation, a swarm of drones takes off and begins to link up automatically. Within minutes, a self-organizing communication network forms without relying on any existing infrastructure. This autonomous connectivity enables rapid assistance exactly where it is needed most.

Self-healing network instead of radio silence

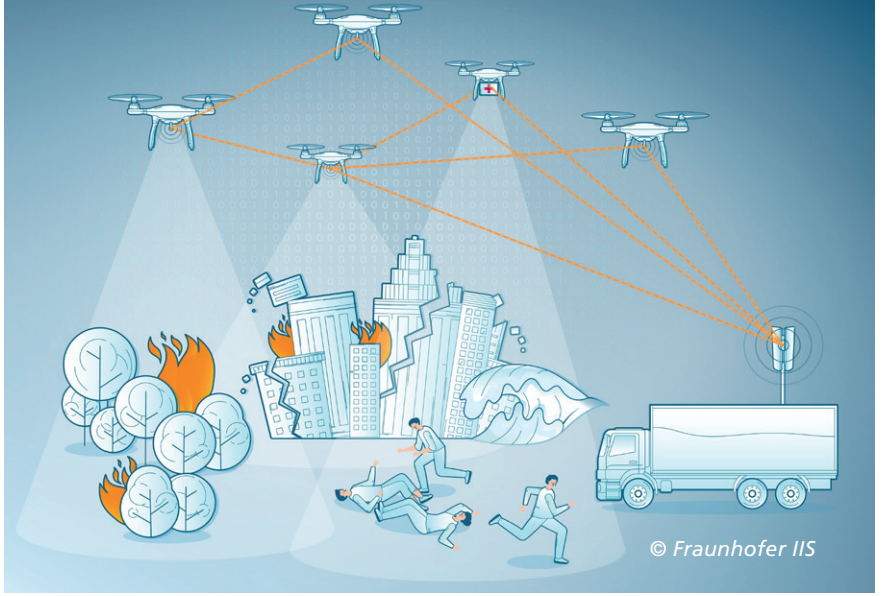
The underlying principle is simple and robust: It's based on a mesh network in which every drone acts as both transmitter and receiver. Data automatically finds the best route to the base station. If a node fails or loses connection, neighboring drones seamlessly take over the relay. In this way, the network continuously adapts, bridges long distances, and remains stable and dynamic without manual intervention.

Rapid situational awareness without risks

The decentralized architecture allows the swarm to scale flexibly: mapping drones chart the terrain, sensor drones locate missing persons, and delivery drones transport supplies to hard-to-reach areas. Rescue teams receive a precise situational overview within minutes without exposing themselves to danger and without relying on cellular or satellite connectivity.

Technical efficiency in tight spaces

The challenge lies in balancing range and energy efficiency. Large directional antennas would be ideal, but they're unsuitable for small, mobile systems, and every extra gram reduces flight time. The mesh approach solves this dilemma: many short, energy-efficient radio links replace a few long ones. This keeps the drones lightweight, long-lasting, and reliably connected at the same time.



Swarms of drones that can communicate via mesh networks are revolutionizing the inspection of remote or underserved areas.

Compact technology with long-term vision

Fraunhofer IIS develops and integrates robust, European mesh solutions ranging from hardware selection and sensor integration to simulation and deployment of complex swarm architectures. The technology can be adapted to various radio standards, such as Bluetooth, multiple IoT protocols, Wi-Fi, and Wi-Fi HaLow. Our solutions make it highly versatile, whether in disaster response, at sea, or in industrial settings such as monitoring and inspecting large construction sites.

A mobile suitcase-based system is all it takes: set up the base station, launch the drones, let the network form. In this way, complex research becomes a reliable lifesaver in critical situation – a communication infrastructure that keeps working even when all others fail.

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mioty®: The Allrounder LPWAN Technology for IoT Communication

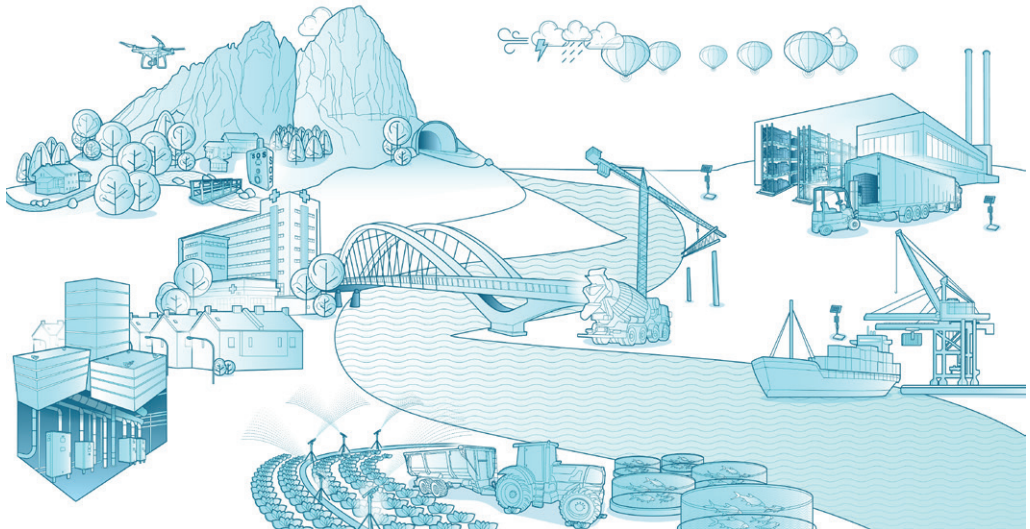
mioty® belongs to the relevant Low-power Wide-area Networks (LPWAN) technologies on which an increasing number of enterprises rely for smart metering, condition monitoring and smart farming applications. Within the mioty alliance we provide a broad ecosystem of companies that deliver components, systems and services based on our mioty®-technology.

5 arguments that make the difference

The mioty®-technology and its ETSI-standardized radio communication protocol with integrated Telegram Splitting excels among others because of its

1. Scalability up to 1 million sensors per base station
2. Robustness and resilience thanks to our patented Telegram Splitting protocol
3. Energy-efficiency enables self-powered operating of sensors and base station or enlarges battery lifetimes to maximum extent
4. Quasi-duplex enables simultaneous transmission and reception
5. Technological sovereignty as a standardized European LPWAN technology

New: Positioning for e. g. asset tracking inside mioty-infrastructures



mioty® keeps on track for mobile assets

High availability and robustness for sensor communication needed – but no stable network around or reliably working? Then mioty® could provide the solid basis to interconnect thousands of sensors and send their data messages to a base station and vice versa responses to the backends and devices. Especially for applications where robust connectivity counts while objects, machines, containers, transportation goods or any other assets in logistic processes have to be tracked – mioty® builds the perfect radio network to communicate and localize at the same time.

The more traffic and transportation of specified, dangerous, expensive or very sensitive goods, the more a reliable and resilient condition monitoring together with an equally secure position information for mobile assets is in demand. The most critical parts of the supply chain or asset tracking are misplacement, damage, tampering, malpractice etc. and monitoring with time and position information.

To enhance global positioning for asset tracking – mioty® infrastructures provide additional to its resilient, robust and scalable sensor communication a positioning option for mobile assets – this works in all smart cities and environments where a mioty® LPWAN is already in use. The mioty® infrastructure can be used as positioning system itself as well as a sort of »docking system« for additional positioning technologies to sharpen positioning results.

Especially in use cases like container tracking in large areas with no or low radio coverage mioty® can be a game changer for tracking and positioning. Its decisive features are energy-efficiency or self-powered operation and its scalability.

An adhoc system set-up for positioning will comprise three base stations together with a maximum sensor connectivity of round about 3 million nodes.



Use case: Logistics

mioty® enables smart, reliable sensor communication

Whether for environmental monitoring, infrastructure supervision, or civil protection, the demand for reliable data is constantly growing. At the same time, conventional IoT solutions often reach their limits. Sensors frequently depend on external power sources, cellular networks, or Wi-Fi – precisely the infrastructures that are often unavailable in remote areas or during emergency situations. The result is increased maintenance effort, higher operating costs, and limited resilience. Autonomous IoT sensors based on mioty® offer a future-proof solution.

Independent monitoring – anywhere, anytime

IoT sensors collect data independently of existing infrastructure. They require neither wired power supply nor cellular networks or Wi-Fi. Instead, they operate with extreme energy efficiency and can be deployed for years with minimal maintenance. Combined with mioty®, sensor data can be transmitted reliably even from remote or hard-to-access locations, such as rural regions or industrial sites.

Energy efficiency and Energy Harvesting

A key element of autonomous sensor systems is minimal power consumption. mioty® was specifically designed for such requirements and enables ultra-low-power data transmission. When combined with energy harvesting technologies, for example solar energy, vibrations, or temperature differences, sensors can completely operate autonomously. This eliminates the need for battery replacement, significantly reduces operating costs, and enables long-term, sustainable deployments.

LPWAN technoloy as the communication backbone

As a Low Power Wide Area Network (LPWAN), mioty® enables the wireless transmission of small data packets over long distances. Its unique telegram splitting mechanism ensures that data is received reliably even in the presence of interference or high network load. Sensors communicate directly with base stations without relying on cellular networks, a decisive advantage in emergency and crisis scenarios.

Reliable solutions for emergency situations

In civil protection and emergency response, reliable communication is essential. Autonomous mioty® sensors continue to deliver data even when cellular networks are unavailable or overloaded. This ensures that critical information on environmental conditions and infrastructure status is continuously available, enabling informed decision-making in real time.

A key trend for a resilient IoT future

Autonomous IoT sensors represent a clear technological trend: fewer dependencies, greater resilience, and maximum scalability. mioty® provides the communication foundation that connects sensors and base stations into robust, future-ready networks.

This enables IoT deployments wherever conventional technologies reach their limits.

mioty

future-proof wireless IoT



Roll-out of mioty®–based SOS buttons to set emergency alarm in every hamlet or village in South Tyrol/Alto Adige

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mioty® – the important building block for effective civil protection

Heavy rainfall and rising water levels are increasingly challenging municipalities and emergency services. Flood events occur more frequently and with less predictability, while monitoring points are often located in remote areas or exposed to difficult radio conditions. In such scenarios, conventional early warning systems quickly reach their limits, due to high costs, lack of scalability, or unreliable data transmission. mioty® provides a solution to these challenges.

Reliable monitoring of environmental parameters

Water levels, precipitation, and soil moisture are among the key parameters in flood protection. With mioty®, this data can be collected cost-effectively, energy-efficiently, autonomously, and over distances of up to 15 kilometers. Sensors can be permanently installed along rivers, even without existing infrastructure.

LPWAN technology and telegram splitting

mioty® was specifically developed for the Internet of Things (IoT) and is particularly well suited for long distances as well as unstable or unavailable cellular coverage. As a Low Power Wide Area Network (LPWAN), mioty® uses a technique known as telegram splitting, in which sensor data is divided into multiple sub-telegrams and transmitted at different times. This ensures reliable and robust communication even in highly congested radio environments, a key advantage for critical infrastructure.

Applications in flood protection

Thanks to its long range and low power consumption, mioty® enables the deployment of large-scale sensor networks for:

- Water level and gauge monitoring
- Heavy rainfall and precipitation monitoring
- Monitoring of sewer and drainage systems
- Analysis of soil and environmental parameters

The continuously collected data form the basis for early warnings and targeted response measures.



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mioty®-based flood detectors to protect people and goods

Beyond flood protection

In addition to flood detection, mioty® is also suitable for further applications in civil protection and smart cities, such as environmental monitoring or deployments in hard-to-access areas.

mioty® provides the digital foundation for a forward-looking and resilient approach to climate-related risks.



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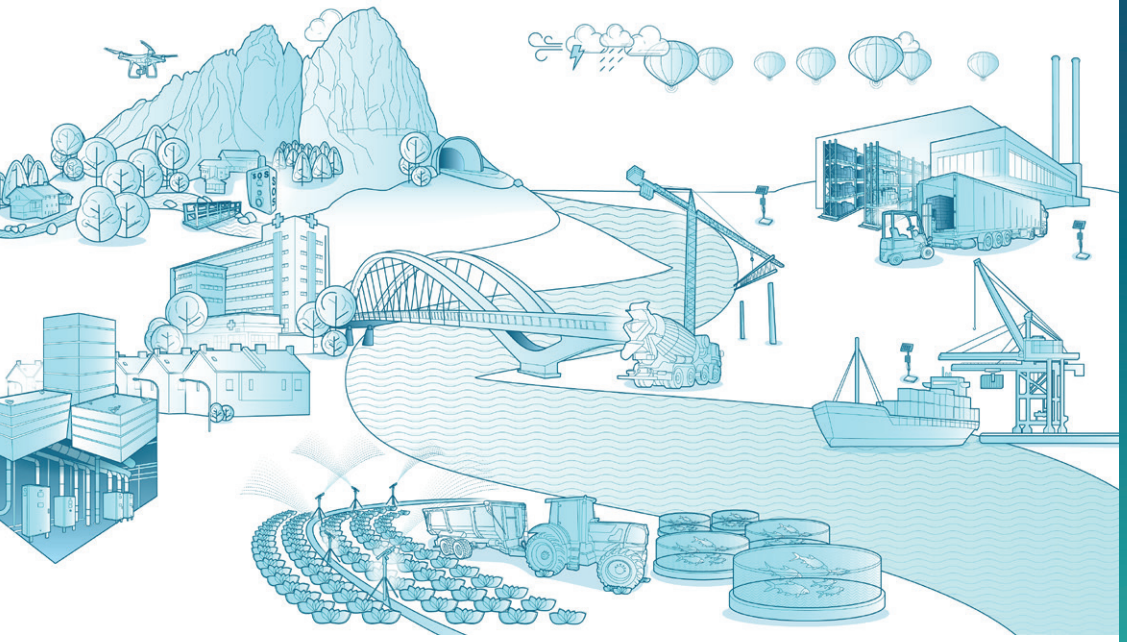
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mioty
alliance

Be part of this movement!



Bavarian Chip-Design-Center´s Focus Areas

IC – Design Ecosystem

- Versatile Edge-AI processor
- RF sensor systems
- Ultrasonic sensors
- Wake-up receiver
- Secure System on Chip
- Application specific Multi-Chip-Modules
- Heterointegrated sensor systems

Supply Chain

- Small volume manufacturing
- Foundry services

Design Talents

- Trainee program
- Course programs



A Case Study in Chip System Engineering: Spexclip at the Bavarian Chip-Design-Center

Wearables such as Spexclip demonstrate how much technology can be packed into very small devices today. For such systems to function properly, the electronics, sensors, and radio technology must interact reliably. The Bavarian Chip-Design-Center (BCDC) focuses on chip and system design with a particular emphasis on innovative start-ups and SMEs, for whom costs and development time – in addition to technical performance – are critical considerations.

From concept to functioning system

Spexclip is an add-on device that can be attached to nearly any pair of glasses. It measures vital parameters such as pulse and oxygen saturation, while also detecting falls to trigger emergency calls via a smartphone. The challenge was to develop the device in a time-efficient manner and to deliver all functionality in a compact, lightweight, low-power device without compromising requirements like reliable Bluetooth connectivity.

Pragmatic system design instead of ASIC development

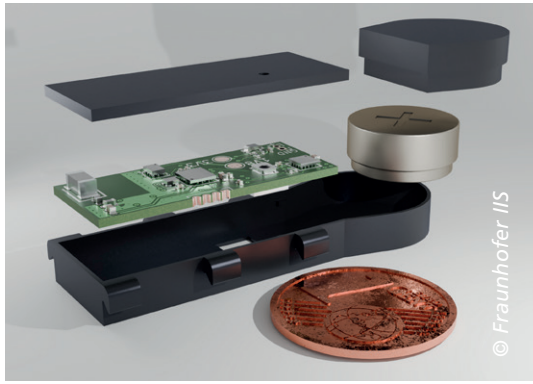
The add-on device is based on carefully selected components-off-the-shelf that have been integrated into a functional system on a compact circuit board. Instead of developing a proprietary ASIC, the focus was on rapid implementation, low costs, and high flexibility. This approach shows how system engineering can be used to create an efficient, energy-optimized overall system even without a customer-specific chip. Such a methodology is a typical entry-level scenario for potential SME projects with the BCDC. However, integration of a customer-specific chip is also possible if desired.

Perspective: even more compact with AS-MCM and chiplets

Importantly, Spexclip demonstrates the potential of more advanced integration approaches: For future product generations or other applications, application-specific multi-chip modules (AS-MCM) based on components-off-the-shelf and custom-built chips – such as chips or chiplets developed by partners of the BCDC – could be used. These solutions enable even smaller subsystems, lower energy consumption, and higher integration density, while significantly reducing development risk and costs compared with a full ASIC.



Spexclip in use: Compact sensor technology turning everyday glasses into an intelligent wearable.



Highly compact system: Spexclip presented as a CAD rendering.

Tools and system engineering for predictable development

To turn innovative products with microelectronics into reality, the BCDC uses AI-supported system design methods, such as stringent requirements engineering and continuous tracking throughout the development process. In the case of Spexclip, sensor and radio circuits were simulated right from the very start to realistically estimate energy requirements and compare technology options. This reduced development effort significantly and established a strong foundation for decision-making.

Support beyond design

Beyond technical development support, the BCDC serves as a partner for prototype production and small series of chips, as well as for preparation for series production. Furthermore, the BCDC offers training courses for beginners and specialists, along with trainee programs in chip design, enabling companies to build up or deepen their technical know-how.

Spexclip: expanding possibilities in chip system engineering

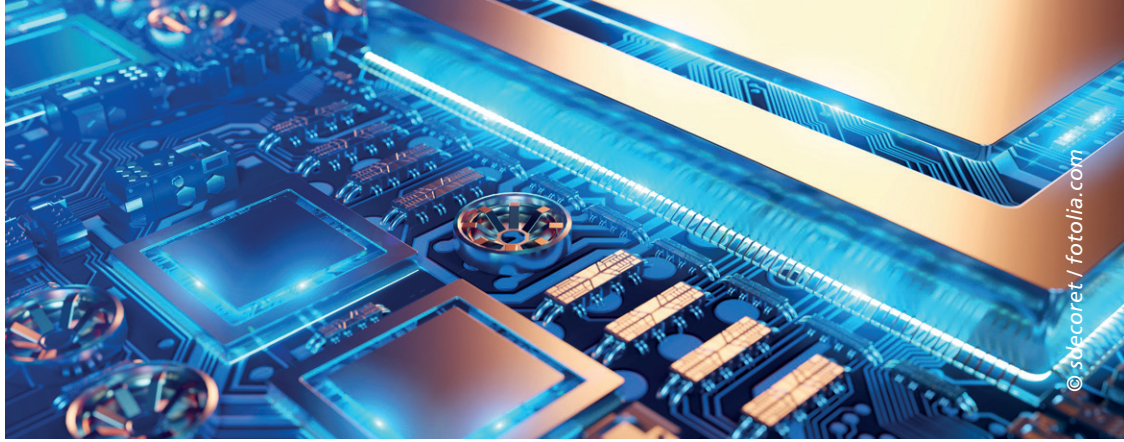
Spexclip was developed as part of the BCDC's six-month trainee program. As such, it is a tangible demonstration that the process from idea to finished integrated system is feasible within foreseeable time frames and costs. This case study also shows that SMEs can develop new products faster, more robustly, and more energy-efficiently through BCDC approaches – thereby making their own microelectronics solutions a reality.

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System-Technology Co-Optimization (STCO) for Advanced Heterogeneous Prototypes



Chiplet system

Part of Forschungsfabrik Mikroelektronik Deutschland

APECS

The rising complexity and cost pressure of electronic systems demands new ways of heterogeneous design approaches and a chiplet-based ecosystem. System-Technology Co-Optimization (STCO) is a key enabler, orchestrating design choices throughout the entire system including the selection of optimal technologies and economic trade-offs. It supports decision-making across domains and hierarchies. In the APECS pilot line, our STCO approach captures and links requirements, data, and rules to inform decisions. This approach exposes trade-offs early on, speeds up cross-team iterations, reduces handover risks, and improves alignment. The result is faster, more cost-effective, high-performance solutions for next-generation semiconductor products.

Modern semiconductor components are becoming more and more complex and cost sensitive. To master technological and economic challenges, new chiplet approaches and heterogeneous integration technologies are becoming increasingly relevant.

Heterogeneous design approaches make it possible to combine different design domains across technological options while satisfying economic and performance demands of the application.

However, a broad spectrum of information must be considered and optimized altogether. Dealing with this range of technology and design choices, while maintaining cost targets, requires a new and extended design approach: the System-Technology Co-Optimization (STCO) design methodology.

System-Technology Co-Optimization

This new approach addresses overall system optimization across different fields of expertise, across abstraction levels or hierarchies, and across different domains of KPI measures.
This sheer complexity is what makes support from cross-domain tools a critical contribution to decision-making in the design process of heterogeneous systems.

Such tooling must help capture, aggregate, and connect requirements, data, rules, etc. to enable the monitoring and control of economic, technological, and design implications stemming from the components, packages, and chiplets that altogether form complex heterogeneous systems for challenging target applications.

STCO in the context of the European APECS pilot line

In the context of the European Pilot Line for Advanced Packaging and Heterogeneous Integration for Electronic Components and Systems (APECS), we are utilizing, extending, and developing design tool solutions for the STCO approach.

It provides a representation of the many details and makes it available to various experts across the development teams and in the value chain.

This will bring enormous value: Problems at handover points will be identified earlier, iteration across teams will be accelerated, and the alignments across expertise fields and domains will be improved.

Establishing the STCO philosophy and respective tools will push the semiconductor ecosystem ever further forward into the new and exciting chiplet era.

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Maximum Energy Efficiency and Service Life for IIoT Systems

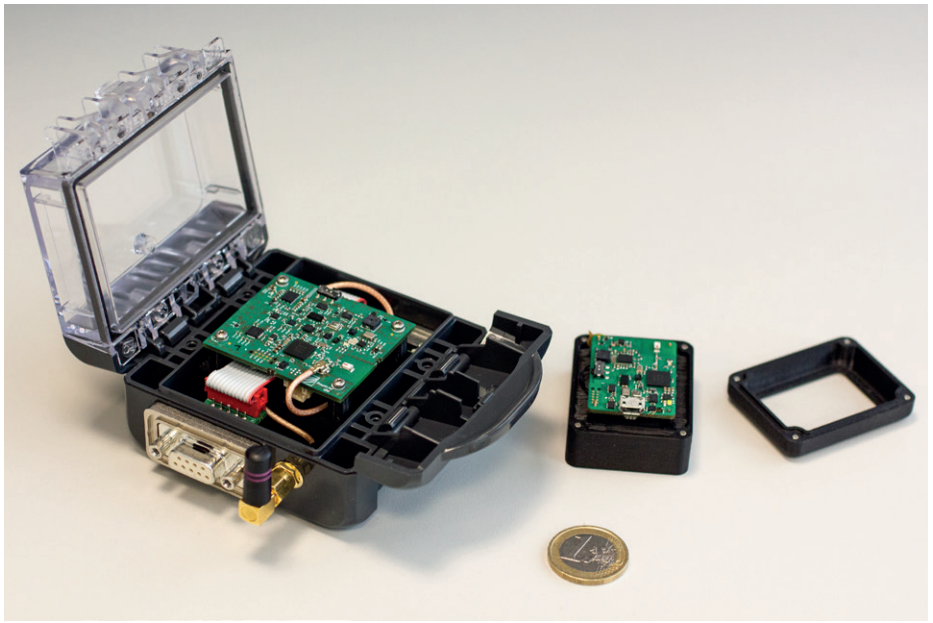
Energy efficiency is the basic prerequisite for sustainable and economically viable IIoT sensor systems. The »Sensor Nodes & Embedded Microsystems« and »Environmental & Reliability Engineering« working groups at Fraunhofer IZM support industry, logistics, maintenance, and environmental authorities in designing energy-efficient IIoT systems and extending their service life.

System partitioning has a major impact on the energy efficiency of an IIoT system. In the (further) development of sensor nodes and systems for smart grids, smart cities, and smart farming, we therefore rely on hardware-software co-design:

- Fast data processing in combination with robust radio transmission,
- An optimized ratio of active measurement and processing phases to extended idle times, and
- Dynamic system configuration that allows individual functions to be switched on and off as needed during operation.

Fraunhofer IZM also develops embedded hardware systems with edge AI that are specifically tailored for the use of artificial intelligence and optimize the efficiency and performance of data processing at the source.

In addition, our environmental experts create life cycle assessments, analyze energy consumption throughout production, transport, operation, and disposal, and investigate failure mechanisms of electronic assemblies. Robust life cycle models enable optimized maintenance cycles and increase the sustainability of IIoT systems.



Modular multi-sensor platform SWARMY: Configurable sensors for various measurement scenarios with local data processing and wireless communication interface | © Fraunhofer IZM I Francis Viebeck

Although performance tests are well established for computer systems, benchmarks for IoT systems are only available in isolated cases. As part of the »Green ICT« research project, Fraunhofer IZM examined various IoT system architectures and determined reference values for energy efficiency.

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Making Integrated Microchips Possible: How the Design Enablement Team Accelerates Innovation

Having a good idea for a new electronic product is one thing, but turning it into a technically and economically viable solution is quite another. Small and medium-sized companies in particular face major hurdles: complex development processes, expensive design tools, limited access to manufacturing. This is exactly where the Design Enablement Team (DET) at Fraunhofer IIS comes in.

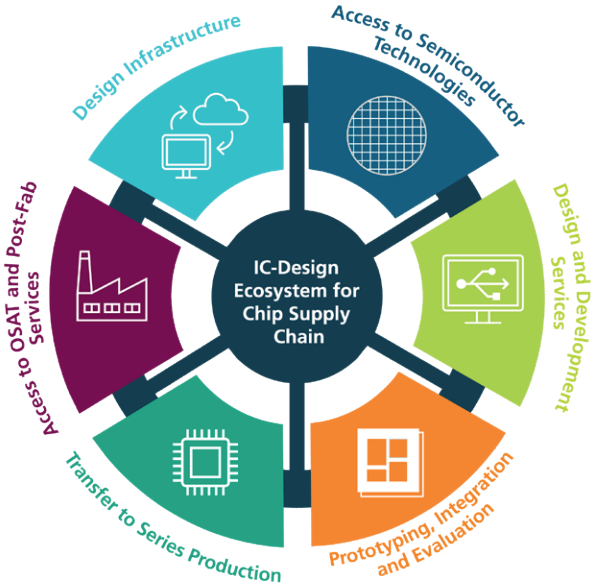
Challenges on the way to your own chip

Anyone who wants to develop a chip has to make fundamental decisions early on: Should the functionality be implemented through a system or software-based solution? Or does an ASIC offer decisive advantages in terms of performance, energy efficiency, size and scalability? Which technology is suitable? Which IP blocks are needed? What is the optimal packaging approach? And last but not least: Can all this be realized economically?

For many start-ups and SMEs, these questions are difficult to answer on their own, especially since any mistake in the early design process can lead to enormous costs later on.

Design enablement that lowers barriers

From the initial technical evaluation through architecture, simulation, and verification, followed by post-fabrication bring-up, testing and transition to series production, the DET ensures that designs are set up for scalability from the outset. The team provides proven design flows, models, and tools within a secure, user-friendly, and scalable EDA infrastructure, enabling easy access to industry-standard EDA tools and PDKs.
This approach keeps initial design flow costs low and shortens development times, especially for small and resource-constrained companies.
The MPW (Multi Project Wafer) offering plays a central role. It enables cost-effective prototype production by allowing multiple projects to share a wafer. This is often the first opportunity for start-ups and SMEs to bring their idea »into silicon«.



Lowering the barriers to silicon: The Design Enablement Team's IC service ecosystem.
© Fraunhofer IIS

A modular ecosystem that opens doors from research to market

In collaboration with research and technology partners from academia and industry – spanning IC design and development, fabrication, and post-fab processes such as packaging, testing, and related activities – the DET has access to an established ecosystem that significantly simplifies access. This modular approach comprises foundry access, cloud- and on-premises-based EDA and PDK environments, design support and expertise, and fabrication services, closing critical gaps in resources and know-how for start-ups and SMEs. They benefit not only from technical expertise, but also from the fact that scientific innovations become usable at an early stage: from energy-efficient edge AI chips to robust sensor designs.

The Design Enablement Team from Fraunhofer IIS sees itself as an enabler. It sets up ideas from the very beginning for scalability and makes microelectronics accessible to those who have strong product ideas but do not have the infrastructure of a semiconductor company, thus helping to bring innovations into application faster and at scale.

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Failure and Reliability Analysis and Testing for Networked Systems

Highly reliable electronics are essential in automotive, industrial and medical applications. The Analysis of Reliable and Trusted Electronics (ARTE) team at Fraunhofer EMFT provides precise IC, package and PCB testing, detailed failure analysis and advanced authenticity and chip security investigations, and also IP patent infringement checks. These methods detect faults early, reduce failures and extend component lifetime. At embedded world 2026, visitors will see how these solutions shorten development cycles, reduce costs and make networked systems future-proof.

Challenge: Complex, networked systems

Modern electronics must be reliable, durable and tamper-proof – whether in autonomous vehicles, industrial machinery or medical devices. Even minor defects can cause significant costs, delays and safety risks. At the same time, developers face increasing design complexity and a growing variety of semiconductor technologies.

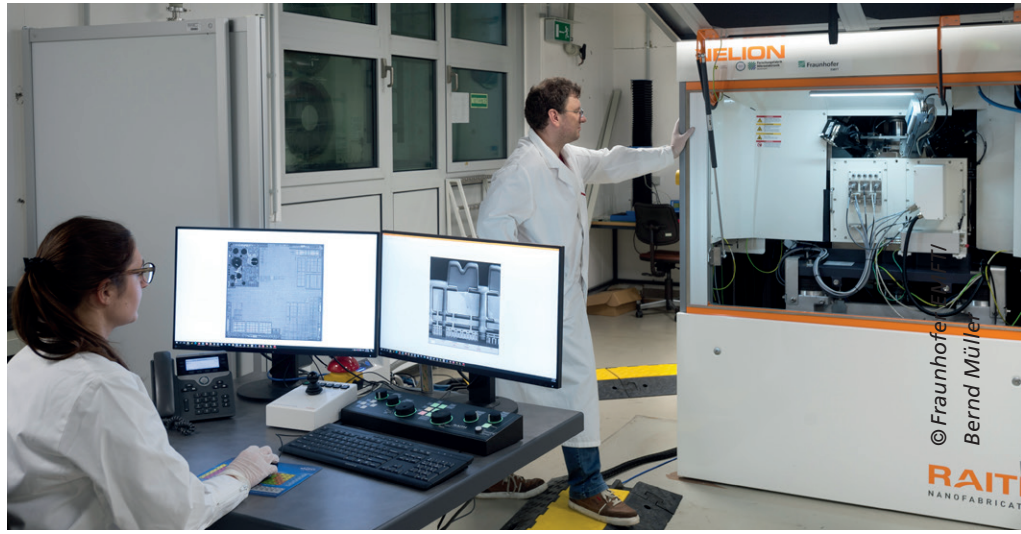
Solution: Holistic analysis and testing

The ARTE team at Fraunhofer EMFT examines ICs, packages and complete systems using state-of-the-art methods. These include thermal and long-term stress testing, IC de-processing, full-surface SEM scanning and high-resolution microscopic analysis. Failure analysis identifies microcracks, soldering defects and ageing effects.

In addition, advanced security feature and IP testing protect components against manipulation or design infringements. As a result, developers identify and correct issues early – before they affect the overall system.

Benefits: efficiency, reliability, security

These combined testing and analysis approaches increase system robustness, extend component lifetime and enable tamper-resistant designs. Development cycles become faster and more efficient, costs are reduced and final products meet strict quality and safety requirements. Fraunhofer EMFT's integrated approach supports companies in implementing innovative and reliable electronic solutions across industries.



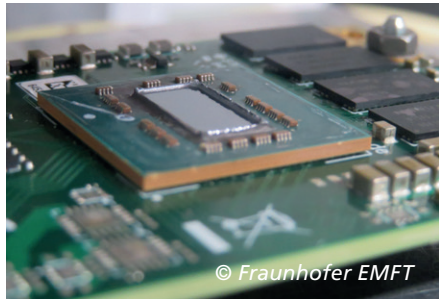
View of the Raith Velion FIB-SEM with the front cover open

Demonstrated in practice

At embedded world 2026, live demonstrations will showcase how Fraunhofer EMFT's analysis and testing solutions are applied – from IC and package testing to system-level evaluations. Visitors will experience first-hand how these methods prevent failures, optimize designs and significantly improve the reliability of networked electronics.

Conclusion: A reliable partner for future-proof electronics

Fraunhofer EMFT delivers precise, reliable results for development, quality assurance and innovation. With advanced analyses, comprehensive IC/package testing and security feature checks, the ARTE team ensures robust, durable and future-ready electronic systems.



Decapsulated module on circuit board – electrical control of the module is still possible

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Save Energy, Gain Control – That's how Smart a Home can be.

Modern buildings listen to their environment: temperature, humidity, and movement. To ensure that everything runs reliably, sensors must always be accessible and, if possible, maintenance-free. This requires wireless solutions that remain responsive at all times while consuming very little energy. One technology that addresses precisely these requirements is RFicient®.

Energy consumption reduced to a minimum

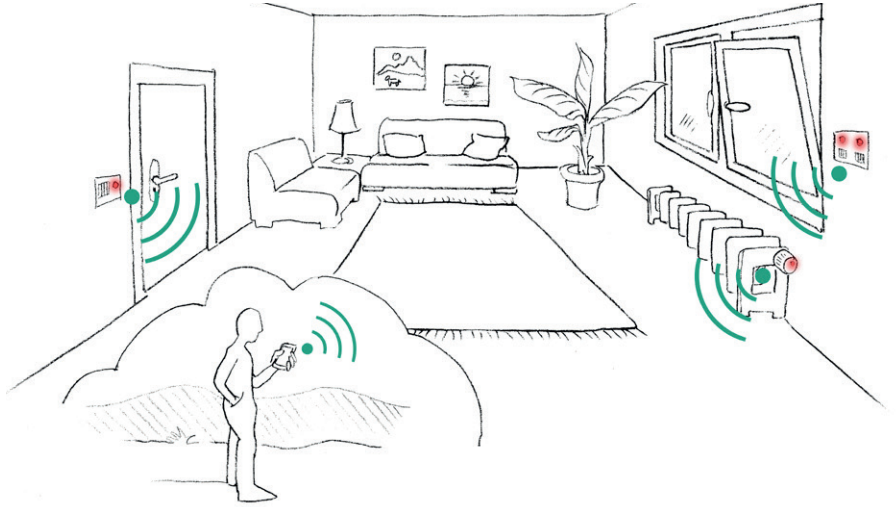
The RFicient® chip belongs to a new generation of wireless wake-up receivers that can continuously monitor radio signals without significantly draining the battery. This is achieved through power consumption in the microwatt range – so low that wireless sensors can be operated with particularly small energy sources.
This opens up new possibilities in building automation, enabling sensors that require virtually no maintenance and can be installed in locations where battery replacement would otherwise be impractical.
The result: improved energy-efficient climate control, smarter access management, enhanced safety monitoring and more.

Ready when it counts

Despite its economical operation, RFicient® remains responsive at all times. The receiver recognizes a wake-up sequence within milliseconds and then activates the downstream system, such as a sensor and radio module, in a targeted manner.
For smart home control centers, this means that sensor data can only be retrieved when it is really needed. This increases the efficiency of the overall system, for example when checking whether a window is still open before adjusting the room temperature.

From idea to application – with the right tool

If developers want to integrate this technology into their own concepts, they need a simple and straightforward way to get started. That is exactly why new compact breakout boards were developed. They provide an integrated RFicient® chip on an extension board including all necessary RF filter components and are shipped with matching antennas.



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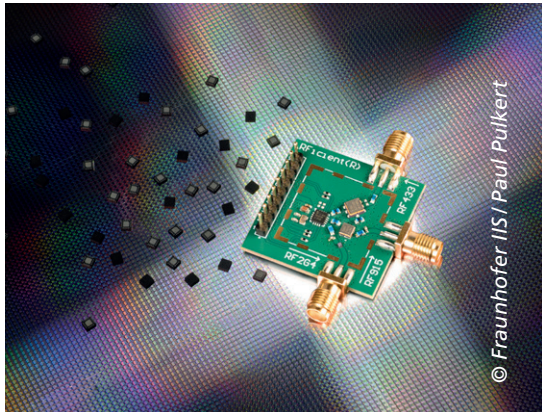
Building automation scenario with RFicient®

This makes the transition from theory to practical implementation much easier, while keeping the option open to add external components like microcontrollers for advanced functionality. Such flexibility is especially appealing to experienced teams who prefer flexible architectures and are looking for cost-effective hardware for early development phases.

A building block for the next generation of connected buildings

RFicient® shows how the demand for wireless, low-maintenance sensor technology in the smart home can be met, enabling long-lasting radio nodes that integrate harmoniously into existing buildings.

In an infrastructure that is increasingly networked, RFicient® can make a significant contribution to reducing energy consumption and making automation systems more robust and efficient.



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RFicient® breakout board

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RFicient®
Low-latency Sub-10-µW IoT Receiver Technology
Fraunhofer IIS

IC Design and Enablement
Fraunhofer IIS

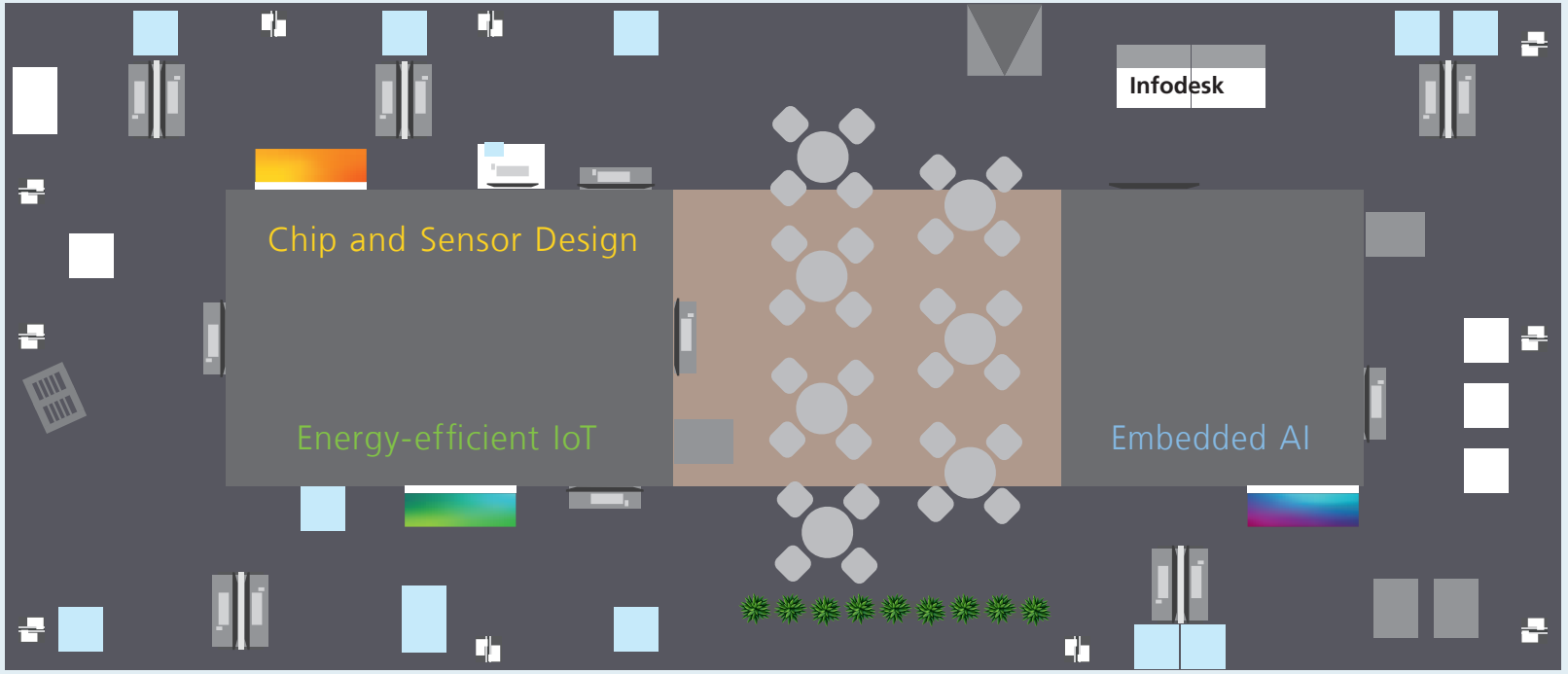
Bavarian Chip-Design-Center

Chiplet Integration
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barrier-free access

Mesh Networks for Autonomous Drone Fleets
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Precise Positioning for IoT Applications
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Competence in Embedded Systems
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