Paving the way for sustainable AI

April 2024

Infineon and you – driving the AI revolution

Our technologies and AI-models drive the development of energy-efficient, high-performance and reliable AI applications of the future – and thus for your successful market entry.

We power AI

Creating a more sustainable future by providing technologies to reduce power losses and cooling costs in greener data centers of the future.

We enable and provide AI

Supporting customer's innovation with semiconductor solutions, software, and tools that help deliver AI innovation quickly, efficiently, and at scale.

We use AI

Moving forward for high-quality solutions by adopting AI across the organization for smarter products and more streamlined processes.

We power AI

Exponential growth in global data by 2030

146-fold
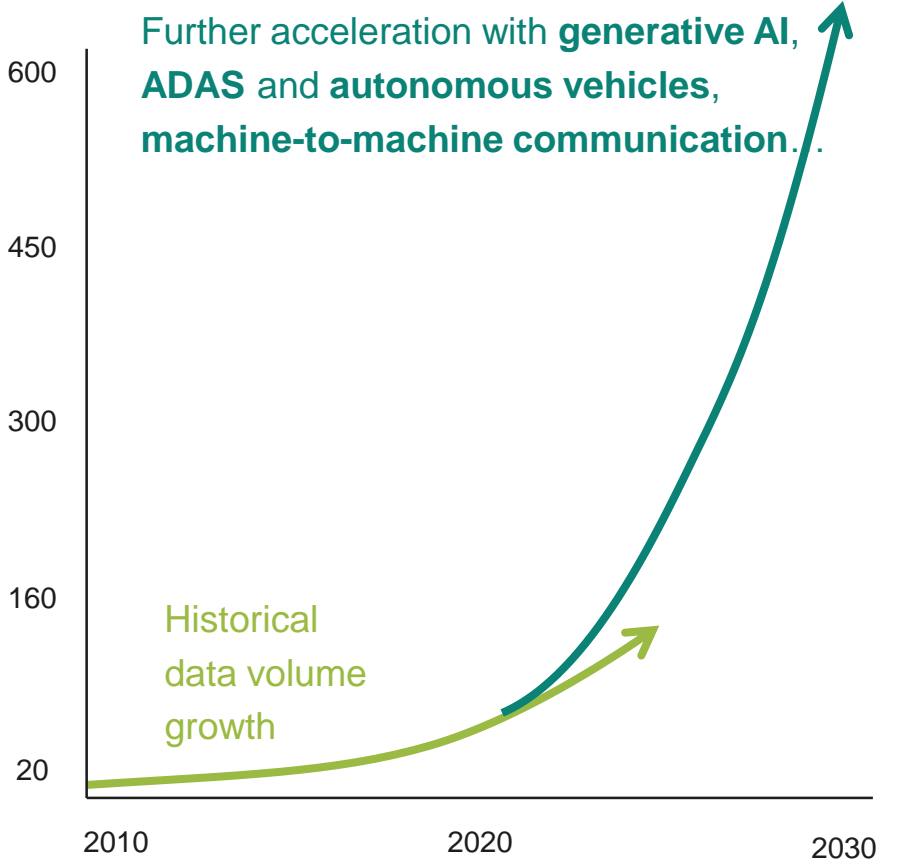
increase of **data volume**
expected between 2010-2025

30 %

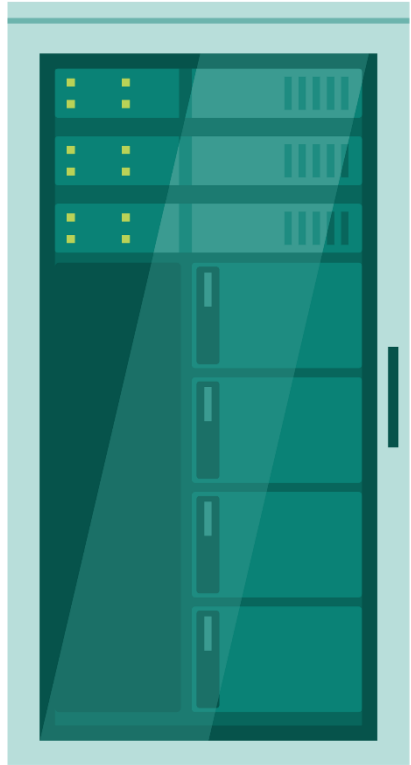**CAGR** of data volume growth by 2030

97 %

of the data is stored with **no active use**

Sources: Statista, NCTA - The Internet & Television Association; Thrive Global; IDC White Paper; UBS; Infineon estimate

Data volume in zettabyte (per year)

Further acceleration with **generative AI**, **ADAS** and **autonomous vehicles**, **machine-to-machine communication**...

Historical data volume growth

600

450

300

160

20

2010   2020   2030
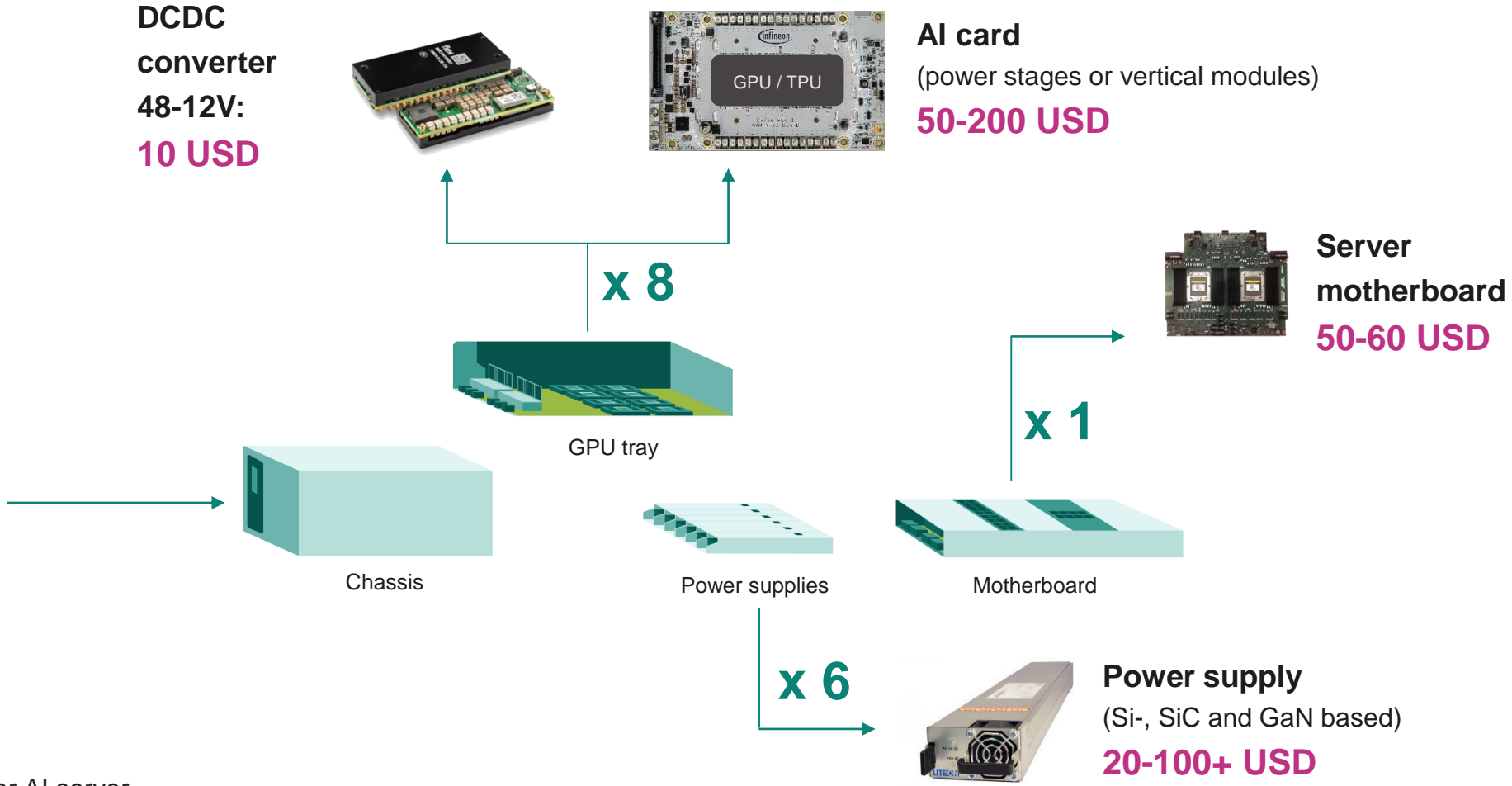
1 ZB = **1.000.000.000.000 GB**

Infineon offers power semiconductor solutions with increased energy efficiency compared to existing solutions

Average Infineon BOM per AI server about 850 to 1800 USD

DCDC converter 48-12V:
10 USD

AI card
(power stages or vertical modules)
50-200 USD

GPU / TPU

x 8

GPU tray

Server motherboard
50-60 USD

x 1

Chassis

Power supplies

Motherboard

x 6

Power supply
(Si-, SiC and GaN based)
20-100+ USD

1 Server rack includes
   4 AI servers

USD = potential Infineon content per AI server

We power greener AI, shaping the future with our solutions

Technology can help us save the planet!

> 22 million

metric tons
CO_2 equivalent

could be saved by using Infineon products in all data centers.

We master all…

✓ **System innovation** with **leading companies**

✓ Industry-leading **system and innovation expertise**

✓ Best-in-class in **efficiency** and **lowest cost of ownership**

✓ Full control of quality and supply- through **vertically integrated manufacturing flow**

Infineon is in a pole position to further grow market share!

We enable and provide AI

Real-time requirements and the need for power-efficiency, security and privacy drives AI-processing at the edge
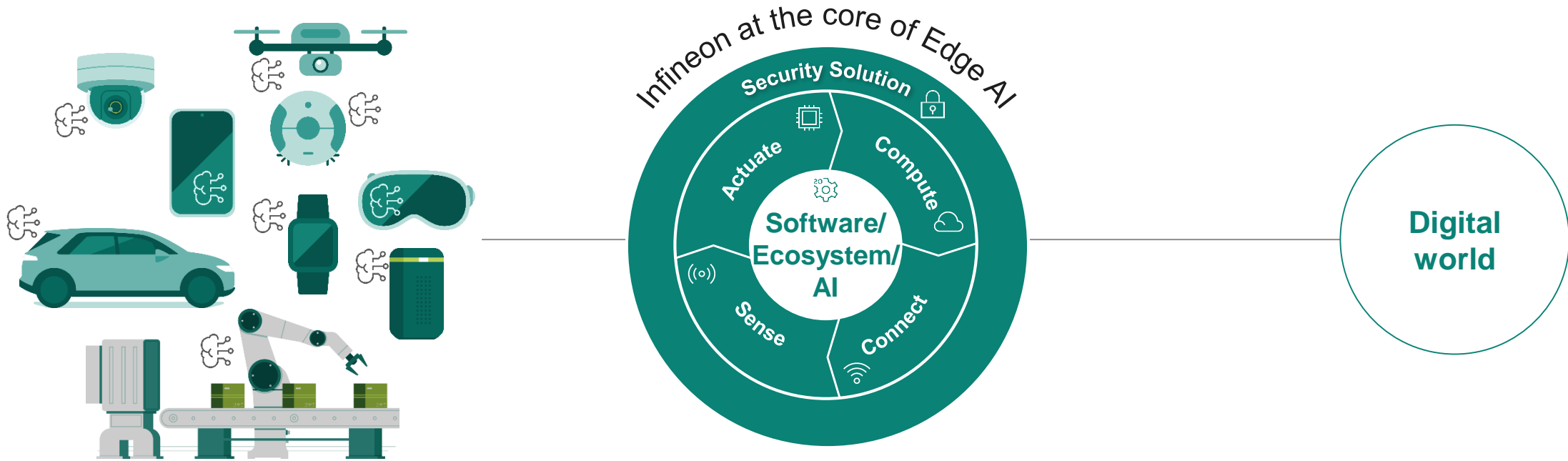

AI at the Edge

Training in the cloud

Processing data closest to the source

Inference in the chip
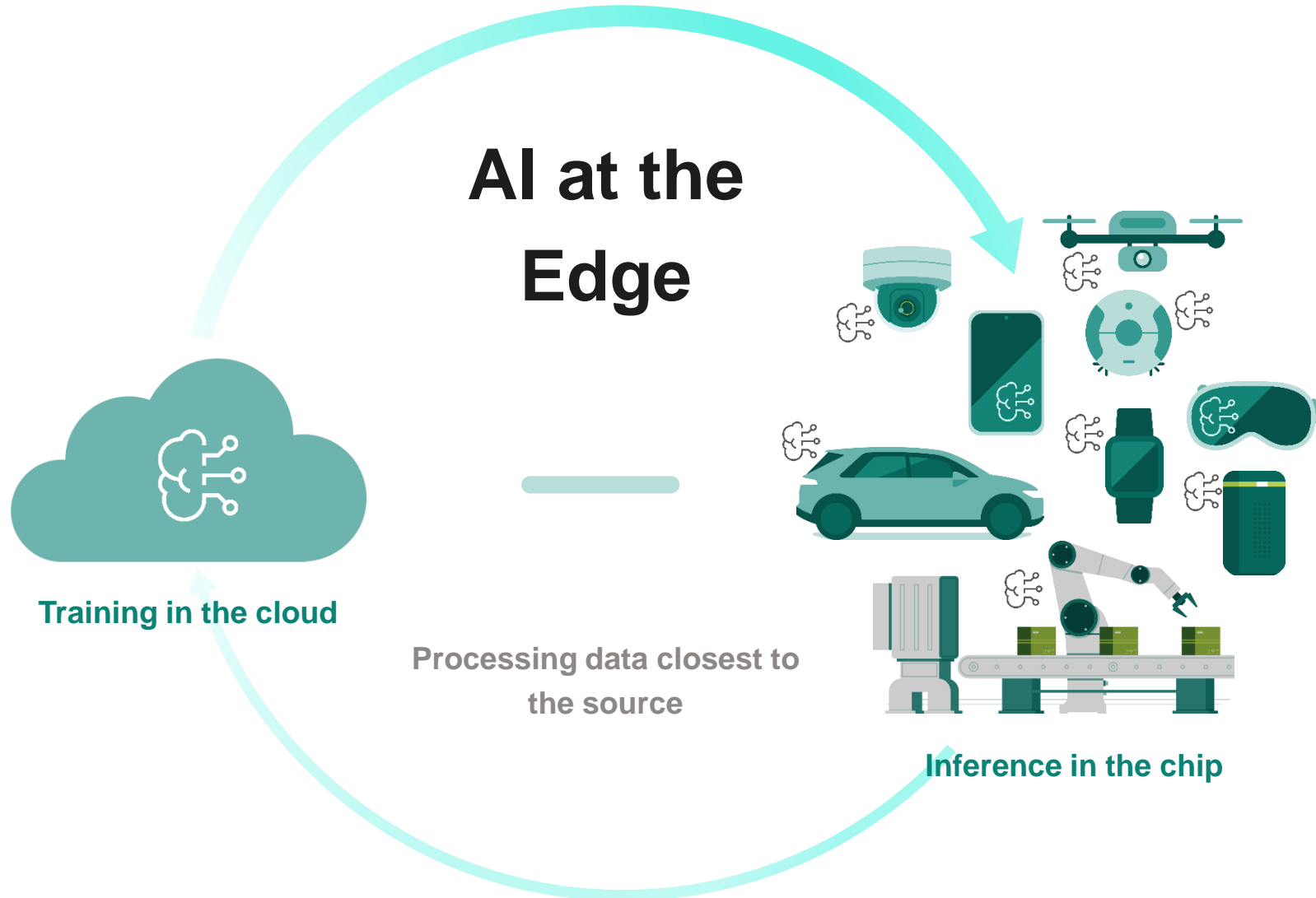
Key benefits of Edge AI

Low latency and real-time response

Higher power efficiency

Improved security and data privacy

Reduced cost

We provide & enable a wide range of technology-solutions for your AI solutions – for every level of AI knowledge

Infineon at the core of Edge AI: Infineon's complementary set of AI-specific products and solutions, an end-to-end ML platform as well as an extensive application knowledge and a broad network of experienced AI partners allows you to get your AI application to market quickly – without having to be a proven AI expert.

Infineon offers end-to-end technology solutions for your AI market entry

Digital Services and AI solution platforms

INDUSTRIAL ANALYTICS

In-field Power Analytics

XENSIV™ sensor solutions

Hybrid AI-based services   e.g. RUL*   e.g. Sleep quality service   And others…

AI-models for a wide variety of applications

imagimob
An Infineon Technologies Company
Ready Models

Baby cry detection	Siren detection	Surface detection	Wearing detection (for headphones, helmets, etc.)
Coughing detection	Alarm detection	Yelling & commotion detection	
Snoring detection	Gesture detection	Arc Fault Circuit Interrupters	...

End-to-end software solutions for easy training & deployment

TensorFlow

K Keras

ONNX

imagimob
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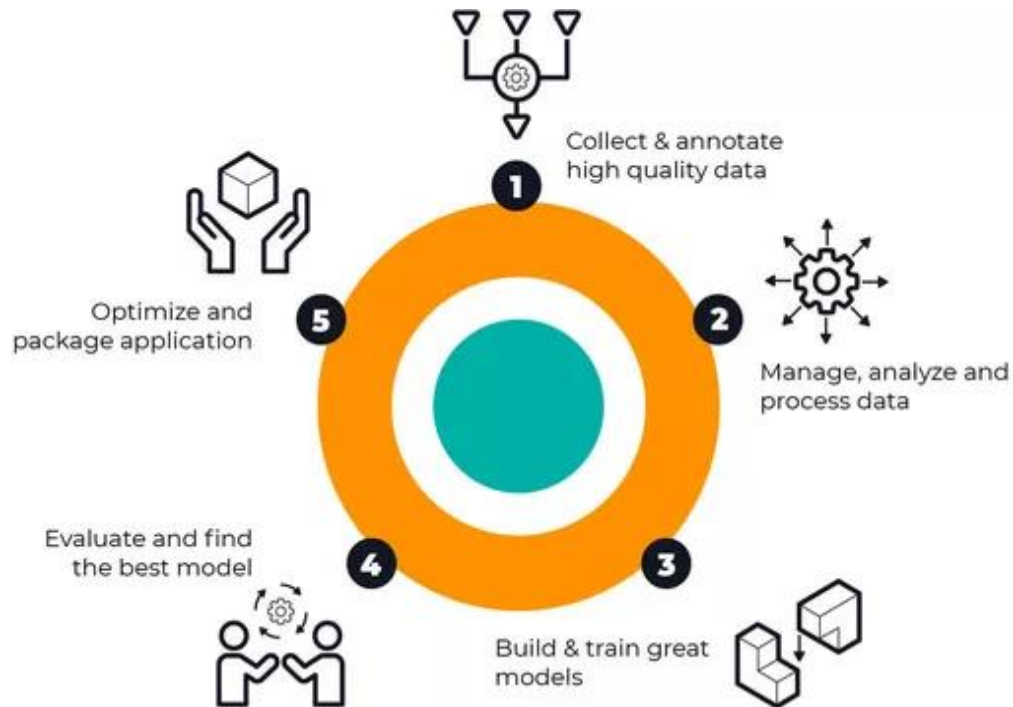Imagimob Studio

ModusToolbox™

AI partner ecosystem:

SYNOPSYS
DesignWare ARC
MetaWare Toolkit

EKKONO

SensiML

The right hardware for your Edge AI model

MCUs: PSOC™   AURIX™   TRAVEO™   XMC™

XENSIV™ smart sensors portfolio for automotive, industrial and consumer

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Imagimob Studio helps you take your Edge AI ideas to production quickly and easily

Collect & annotate high quality data

Manage, analyze and process data

Build & train great models

Evaluate and find the best model

Optimize and package application

- ✓ **State-of-the art, end-to-end ML development platform:** Collect & annotate data directly from your target hardware. Create, train, evaluate & deploy great ML models fast.

- ✓ **Own your own data:** Data is only used by Imagimob to train your models. Data is stored offline on your machine.

- ✓ **Not locked into the Ecosystem:** Build a custom model, or bring your own to optimize for the edge, and deploy on the hardware of your choice.

- ✓ **AutoML functionality**: Auto-generates high performance AI models optimized for speed and low footprint.
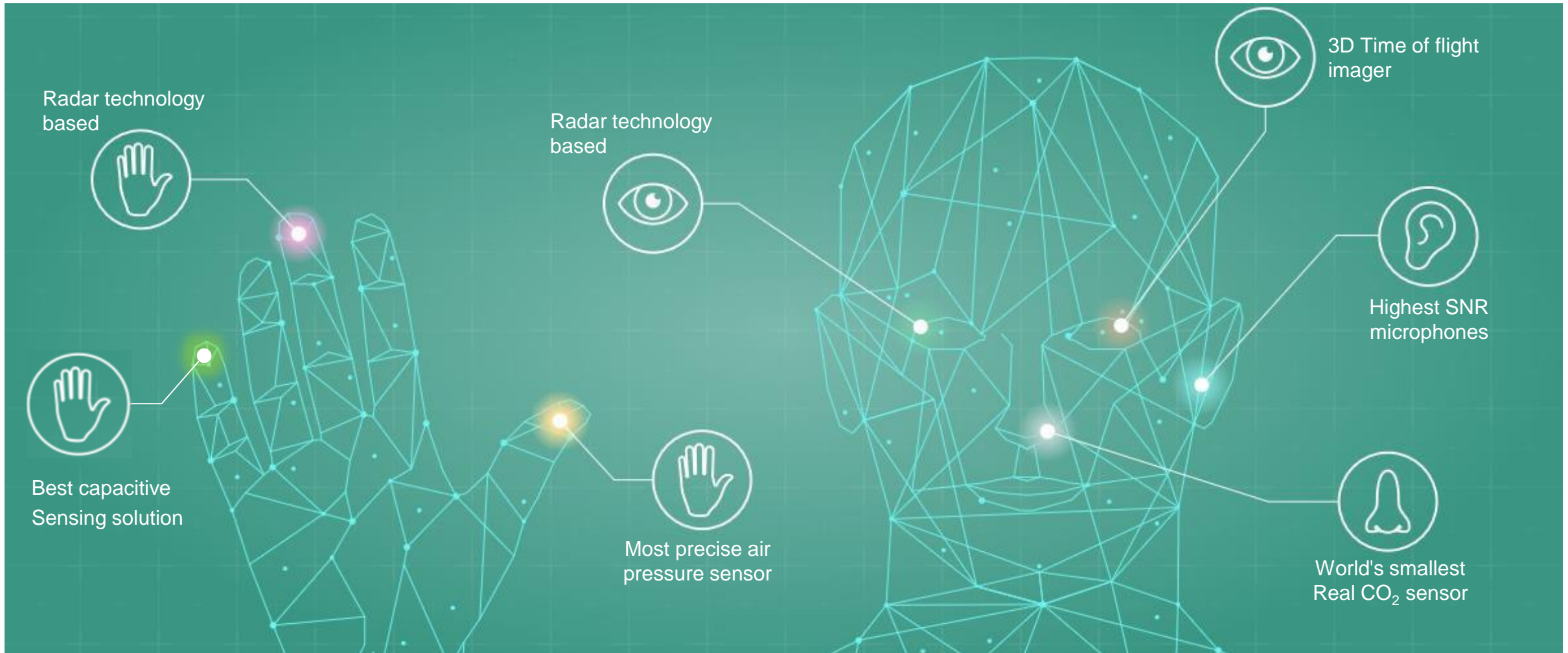
- ✓ **Visualization is king**: No more "black box": Follow your machine learning model creation journey with our Graph UX.

- Imagimob Studio supports all INFINEON Microcontrollers (PSoC™, AURIX™, TRAVEO™, XMC™)
- Imagimob in cooperation with INFINEON can develop customer specific AI-Models

Our intuitive sensors are enabling Edge AI – Giving things the human sense

Infineon **XENSIV™ sensors** are exceptionally precise, thanks to industry-leading technologies. They are the perfect fit for your AI applications in automotive, industrial and consumer markets.

Radar technology based

Radar technology based

3D Time of flight imager

Highest SNR microphones

Best capacitive Sensing solution

Most precise air pressure sensor

World's smallest Real CO_2 sensor

Our advanced technological solutions address a wide range of Edge AI applications

AI in IOT & Consumer

Democratizing AI by bringing the computational power of AI algorithms **closer to the source data** with **smarter** and **greener** devices for **intuitive real-time** interaction.

AI in Automotive

Ushering in a new era of connected and autonomous vehicles with **reliable**, **safe**, and **secure** systems for **real-time safety critical applications**.

Industrial AI
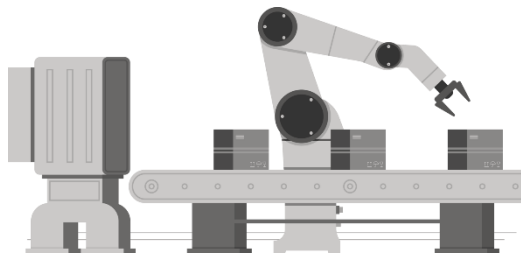
Creating self-learning systems for greater **productivity**, **quality**, and **efficiency** and supporting the adoption of sensor-based **predictive maintenance** models.

AI solutions for IoT & consumer applications

Infineon provides a comprehensive end-to-end embedded AI solution

In-house AI Software
imagimob
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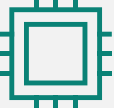## Development & AI Ecosystem
ModusToolbox™ Software
SensiML
Cyberon — Leading Speech Solution Provider
Micro.ai

+

PSoC™ 6 or PSOC™ Edge Microcontroller

+

Infineon sensors

Connectivity & security solutions

PSoC™ 6 AI Evaluation Kit is Infineon's HW Platform for Edge AI. It Enables the full ML to embedded SW journey with endless possibilities for customers.

Infineon

Launching 06/24

Easy to use & low-cost
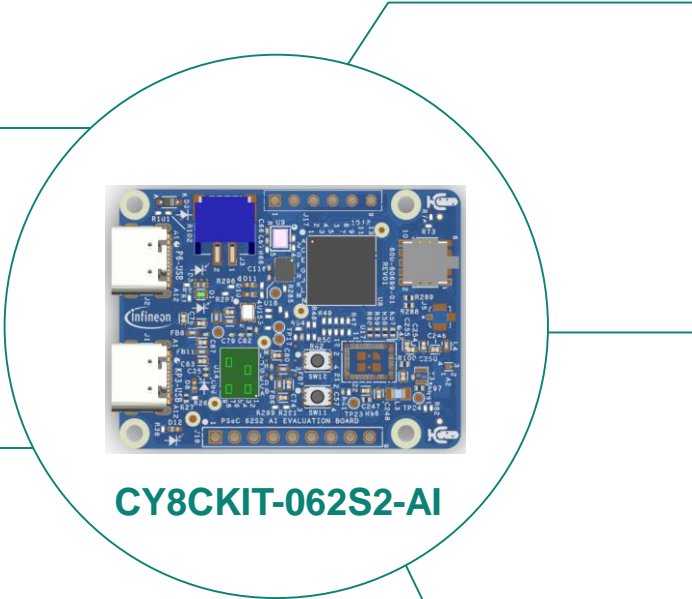Evaluation board with efficient form factor for easy prototyping

Fast time to market at minimal development cost
Direct launch for PSoC™ 6 & AURIX™

Easy creation of ML models
Sensor fusion-, ML-, acoustic-, time series- and radar models

CY8CKIT-062S2-AI

End-to-end
Collect data, create, train, evaluate & deploy your ML models fast

Connect easily & continuously improve models
Wired & wirelessly

The best of Hardware, Software & ML
Solution approach with PSoC™ 6, QSPI Flash & multi-sensor input: radar, microphone, pressure & 6-axis motion sensor

Customized Machine Learning on PSoC™ Edge with Imagimob Studio and ModusToolbox™

With the seamless integration of **Imagimob Studio** and **ModusToolbox™** companies can build and deploy robust machine learning models. When paired with **PSoC™ Edge**, companies can optimize power consumption and improve efficiency while adding intelligence to products.
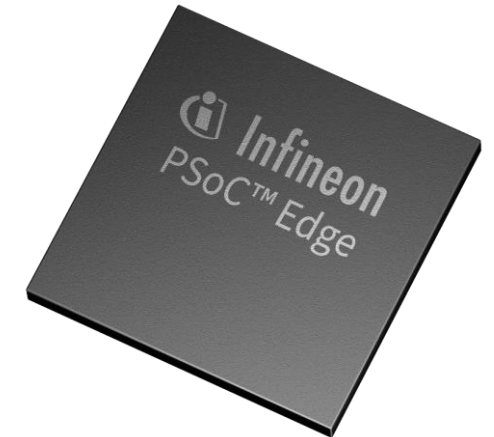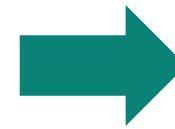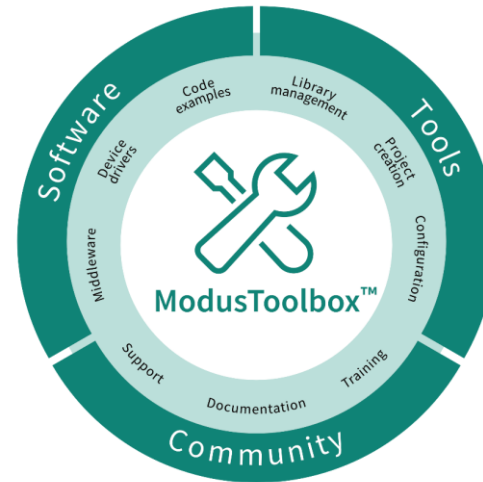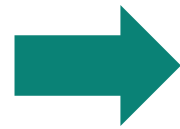
Imagimob Studio, Infineon's platform for machine learning development, makes it easier to create Edge AI models

ModusToolbox™ Software is a modern, extensible development ecosystem

PSoC™ Edge is the next generation Machine Learning-enhanced sensing, low power, secured, and advanced HMI high-performance microcontroller family

Next-generation PSOC™ Edge portfolio: Infineon PSOC™ Edge E81, E83 and E84 MCUs

PSoC™ Edge – Enables a new generation of responsive machine learning devices
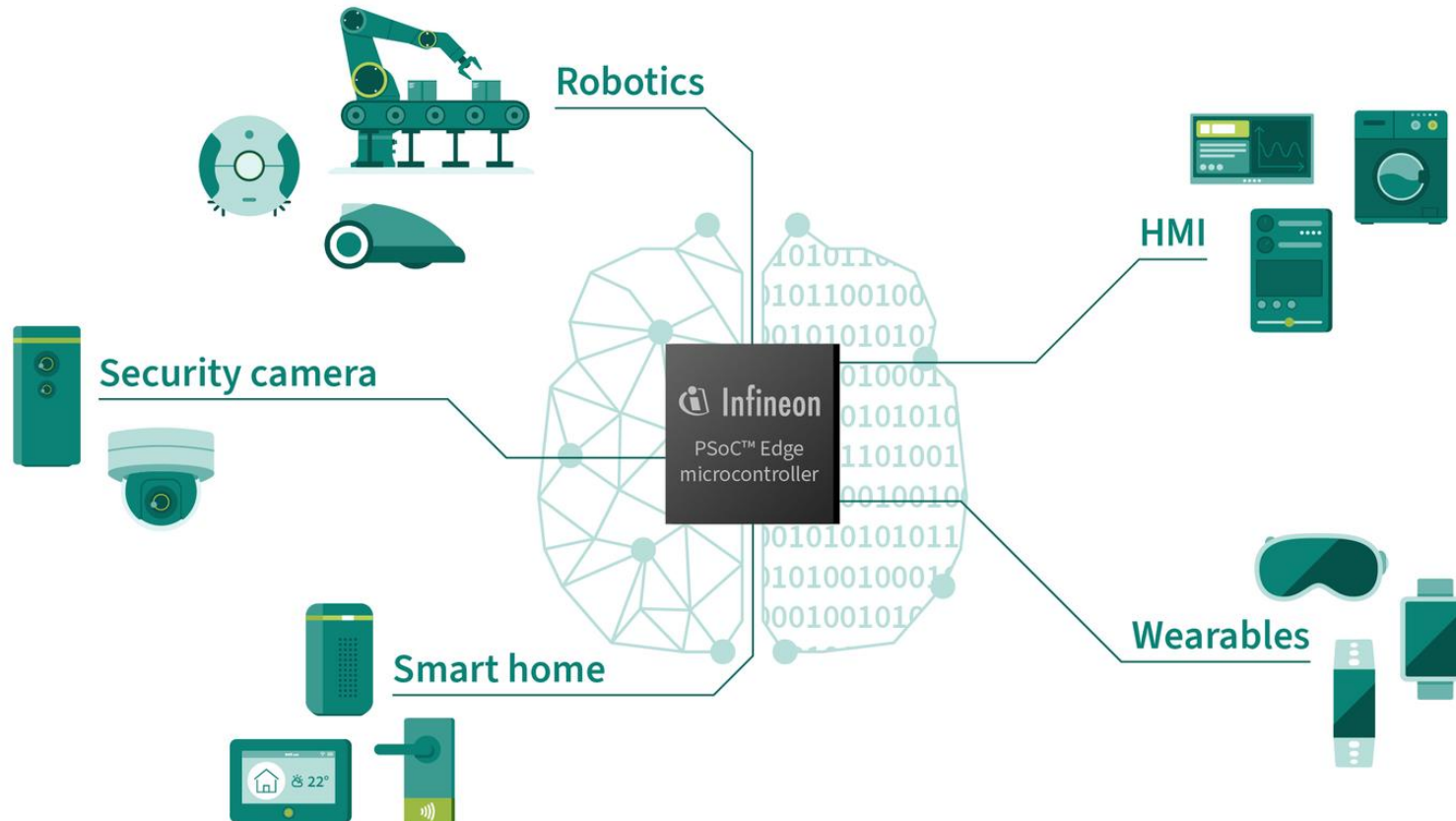
Fully integrated system-on-chip (SoC) devices supported with comprehensive system design tools and software.

Based on the high-performance Arm® Cortex-M55.

Quick move from concept to product.

Fast time-to-market for IoT and consumer applications.

Security is key in the context of AI and in our portfolio

Security is crucial for Edge AI ➕ **Security is part of our DNA** ❯ **New PSOC™ EDGE E8X product family**

Multiple points of attack

Critical IP

Sensitive data

Designed to meet highest certification level provided in the Platform Security Architecture (PSA) PSA L4 iSE

Integrated secure enclave to support boot-time and run-time security services

Isolation of security protection and AI acceleration computation

Our solutions help you make the most from our sensors. Making sleep measurable with the XENSIV™ Sleep Quality Service

Customer evaluation kit

XENSIV™ Sleep Quality Service

Key analytics

Sleep Attributes: *Distinguishing between sleep and wakefulness*	**Sleep Stages:** *Detecting and monitoring different sleep stages*	**Respiratory Factor:** *Detects breathing events by analyzing relative changes in breathing intensity*
• Total sleep time	• Absence	• Breathing rate
• Sleep efficiency	• Presence /awake	• Breathing patterns
• Time to sleep	• Sleep	• No. of respirational anomalies
• No. of awakes	• REM	
	• NREM	

XENSIV™ Sleep Quality Service

Product details

- **Embedded Sensor:** IFX **60GHz Radar** for precise sensing
- **Compute and Connect:** IFX **PSoC™** and **Wifi+BT module** for edge compute and cloud connectivity
- **Cloud AI:** Globally accessible, near real-time analytics
- **OEM Data Ownership:** Secure, exclusive consumer data control and anonymized user data for on-boarding (BirthYear, Timezone, Gender)
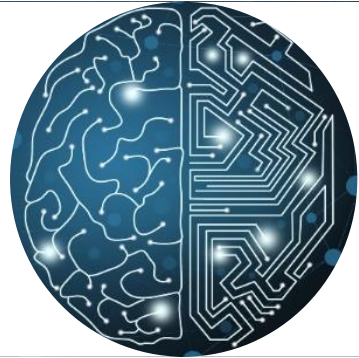- **Sleep Analytics API:** Instant access to sleep and other SQS insights

Embedded AI solutions for Automotive

AURIX™ TC4x Parallel Processing Unit (PPU) enables affordable artificial intelligence use cases for Automotive

Artificial Intelligence & Neural Networks

Optimize Automotive Use Cases
› Cost Reduction
› Innovation
› Improve Performance
› Accelerate Time to Market

Automotive AI Use Cases

Domain/Zone Control
› Modelling
› Model Predictive Control
› IDPS & other security methods

ADAS
› Object classification
› Advanced Radar Signal Processing
› Sensor Fusion

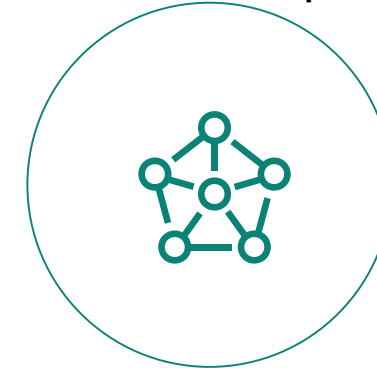### xEV Applications
› Predictive Control
› Virtual Sensing
› Advance State of Health (SoH) and State of Charge (SoC) algorithms

PPU accelerator

SIMD vector DSP Co-processor

› Data processing of linear algrebra (e.g. matrix operations) and signal processing (e.g. filtering, convolutions)
› Ultra fast control loop implementation
› Implemented in low-latency cluster with mixed signal peripherals

For instance, AURIX™ TC4x PPU empowers the e-Drivetrain of the future for best-in-class system efficiency and cost-innovation

TC4x PPU is enabling
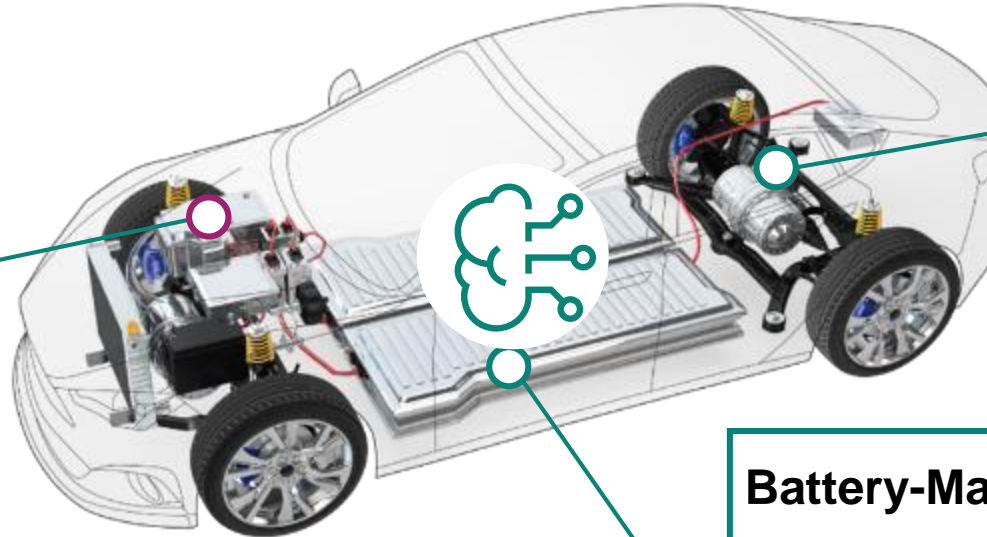
Power-Conversion

› Combining control and communication functions and reducing number of system MCUs from up to 7 to 1

clear cost-down path and further efficiency increase

HV Traction Inverter

› Motor Position Sensing
› Health Observing
› Temperature Estimation
› Model Predictive Control

best-in-class system efficiency and cost-innovation

Battery-Management

› Electrochemical models
› Hybrid ML accelerated models
› Artificial intelligence

optimized Charging, extended vehicle range and battery life

Up to **12x**

TriCore performance, eg. for AI-applications based on 256 bit PPU

Infineon provides a comprehensive end-to-end embedded AI solution with automotive qualified hardware and software

End-to-end solution stack for Automotive AI
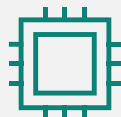
In-house AI Software

imagimob
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AI Partner ecosystem

SYNOPSYS® **EKXONO** AI

+

ASIL-D qualified AURIX™ Microcontroller

+

Automotive qualified sensors

Power management solutions

Connectivity & security solutions

Industrial AI solutions

IAX provides digital representations of physical assets, housed in a docker with standardized interfaces to customer applications

1. Digital Twin / Digital Twin Library

- Database of digital replicas for industrial equipment
- Physics-based models reflecting real-world properties of the corresponding

asset for high accuracy and efficiency
- Simulation of asset condition to predict failures, optimizing lifespan & energy use

4. Customer Applications

- Customer applications (e.g. Building Management Systems) can seamlessly integrate data from deployed ACE
- IAX offers complementary applications like interactive dashboards and mobile apps that can be customized to specific front-end use cases

ACE

Vacuum Pump Twin
Type: NASH 904

2. Analytics Core Element (ACE)

- Acts as pre-processing brain of the Digital Twin
- Stored on a PLC on site and compares sensor input data with model data
- Runs essential real-time analytics tasks, identifying anomalies and reports product status via APIs to Customer Applications

3. APIs

- Standardized interfaces for seamless integration of Digital Twin Model and ACE into customer applications, enhancing functionality
- Promotes ecosystem growth through third-party application development
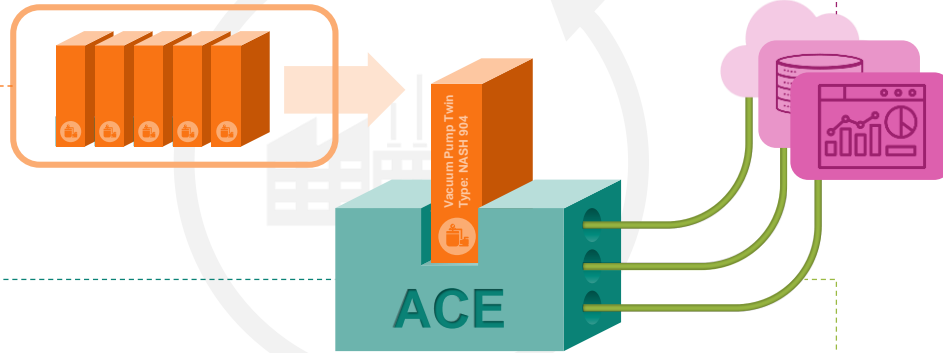
Value Proposition to Our Customers

- Highly accurate and reliable physics-based models tailored to specific equipment and components
- Precise analytics providing event notifications, alerts and status reports in real-time.
- Ease of implementation thanks to standardized interfaces to common customer applications

INDUSTRIAL ANALYTICS

In the future, ACE Forge will mostly automate creating digital twins with ACE dockers that are compatible with customer infrastructure

Customer Data Inputs

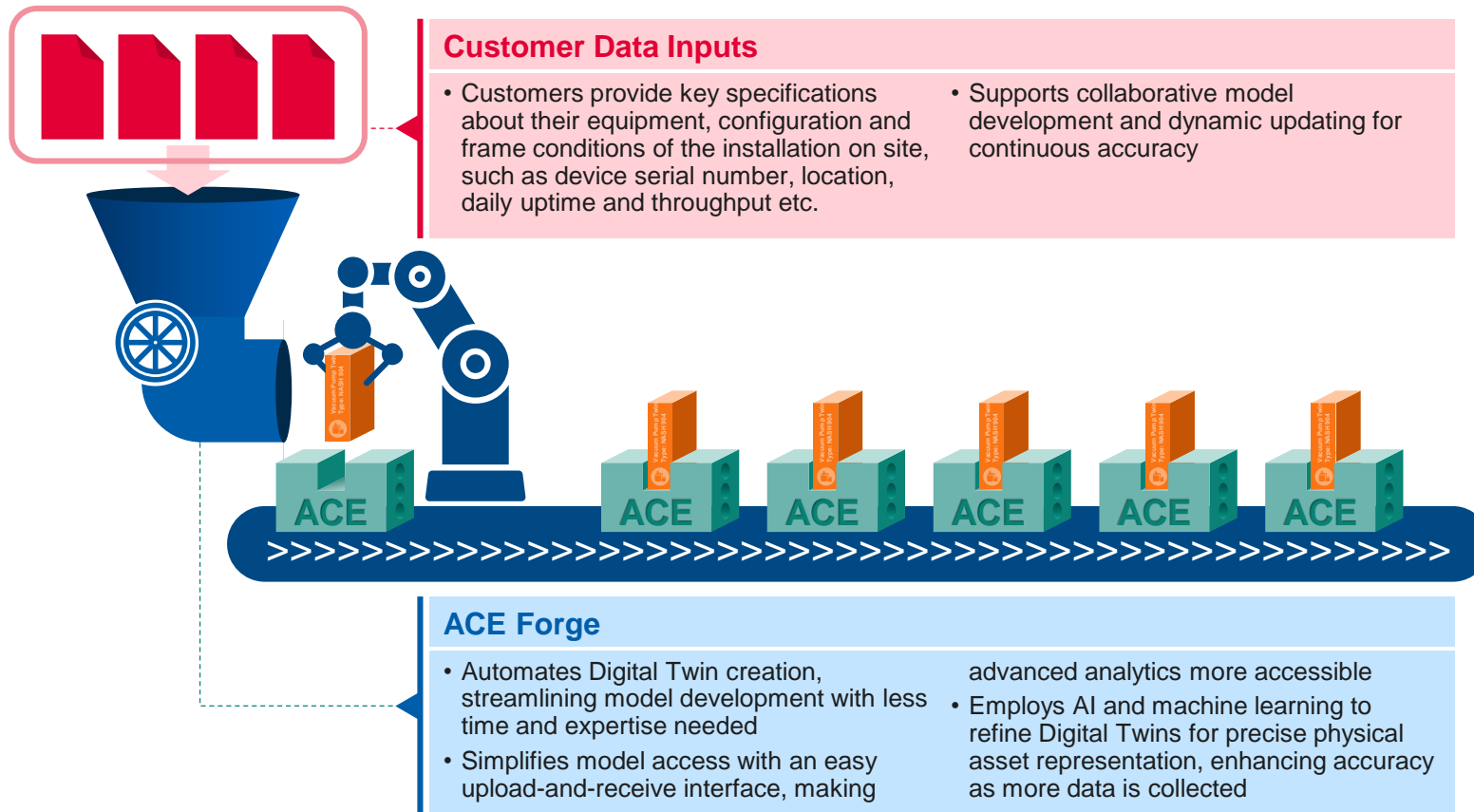- Customers provide key specifications about their equipment, configuration and frame conditions of the installation on site, such as device serial number, location, daily uptime and throughput etc.

- Supports collaborative model development and dynamic updating for continuous accuracy

ACE ACE ACE ACE ACE ACE ACE

ACE Forge

- Automates Digital Twin creation, streamlining model development with less time and expertise needed
- Simplifies model access with an easy upload-and-receive interface, making

advanced analytics more accessible
- Employs AI and machine learning to refine Digital Twins for precise physical asset representation, enhancing accuracy as more data is collected

Value Proposition to Our Customers

Simple data entry thanks to user-friendly interface and menu navigation as well as plausibility check

Immediate assessment of potential savings and immediate cost estimate

Fast and automated model development through the use of generative AI solutions

INDUSTRIAL ANALYTICS

In-field Power Analytics Service, enhancing Converter Monitoring Solutions with unprecedented insights about the power stage.
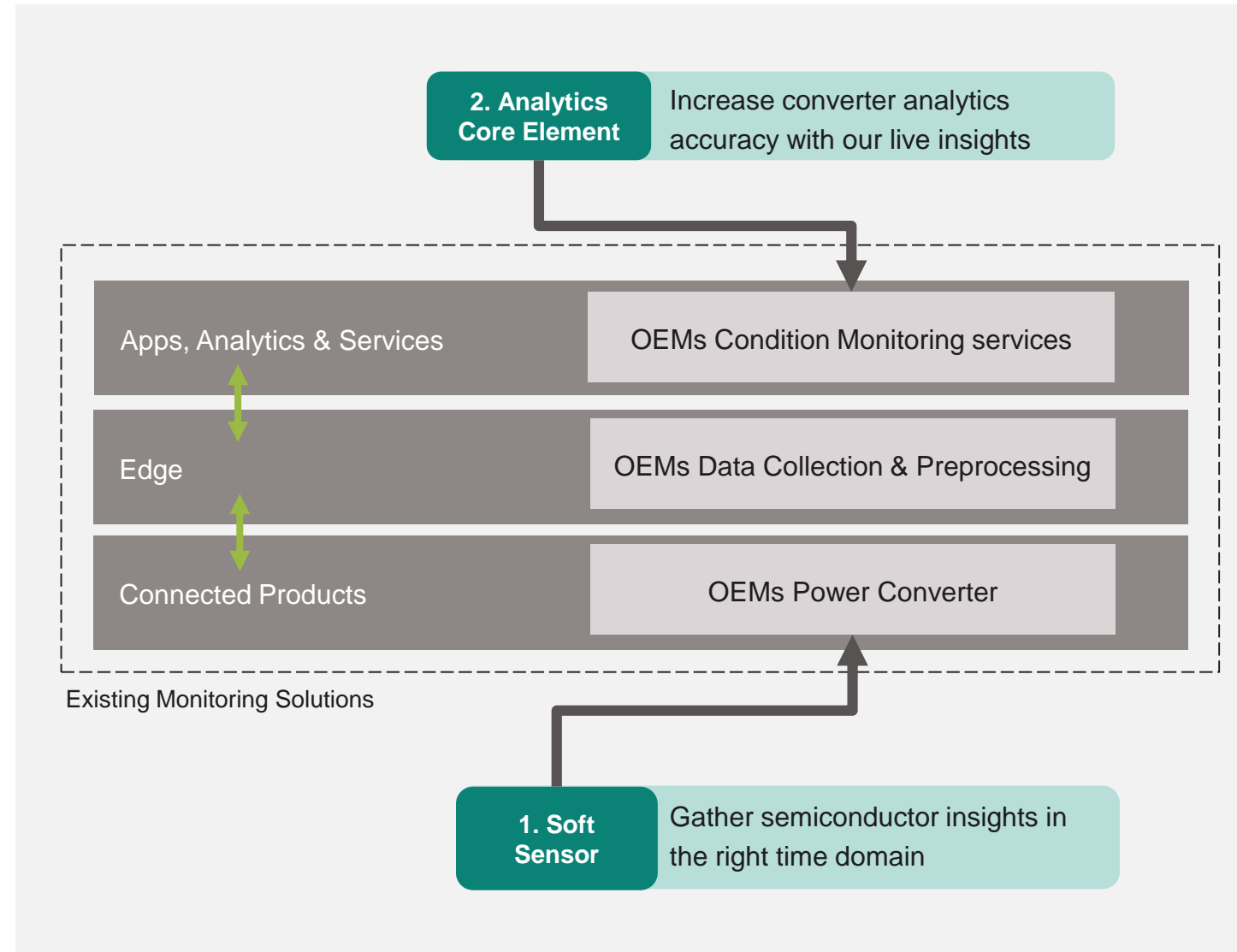
Existing monitoring solutions focus mostly on mechanical components. For this reason we have designed a service to help OEMs:

- **Minimize unexpected downtime due to Power Semiconductors failure**
- **Increase coverage of your monitoring solutions**
- **Optimize converter operation in real-time**

To do so, In-field Power Analytics Service has two main components:
1. Soft Sensor
2. Analytics Core Element

2. Analytics Core Element — Increase converter analytics accuracy with our live insights

Apps, Analytics & Services	OEMs Condition Monitoring services
Edge	OEMs Data Collection & Preprocessing
Connected Products	OEMs Power Converter

Existing Monitoring Solutions

1. Soft Sensor — Gather semiconductor insights in the right time domain

Enhancing converter´s digital journey: In-field power analytics service Unprecedented Insights into the Power Stage

Power Converter

Power Stage | Controller

Motion Control

Soft Sensor
Chip temperature & operating data

Analytics Core Element

- Remaining Useful Life
- Anomaly Detection
- Performance Optimization

Customer´s Monitoring Solution
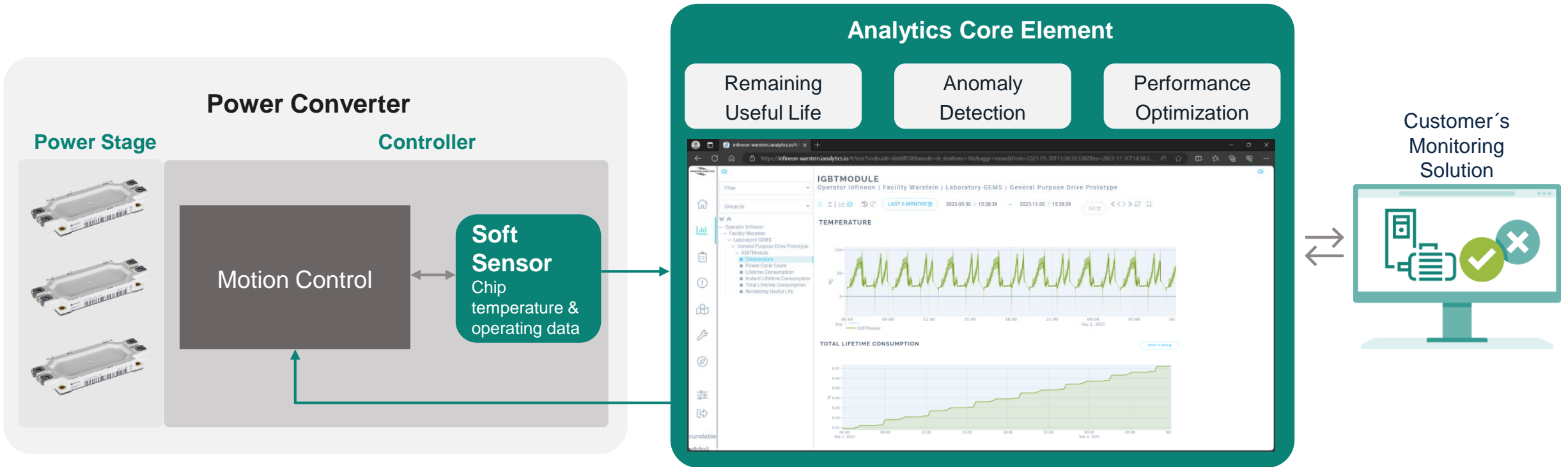
Infineon GIP
Power Electronics expertise

Industrial Analytics
SW and Analytics expertise

Modernize Industrial HVAC Equipment Anomaly Detection and Intelligence with AWS AI and tinyML at the Edge

Office buildings, industrial and manufacturing facilities, and commercial living spaces rely on modern, industrial HVAC systems to meet their respective heating and cooling needs.
While the aim is to provide customer comfort in a climate-controlled environment, configuration complexities in modern equipment, as well as compatibility issues with legacy systems, can result in **costly failures and downtime**.

Monitoring the status, health, and working condition of industrial HVAC is key!
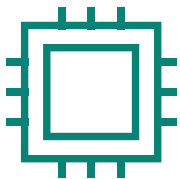
Infineon and **Klika Tech** provide a solution incorporating highly precise **XENSIV™ sensors**, **XMC™ microcontrollers**, and **OPTIGA™ Trust** family, sensors that will feed data into the **TinyML model** that can **detect anomalies in real time** enabling the system to transmit the identified anomaly information, along with relevant sensor data, to a cloud-based AI solution generator .

We use AI

Infineon's mission – to make life easier, safer and greener with responsible AI

Manifest for responsible AI

Responsible and transparent use of AI

Human-centric AI

Safety and security

AI

AI for privacy and data protection

Sustainability

Inclusion