PSOC Edge from Infineon

Discussion from Skip Ashton – Distinguished Engineer

- Skip Ashton –
- Skip is a Distinguished Engineer at Infineon. His current focus is kits, software and ease of use for customers as they develop new products.
- He has previously been on the Board of Directors for the Connectivity Standard Alliance, Zigbee and Thread, as well as other IoT consortia. Skip was the Vice President of Software for Silicon Labs helping to build their IoT portfolio and software teams. Skip was responsible for IoT efforts across Zigbee, Thread, Bluetooth and proprietary wireless in addition to 32b MCU and the software tools at Silicon Labs. Throughout his career, Skip has held a variety of program and engineering management positions focusing on high quality product development. Skip has worked with companies in home automation, connected lighting, smart energy and the systems required for success of these products. Skip holds a BSME from Georgia Tech and also worked on nuclear power in the US Navy.

Agenda

– Brief Infineon Overview

– Our involvement in AI – cloud and Edge

– Benefits of Edge AI on power consumption, security, latency

– Architecture of Edge AI devices

– What Development looks like for Edge AI

Infineon Overview

- Driving decarbonization and digitization. Together

- World Leader in semiconductor solutions with ~57,000 employees in >100 locations

- Our Mission: We make life easier, safer, and greener – with technology that achieves more, consumes less and is accessible to everyone. Our products power decarbonization and digitalization. Microelectronics from Infineon is the key to a better future.
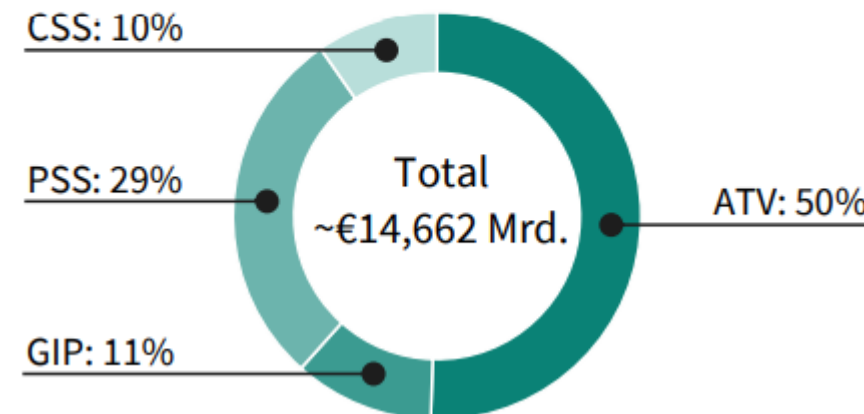
Market Position

Automotive	Power	Security ICs
# 1	# 1	# 1

Revenue distribution

(by segment and product category)

FY25

- CSS: 10%
- PSS: 29%
- GIP: 11%
- ATV: 50%

Total ~€14,662 Mrd.

We are driving the revolution of Artificial Intelligence

We power AI

We enable AI

From grid…

…to core and the edge

For a more sustainable future.

For secured intelligence everywhere.

Cloud AI and Edge AI complement each other to enable unlimted possibilities
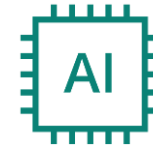
Cloud AI Systems

- ✓ Powerful
- ✓ Scaleable
- ✓ Constant learning

Suitable to process large datasets and to run complex AI models

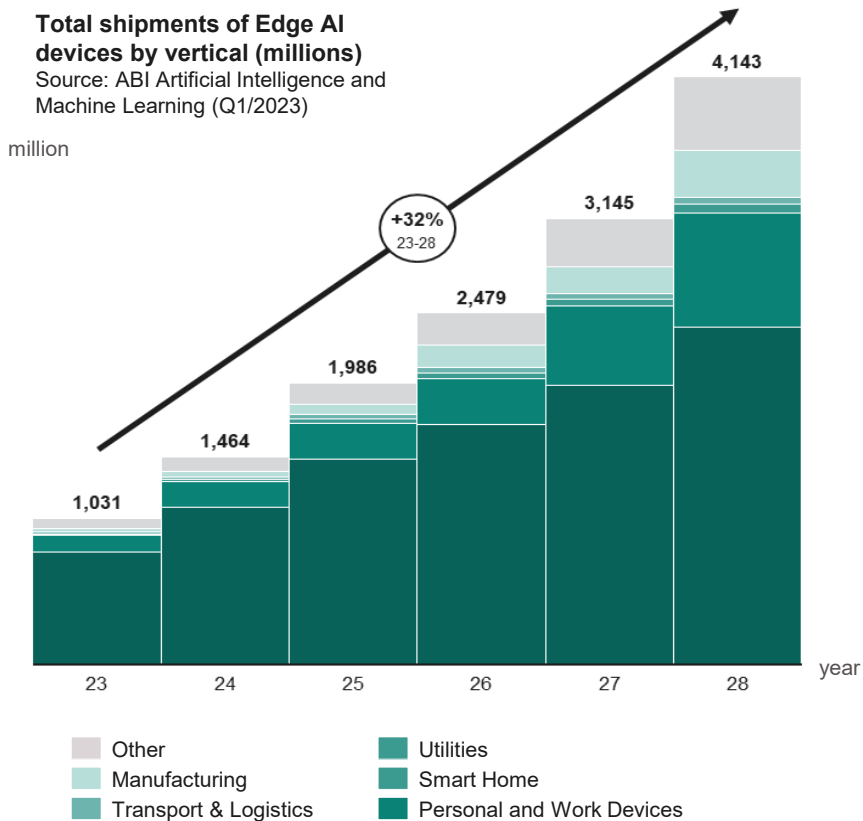## Edge AI Systems

- ✓ Fast
- ✓ Secured
- ✓ Efficient

Suitable for application in the field and the enablement of new IoT use-cases

Edge AI is a key enabler of IoT and beyond, offering significant market opportunity for intelligent devices

Edge AI models run on devices at the edge of a network. Close to the source of data. Available on MCUs.

Edge AI is growing

Total shipments of Edge AI devices by vertical (millions)
Source: ABI Artificial Intelligence and Machine Learning (Q1/2023)

million

+32%
23-28

4,143
3,145
2,479
1,986
1,464
1,031

year
23   24   25   26   27   28

- Other
- Manufacturing
- Transport & Logistics
- Utilities
- Smart Home
- Personal and Work Devices

Benefits of Edge AI

Edge AI allows for intelligence everywhere – **no permanent internet connection required**

Edge AI processes information on the device – allowing **real-time operations**

Edge AI reduces data transfer to the cloud – resulting in a reduced **energy consumption by up to 50%***

Edge AI doesn't require data to leave the device – **security and privacy risks are significantly mitigated**

Security is key in the context of AI and in our portfolio
Scalable security solutions for trusted protection in IoT and Edge AI

Security-hardened microcontrollers

Security services

Discrete Secure Elements
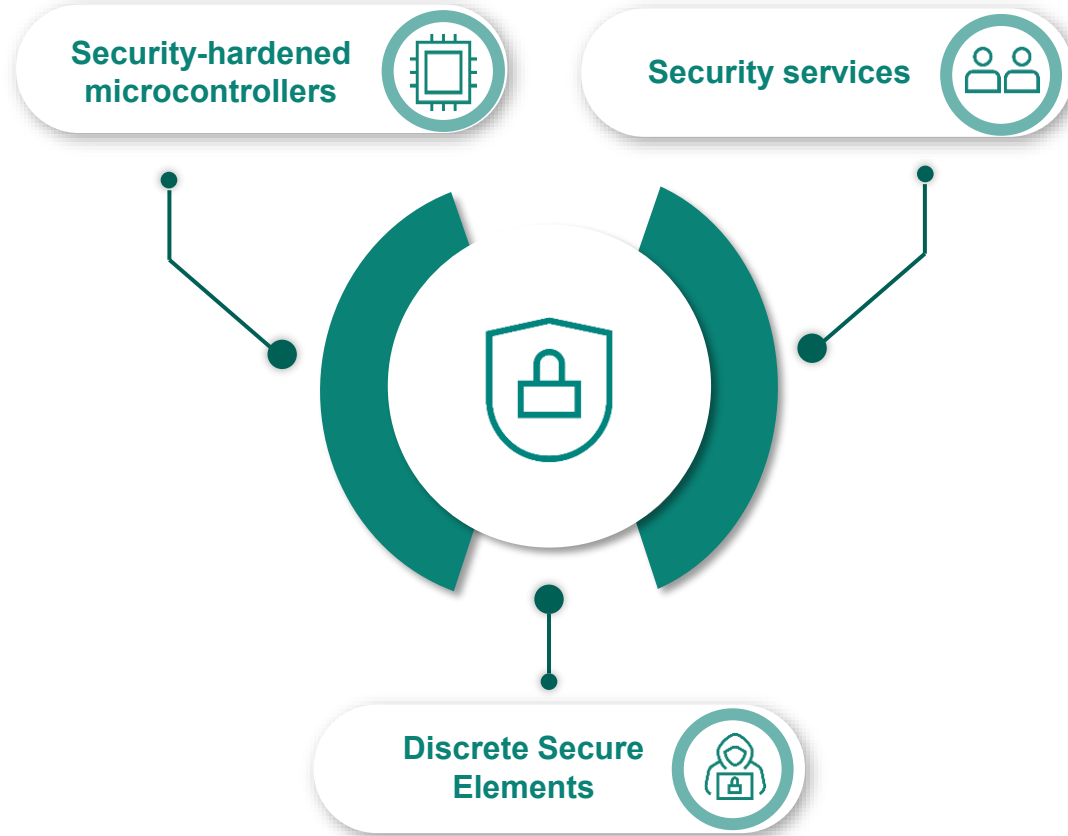
Typical security use-cases for Edge AI

- Data security & privacy (e.g. voice/gesture recognition)

- Protection against un-authorized modification and access; intrusion detection (e.g. Secure Boot, root of trust)

- Supplier IP protection (e.g. confidentiality of AI software)

Our tailored security solution for Edge AI PSOC™ Edge is targeted to meet global compliance standards

psacertified™ level four iSE / SE

PSA level 4

CE

EU CRA compliance

US Cyber Trust Mark

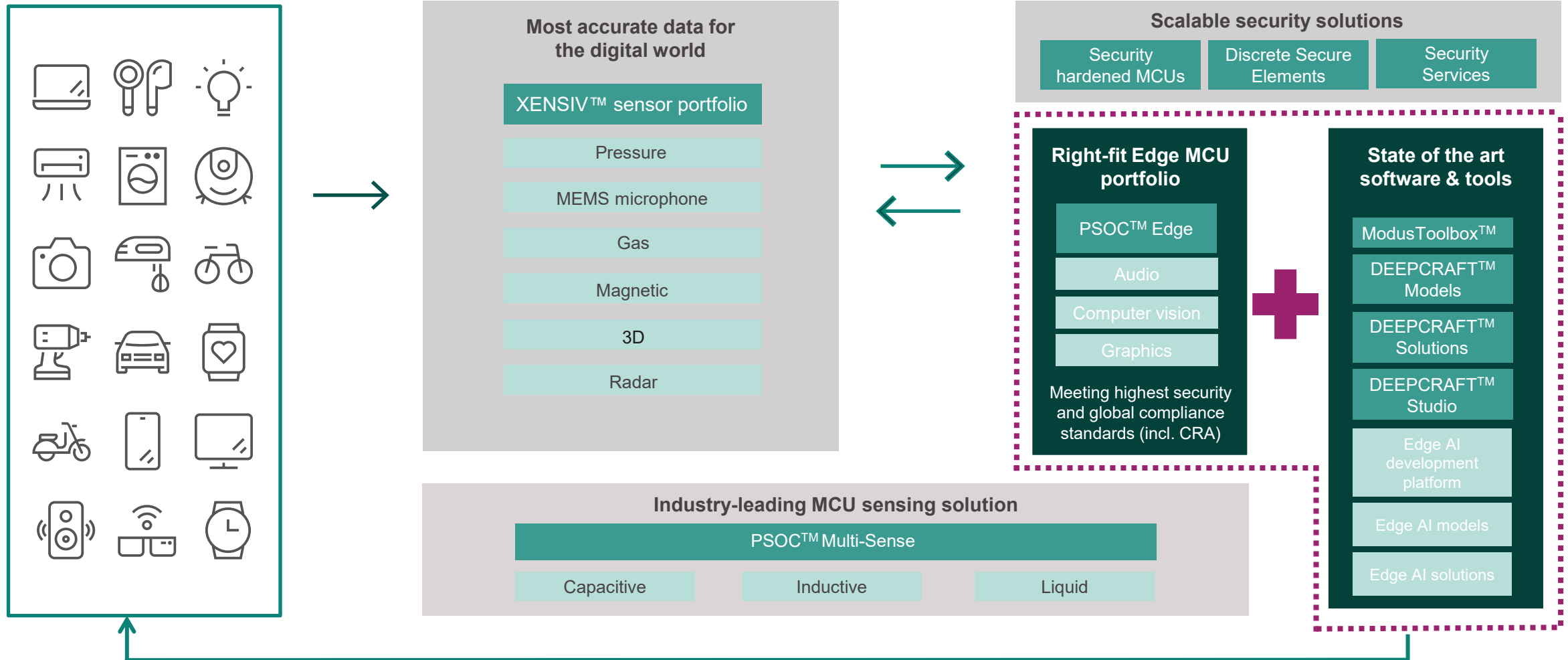**Cybersecurity Labelling Scheme SG**

Infineon enables intelligence at the edge –Embedding AI within your devices.

Physical information

Collect and transform information into high-quality data

On-device processing and analyzing data into high-quality, reliable AI-based insights

Most accurate data for the digital world

- XENSIV™ sensor portfolio
- Pressure
- MEMS microphone
- Gas
- Magnetic
- 3D
- Radar

Industry-leading MCU sensing solution

PSOC™ Multi-Sense

| Capacitive | Inductive | Liquid |

Scalable security solutions

| Security hardened MCUs | Discrete Secure Elements | Security Services |

Right-fit Edge MCU portfolio

- PSOC™ Edge
  - Audio
  - Computer vision
  - Graphics

Meeting highest security and global compliance standards (incl. CRA)

+

State of the art software & tools

- ModusToolbox™
- DEEPCRAFT™ Models
- DEEPCRAFT™ Solutions
- DEEPCRAFT™ Studio
- Edge AI development platform
- Edge AI models
- Edge AI solutions

We are expanding Edge AI use cases, for example by innovating in AI-driven audio & computer vision capabilities

computer vision

now	soon to come	future
– Gesture detection – Face ID – People detection	– Customizable object detection – Image segmentation	– Activity analysis – People position/ localization – Stereo Vision – Optical Character Recognition (OCR)

now   **soon to come**   **future**

audio

now	soon to come	future
– Sound classification – Key word spotting – Simple commands	– Voice Assistant for natural commands – English – Audio enhancement – Voice ID	– Small language models – Voice assistant Multi-Language – Multi-microphone audio enhancement

Game-changing Architecture & Ecosystem

High-Performance, Low-Power Architecture

- Cortex®-M55 MCU core with Helium™ DSP – up to 400MHz
- Always-on, low-power domain Cortex®-M33 MCU core – up to 200MHz

Energy Efficient Edge AI

- Ethos-U55 NPU – up to 400 MHz
- Infineon's NNLite NPU – up to 200 MHz
- Enabled by DEEPCRAFT™ AI Suite

State-of-the-Art Security

- Secured Enclave architecture
- Infineon EPC4 with PSA Certified L3/L4 integrated Secured Enclave (iSE)
- Edge Protect Bootloader and TF-M Stack available in MTB

Multi-Modal, Advanced HMI

- Voice, Natural Language & Generative AI
- Accelerated multi-microphone audio
- Vision-based awareness & interaction
- Low-Power Graphics with 2.5D GPU – up to 400MHz

Easy to Use Software & Tools

ModusToolbox™
Code examples, middleware, device drivers, project creation, library management, & configuration

DEEPCRAFT™ AI Suite
DEEPCRAFT™ Studio, DEEPCRAFT™ AI Hub, DEEPCRAFT™ Solutions & More

Development Journey
Remote Lab, PSOC™ Edge E84 AI Kit, PSOC™ Edge E84 Evaluation Kit, Multiple partner solutions to expedite time to market

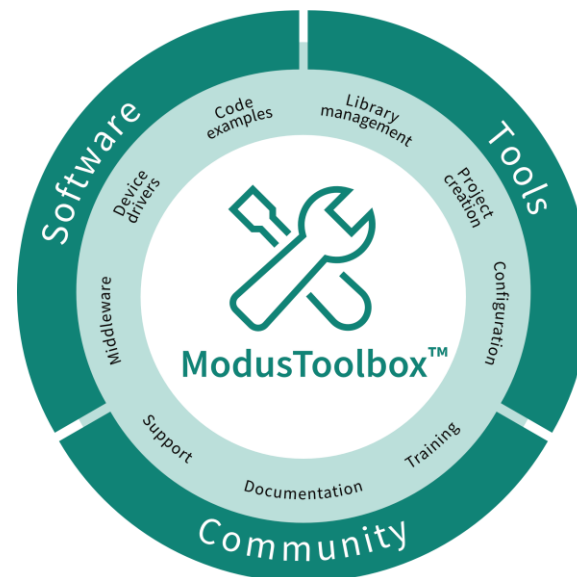# Comprehensive Ecosystem for Edge AI Applications

DEEPCRAFT™ AI Suite

ModusToolbox™ Zephyr

Embedded Development

DEEPCRAFT™ AI Suite – Fast-track to intelligent, power-optimized Edge AI products

- Integrated platform and tools for end-to-end AI workflow
- Comprehensive AI solutions (voice, audio, vision, sensing)
- Centralized DEEPCRAFT™ AI Hub

ModusToolbox™ – Collection of tools, software and resources

- Flexible development tools and resources
- Robust software, middleware, and security ecosystem
- Comprehensive Zephyr RTOS enablement for seamless integration and rapid development

PSOC™ Edge Development Boards – Fit for evaluation, prototyping and deployment

- PSOC™ Edge E84 Evaluation Kit: full functional prototyping kit including the PSOC™ Edge E84 System-on-Module (SOM) with minimal system components
- PSOC™ Edge E84 AI Kit: Low-cost kit with multiple sensors for evaluation of AI capabilities and fast prototyping

DEEPCRAFT™ Studio provides the full journey from AI model development to embedded software

Build a new custom model, starting from scratch or using a DEEPCRAFT™ Studio Accelerator

OR Bring your own model

Model development and customization

DEEPCRAFT™ Studio

Choose a Studio Accelerator or create a new project → Data Acquisition → Preprocessing → Model Training
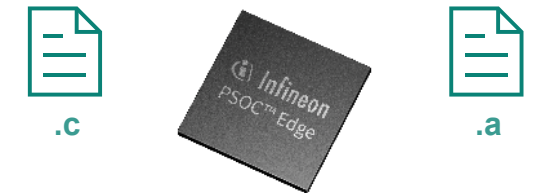
Model optimization

DEEPCRAFT™ Studio

Model evaluation   Optimization

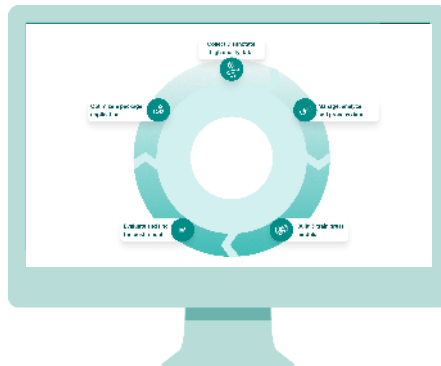## Model deployment on MCU

ModusToolbox™ - for PSOC™ and TRAVEO™

.c   PSOC™ Edge   .a

Deployment

AURIX™ Development Studio
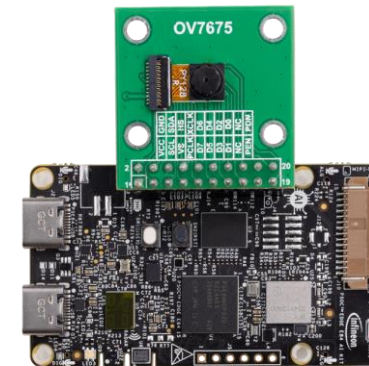
.c   AURIX™ TriCore™   .a

Deployment

PSOC Edge Kits

– Two kits for PSOC Edge
  – Evaluation Kit
  – AI kit

– Kit Out of Box efforts
  – Graphical interactive user experience on Evaluation kit
  – Web base OOB for AI kit for different applications
  – Live Lab to allow kit interaction over the web

– Plan is to stock labs here with AI kits

PSOC Edge AI kit Overview

- PSOC Edge Artificial Intelligence Kit
  - PSOC Edge Processor – M55 high performance MCU, M33 low power MCU, Ethos N55 NPU and secure enclave
  - Sensors – 6 axis IMU, 3 axis magnetometer, humidity and temp sensor, 60 GHz radar, barometric pressure and temp sensor
  - 2 digital and 2 analog microphones
  - CYW55513 tri-band Wi-Fi and BT module
  - DVP camera
  - MIPI DSI display connector

- Small form factor kit allowing extensive sensor data collection, strong AI engine and wireless connectivity

- Popular for hobbyist, prototyping and for engineers to start development efforts

6 Axis IMU

DVP Camera

Display Connector

XENSIV 60 GHz RADAR

Humidity and Temp

Pressure

PSOC Edge

CYW55513 Module
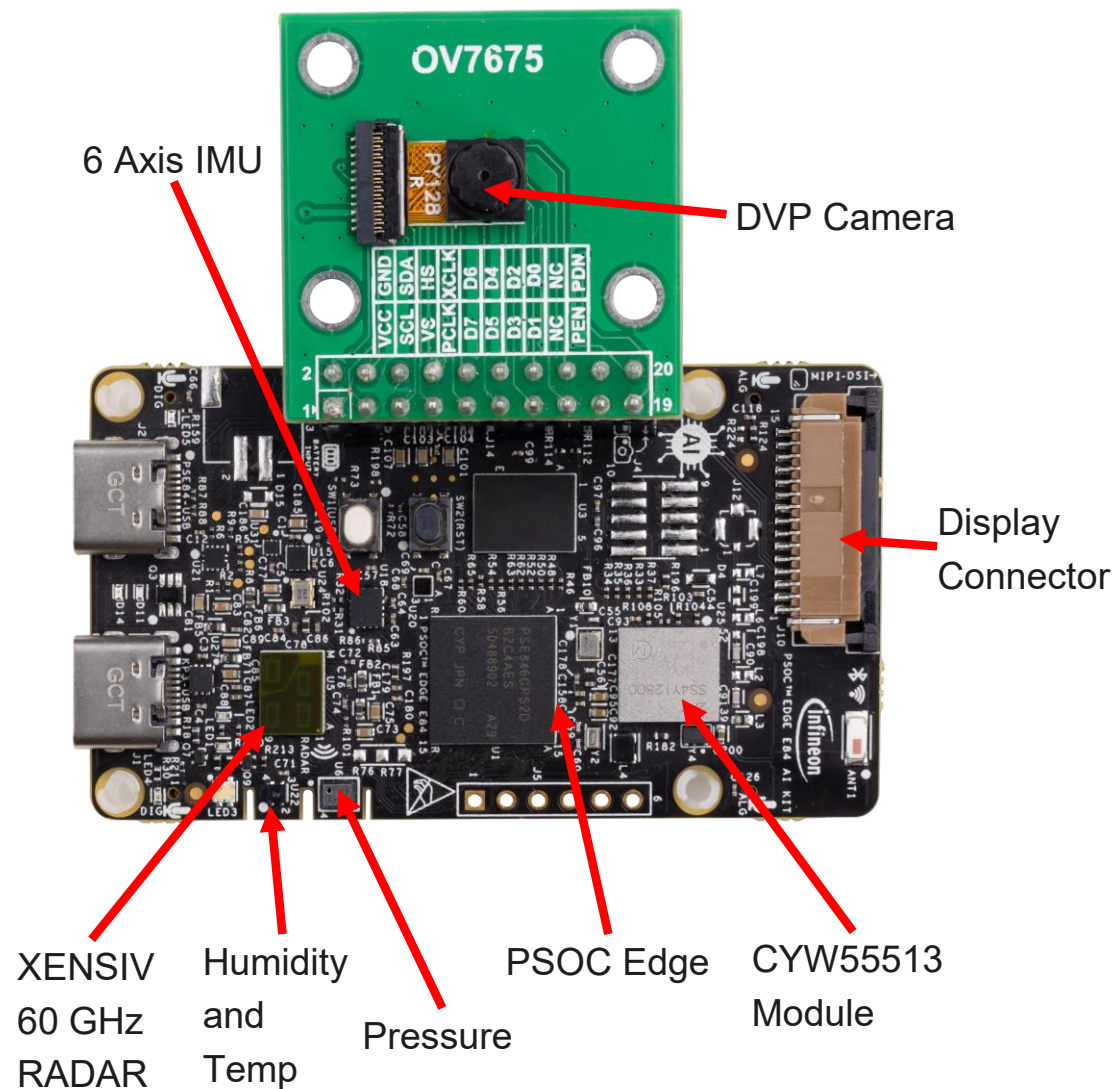
Using the PSOC Edge AI Kit – Options Available

- Out of Box using terminal window
  - Common customer usage
  - Ships with Local Voice Lighting application, Radar Gesture Control
- Out of Box using Display
  - For customers interested in adding graphics capabilities
  - Updating apps provides Rock, Paper, Scissor application with video on display
- Web based out of Box
  - Allows selection of additional applications
  - User can select demonstrations of interest and program them into the kit and interact using the web interface
  - Goto – devkit.Infineon.com and select PSOC Edge AI kit

- Using ModusToolbox for MCU application development, debug and programming
- Using DEEPCRAFT Studio for AI data collection and model generation
- Using DEEPCRAFT Voice Assistant for building voice command models

- See all available models and tools at deepcraft.Infineon.com

Hands on Demo Graphics and Vision on PSOC Edge EVK

Demo of PSOC Edge AI kit

Where to Start Development for PSOC Edge

– Build a model

– Use a starter model or build your own
– Use DEEPCRAFT Studio
– Can add data to existing models
– Models are rebuilt on the web and downloaded

– Wake Word and Command model

– Start with Voice Assistant (web page)
– Allows customizing commands and parameters
– Provides variables and actions

– Bring in 3rd party model

– Many 3rd party models exist
– Use model converter to convert model to PSOC Edge
– Supports tf and tflite, pytorch today

– Start on embedded code

– Can look at various examples available on github
– Can use ModusToolbox to load examples
– Use Eclipse or VS Code generally
– Number of projects with model folders already there to get you started

Where to find more information

- www.infineon.com/psocedge   - product page

- https://github.com/orgs/Infineon/repositories?q=Edge   - sample apps on github for PSOC Edge

- https://deepcraft.infineon.com/   - AI Hub for PSOC

- www.infineon.com/psocdeveloper   - Developer workflow pages

- https://www.infineon.com/design-resources/development-tools/sdk/modustoolbox-software - Development Tools