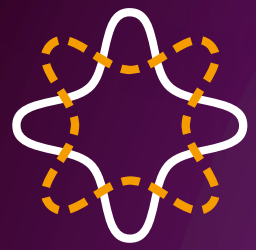

CVG

Custom vs off-the-shelf - perspectives for 2025

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Overview

- Embedded systems market trends
- Embedded systems are getting more complex
- Why design custom hardware
- Considerations for a custom hardware design
- Levels of customization
- CVG Convergens services

Embedded systems market perspectives for 2025

- Embedded market continues steady growth
- Worldwide market expected to be 161-210 billion USD in 2030-2031 (145-189 billion Euros)
- 4-7% annual growth (GAGR) from 2024 to 2031
- Drivers: IoT, automotive and industrial electronics
- Sources: IMARC Group, Fortune Business Insight, Reasearchandmarket and Verified Market Research

Embedded systems trends 2024 and 2025

- Connectivity: Wi-Fi, BLE, 4G, 5G
- Doing more with less – e.g. energy, cost
- Regulations and safety – e.g. cybersecurity, ESG
- Supply chain reliability
- Industrial HMIs vs. smart phones
- Open-source is not answer to everything
- Memory safety vs C/C++

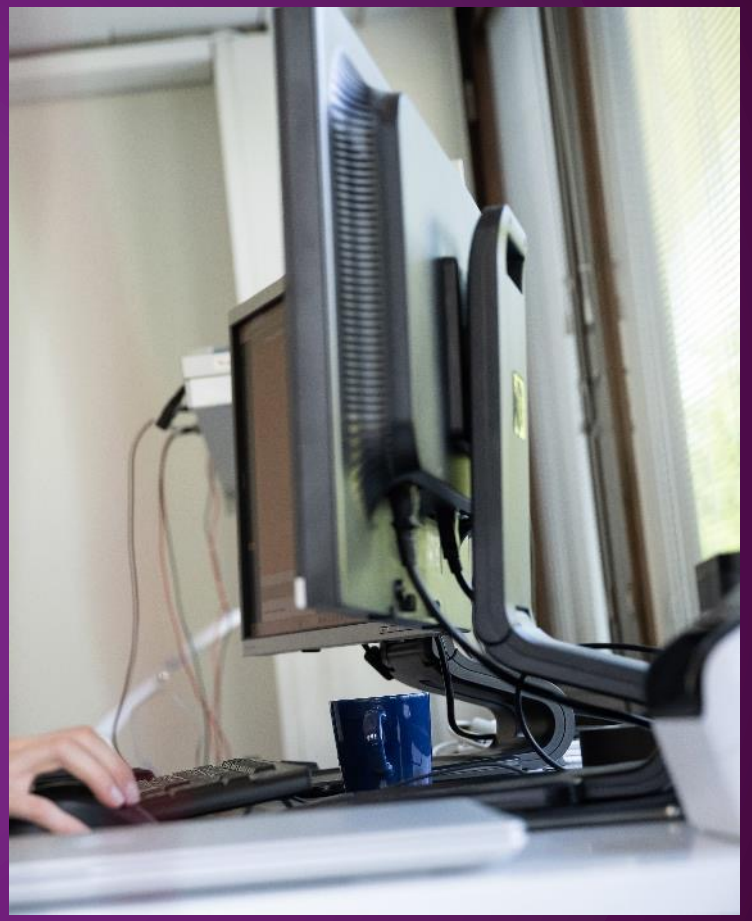
Programming language trends

Embedded systems

- C (~70%)
- C++ (~23%)
- Python (~5%)
- Assembly (<2%)
- Other (<1%)

General programming (TIOBE index)

- Python (~20.17%) ↑
- C++ (~10.75%) ↑
- Java (~9.45%) ↓
- C (~8.89%) ↓



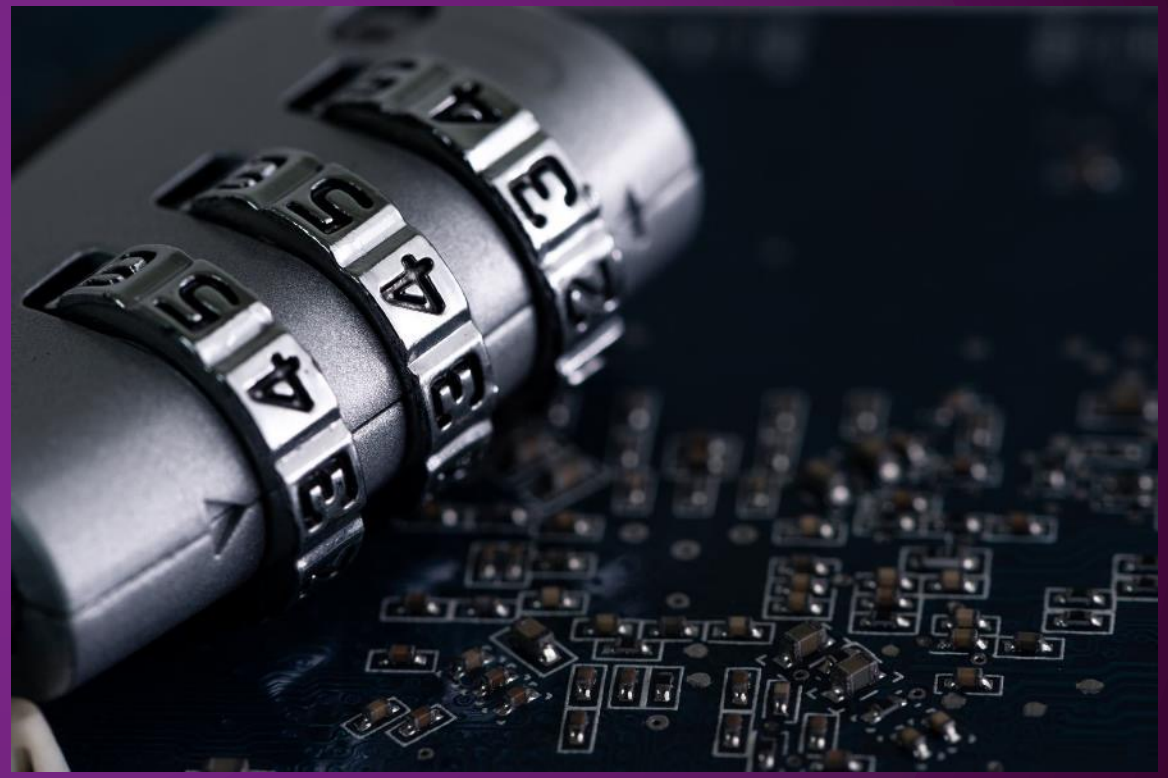
- Sources: https://www.embedded.com/embedded-rust-where-are-we-today/ and https://www.tiobe.com/tiobe-index/

Embedded systems are getting more complex

- More functionality
- Performance
- Networking
- Increasing regulation
- Cybersecurity
- Remote updates
- Centralized management

Cyber security requirements

- Network and Information Security Directive (NIS2), Cyber Resilience Act (CRA), Radio Equipment Directive (RED)
- IEC 62443 for Automation and Control Systems Cybersecurity
- ETSI EN 303 645 for Consumer IoT Devices



Cyber security requirements

- Secure boot, HSM
- Encrypted communications
- Centralized management
- Remote software updates
- Multi-factor authentication
- Life-cycle and supply-chain
- Vulnerability management

Why design custom hardware

- Control over product and IPR
- Form factor and design
- Physical security
- Energy efficiency
- Temperature range and environment
- Special interfaces and connectors
- Long product lifetime
- Control over supply chain
- Manufacturing cost optimization

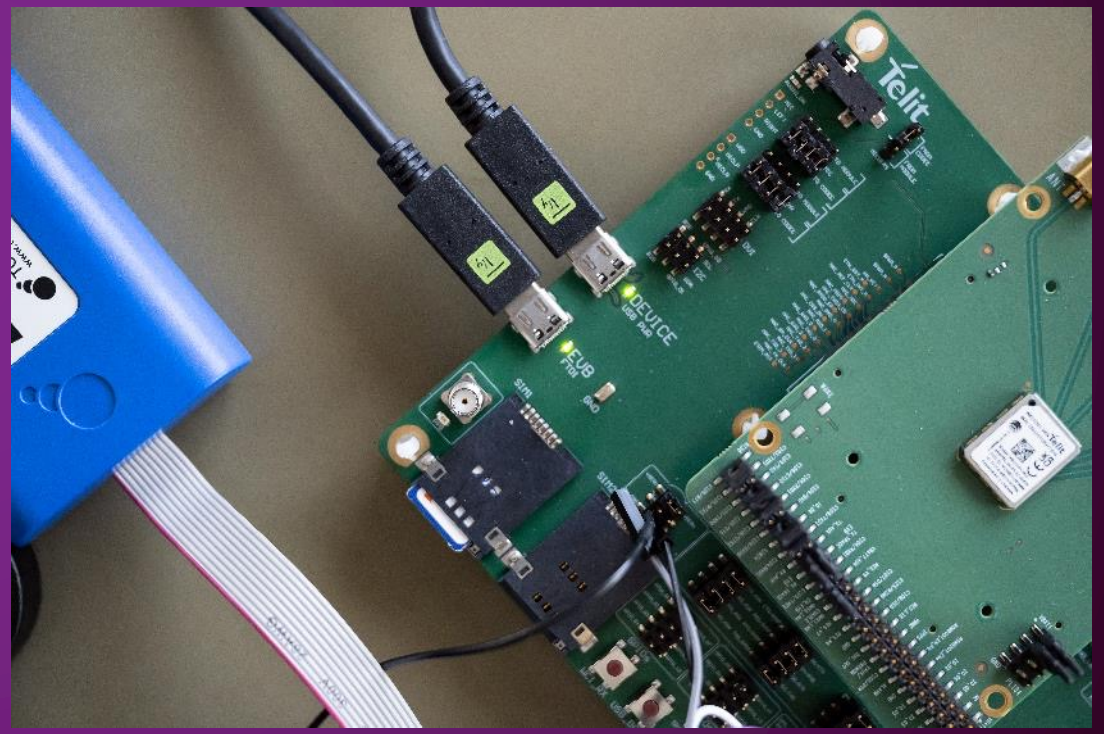
Considerations for a custom hardware design

- MCU or CPU? Or both?
- Operating system selection (Linux or RTOS or ?)
- Cost target
- Estimated production volume
- Planned product lifetime
- Supply chain
- Regulatory requirements
- Existing designs re-use

- Non-recurring engineering (NRE) costs must be considered to analyse if a new product will be viable.

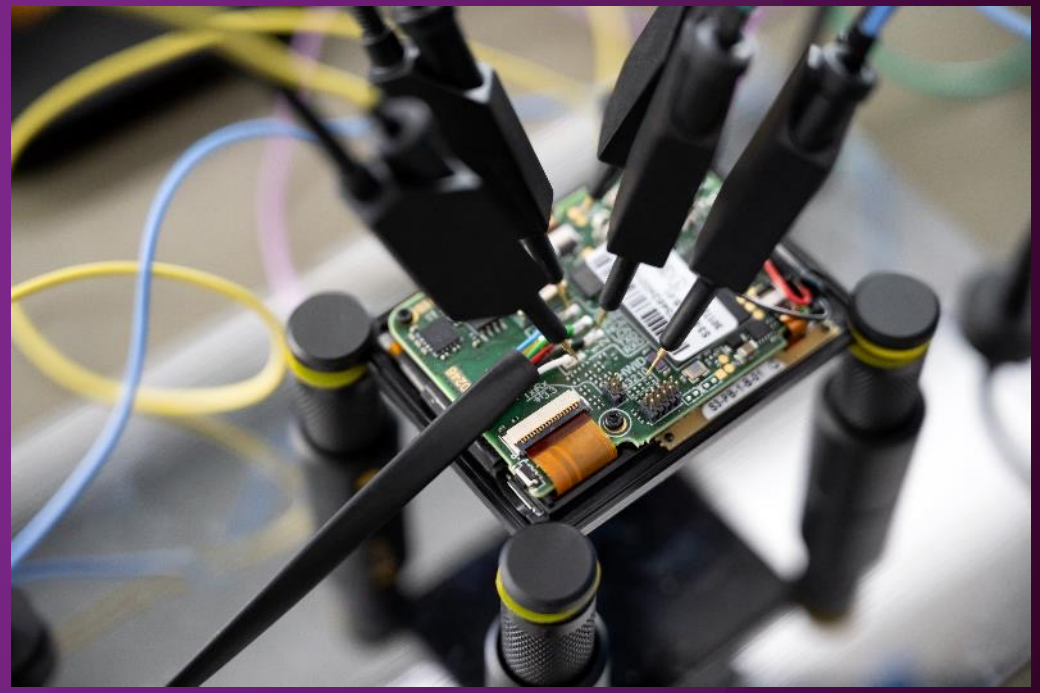
Custom hardware starts often with rapid prototyping

- Rapid prototyping is a key enabler in innovation
- Easier and faster than ever to build a prototype
- Almost the real thing! – but not market ready
- There is a lot to do from the proof of concept to a market ready product



Some steps to make a market ready product

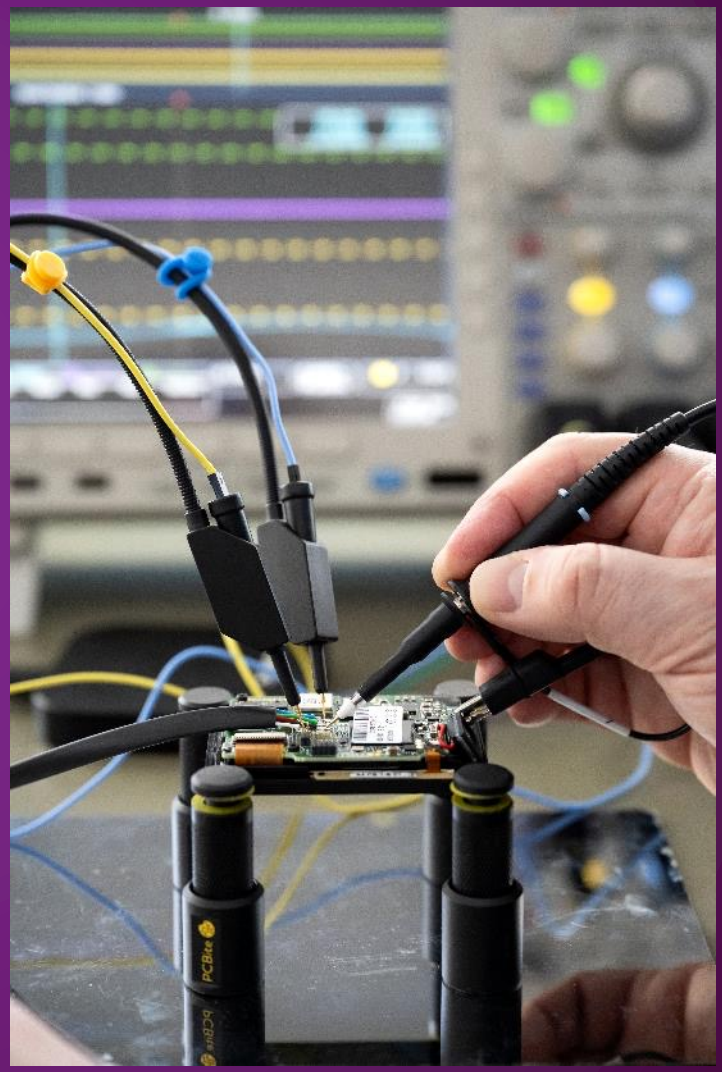
- Electronics, software and mechanics design
- Verification and documentation
- Sourcing components
- Manufacturing and testing facilities
- Pre-compliance testing
- Production tooling design
- Production test procedures and systems
- Manufacturing and verification



From idea to a product

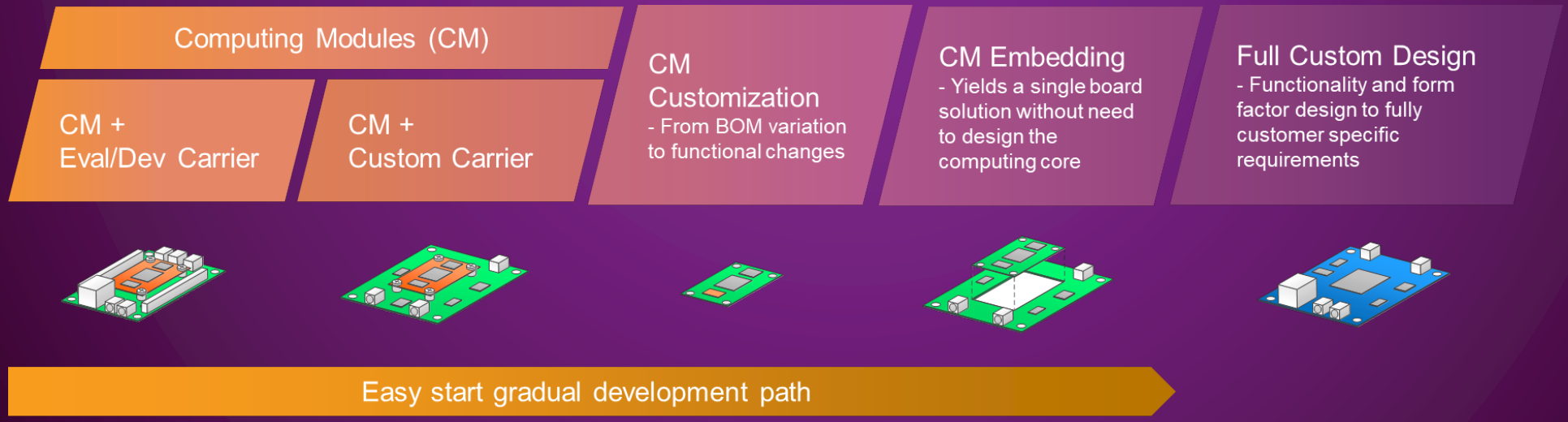
- Traditional full custom design route takes often 8-12 months from concept to deployment

- Accelerated development method takes 4-8 months depending on level of customization



Levels of customization

- Desktop PC, laptop, industrial computer
- Single board computer in custom case
- Computing module on standard carrier board
- Computing module on custom carrier board
- Computing module embedding and customizing
- Full custom design



Use modules and known good designs

- Customized carrier board is less complex than a full custom design
- Use pre-certified RF modules for easier certification
- Use tested and known good hardware designs
- Re-use of known software modules (operating system, drivers, libraries)

CVG Convergens

- Engineering consulting company with specialization in embedded systems, IoT and ICT systems
- 26 years' experience (established 1996)
- Solid experience in all aspects for embedded systems
- We concept, develop, manufacture and sustain products for our clients on long-term basis
- Over 500 products developed
- Over one million products manufactured

Services

- Product development
- Design
- Manufacturing
- Life-cycle
- Consulting

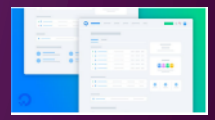
Product examples

- Single-board computers
- Computing and control modules
- IoT sensors, actuators and gateways
- Communications equipment
- User interfaces (HMI)
- Mobile devices
- Embedded software

Board Level

Finished Products

SW & Systems



Thank you for listening!

- Meet us at our table
- Visit https://www.cvg.fi/
- E-mail: sales@cvg.fi

- Please do not hesitate to contact us! We are always happy to discuss about your ideas and think about ways how we could help you to achieve your goals.