

ebs group

ecore

SOFTWARE REFERENCE
ARCHITECTURE

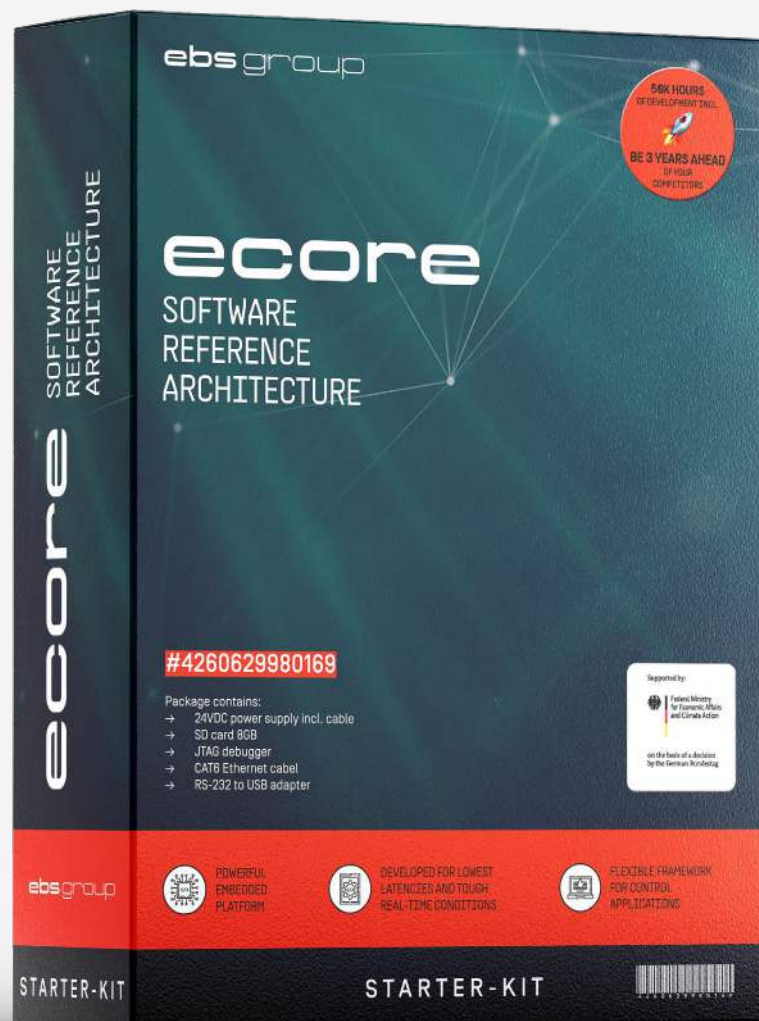
**Real-time control,
made simple.**

Supported by:



Federal Ministry
for Economic Affairs
and Climate Action

on the basis of a decision
by the German Bundestag



IN BRIEF

What is ecore?

“ecore is more than a Real-Time Control Platform — it is the result of 60,000 engineering hours.”

This sophisticated real-time architecture for AMD® Zynq® UltraScale+™ MPSoCs enables the parallel execution of low-latency control algorithms — optionally based on Simulink® — alongside an embedded Linux distribution. A lightweight hypervisor ensures clean separation between management tasks and real-time control.

ecore

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ARCHITECTURE



100% Model-based

Develop control apps end-to-end in Simulink®.



Hard Real-Time

Deterministic <math><1 \mu\text{s}</math> FPGA latency.



Totally Synchronized

across internal & external time domains.



Simple Operation

Web UI, REST API, Parameter Manager.



Standardized Toolchain

provided alongside.



Seamless Integration

Plugs easily into existing structures.



Open-Source Foundation

Debian Linux & Jailhouse Hypervisor



365/24/7 Operation

Watchdogs, A/B updates, auto-rollback.



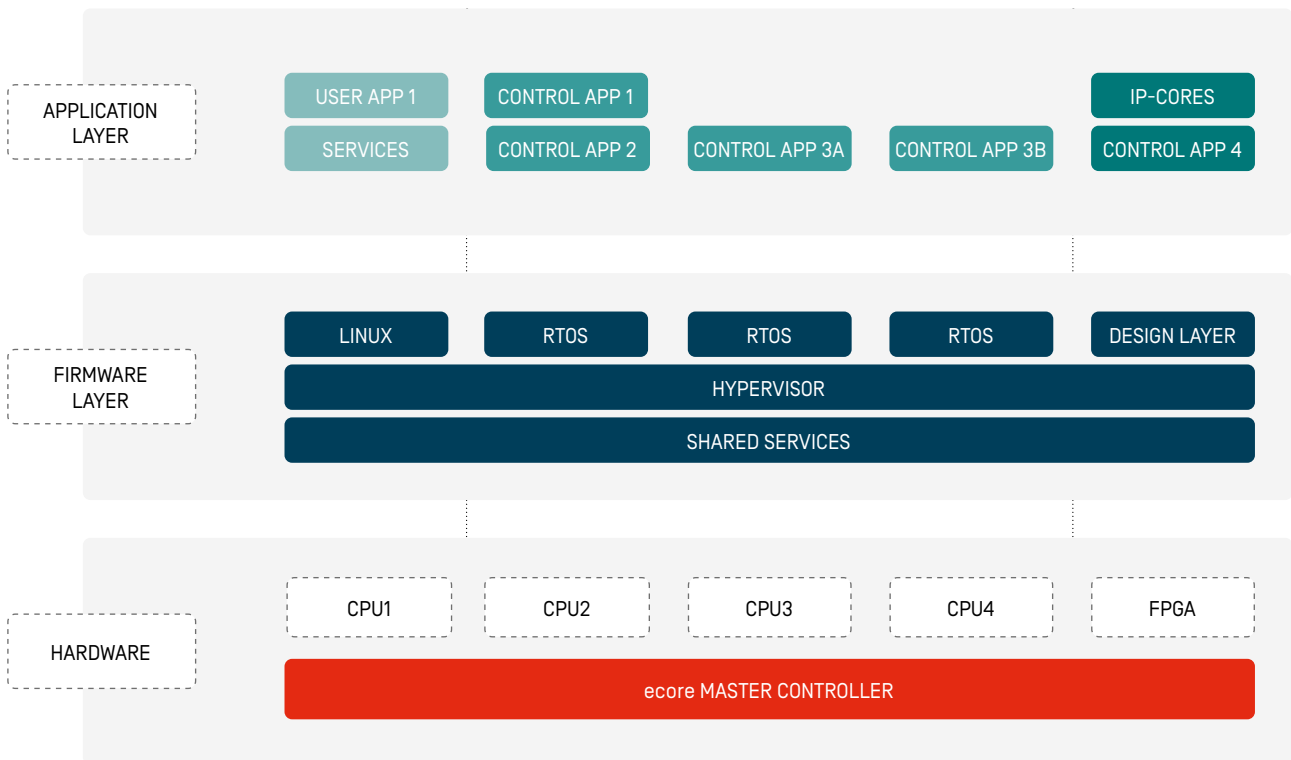
Secure Design

Secure Boot, signed firmware, encryption.

ARCHITECTURE

Master Controller Architecture

User control applications can run on the different CPUs as well as on the FPGA. Data exchange between applications is fully synchronized and handled by ecore. The workflow can be 100% model-based — no deeply embedded knowledge required.



Linux Core

<25 ms <1 kHz

Web server, REST API, parameter manager, logging, updates

RTOS Cores

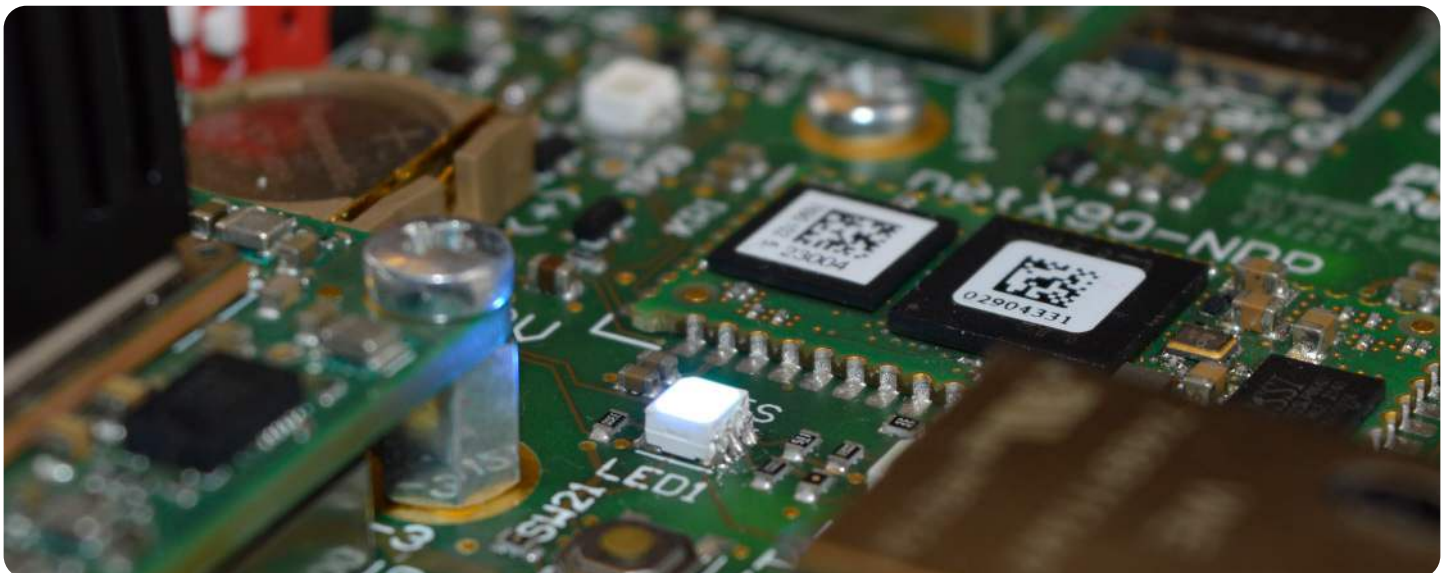
<5 μs 10 kHz

Hard real-time control loops, synchronized inter-core comms

FPGA

<1 μs 640 kHz

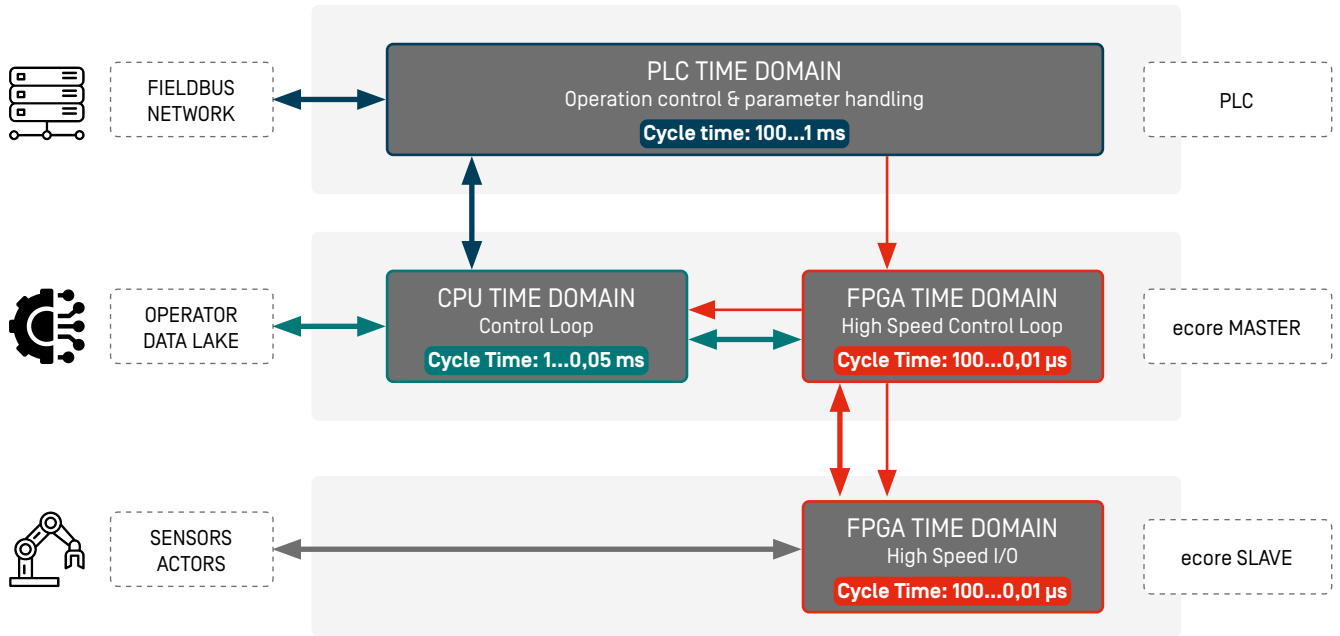
High-speed control, custom IP cores, sensor I/O



TIME DOMAINS

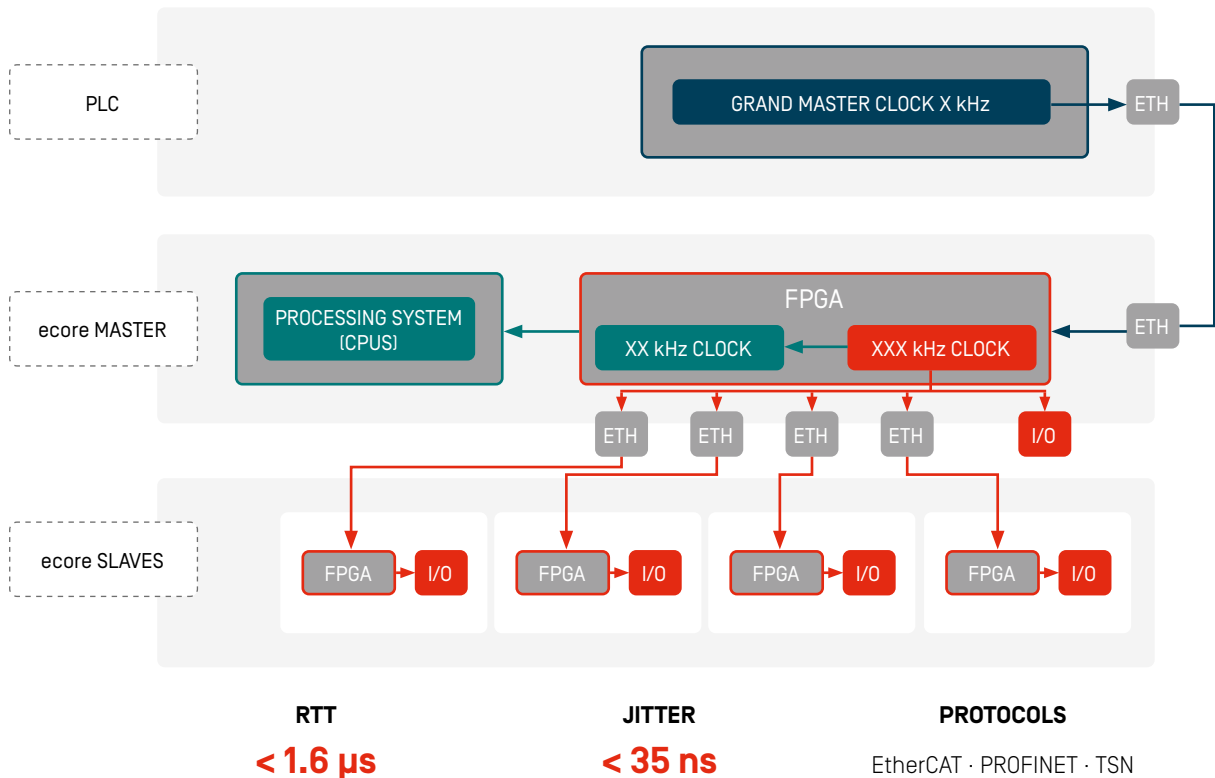
Data & Clock Synchronization

Control applications run within the CPU Time Domain or the FPGA Time Domain. Synchronized data exchange between CPU and FPGA, CPU and PLC, and Master and Slave is handled by ecore.



SYNCHRONIZATION ARCHITECTURE & TIME DOMAINS

The Master-Slave interface can be parallelized with extremely low jitter and round-trip-time (RTT). All blocks can be synchronized to a grand master clock.



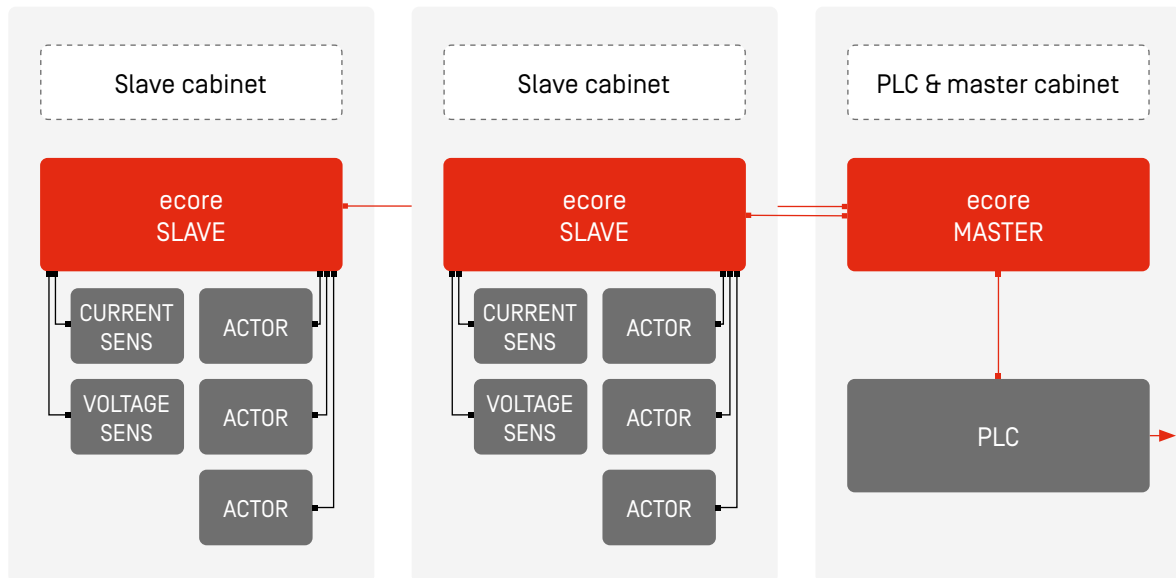
DISTRIBUTED SYSTEM

Master-Slave Architecture



ecore scales to distributed systems through a Master-Slave architecture. The slave acts as the sensor/actor interface and can be placed close to the periphery — reducing cable lengths and EMC exposure for sensitive measurement signals.

SIMPLIFIED SETUP WITH AN ecore MASTER AND TWO ecore SLAVES



- CAT6a cabling Shielded: Copper between Master and each Slave
- Up to 32 slaves: Per Master controller
- I/O examples: Gate drivers, current/voltage sensors, actuators
- Deterministic: Round-trip time <math>< 1.6 \mu\text{s}</math> · jitter <math>< 35 \text{ ns}</math>

WHERE THIS MATTERS

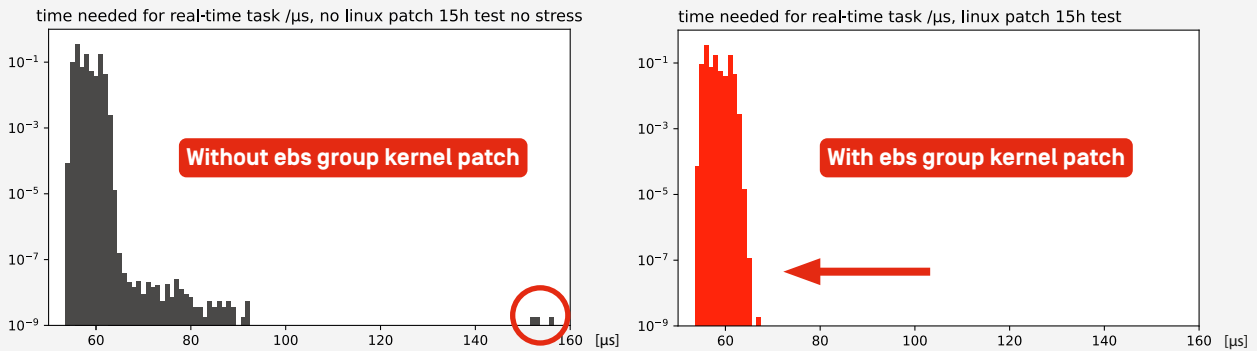
Multi-level inverters with distributed gate drivers Sensor fusion across large machines

Modular test rigs MV-converter cascades Star-connected motor drives

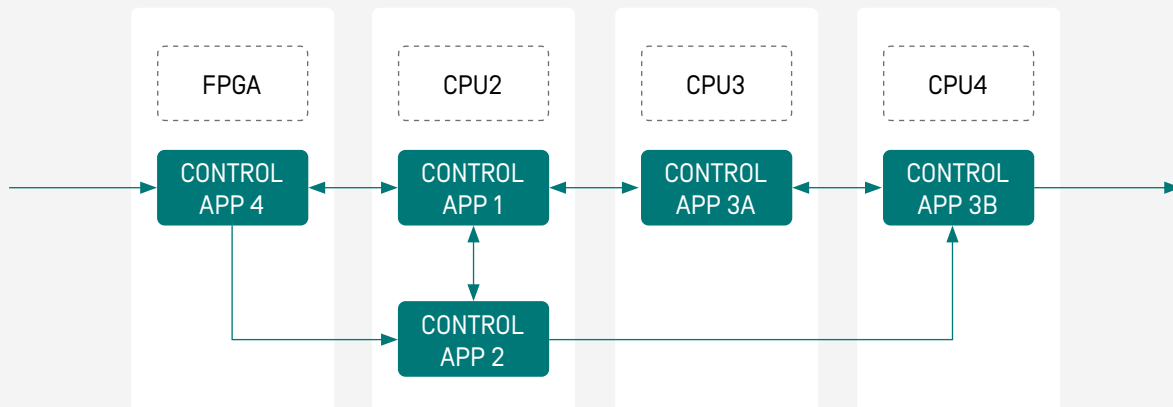
PERFORMANCE

10 kHz stable – proven

The ecore kernel patch — specially developed for the AMD® Zynq® UltraScale+™ — guarantees stable 10 kHz inter-core communication between the real-time cores. Verified using a complex industrial Simulink® control algorithm. With less complex algorithms, even higher sampling rates are achievable.



Example: synchronized control apps distributed across FPGA and three CPU cores.



USER CONTROL APPS CAN

- ...be developed 100% model based,
- ...be freely distributed over FPGA and the CPU cores,
- ...communicate to each other,
- ... run at user-defined cycle times and priorities,
- ... use system in- and outputs,
- ... easily be debugged, parametrized and monitored.

USPs

01

First integration of RTOS, Linux & FPGA

Configurable channels,
A/B updates,
hard real-time.

02

Simulink® Target for RTOS and FPGA

No VITIS® setup;
native blockset;
External Mode.

03

Full SW & HW flexibility

Source-controlled
by ebs group;
custom extensions.

SOFTWARE STACK

Feature highlights

A complete software stack — built for industrial use, ready for integration. Exemplary features of the ecore Software Reference Architecture are described below:



Web & IoT

Web server and REST API. Touch-optimized web interface for system info and configuration. Cloud/IoT-ready.



Remote SW Update

Remote-controllable A/B update mechanism for Master and Slave. Signing, encryption, automatic rollback on error.



Configurable Watchdog

HW/SW watchdog for real-time cores and Linux. Reset reason logged for forensic analysis.



Secure Boot

Optimal protection against compromised software. Trusted boot chain from ROM through application.



Centralized Logging

Syslog-based logging across all ARM® cores. Extendable with configurable event messages and severity levels.



Simulink® Target

In-house blockset for the real-time cores. Full Simulink® integration — no VITIS® required. External Mode supported.



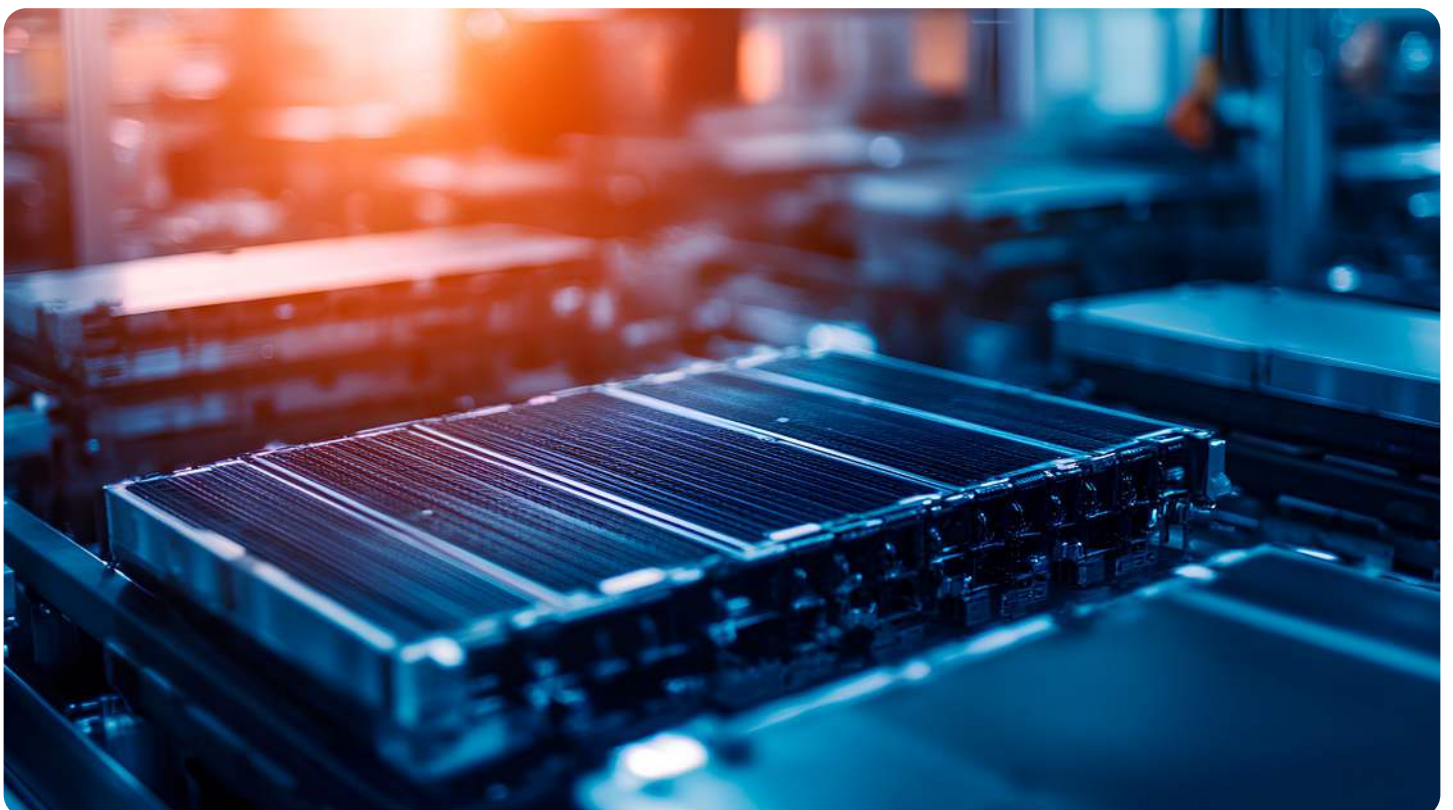
Parameter Manager

Centralized parameter management in Linux. Editable via web interface or primary controller. Persistent SD storage.



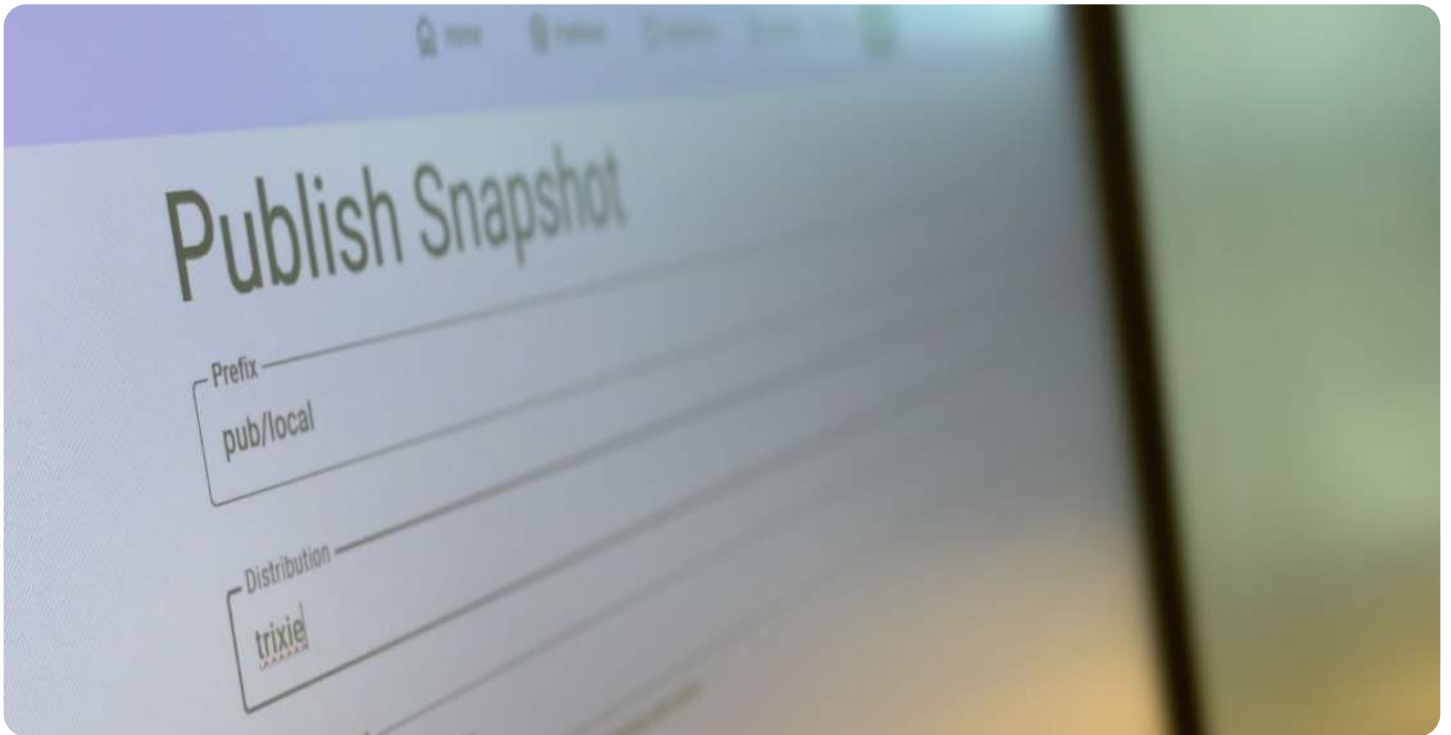
Compatibility

Runs on all AMD® Zynq® UltraScale+™ MPSoC, variants including AMD® Kria™ boards. SoM-flexible.



ELKE & TRILOG

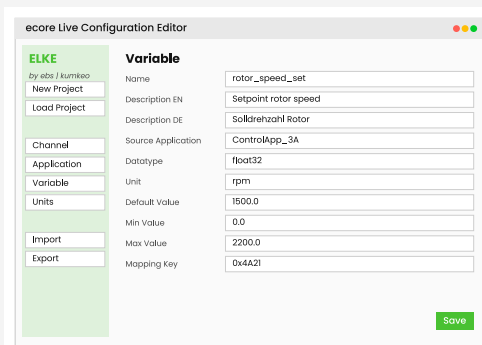
Two first-party tools close the loop between configuration and field data — both proven in industrial deployments.



ELKE

ecore Live Configuration Editor

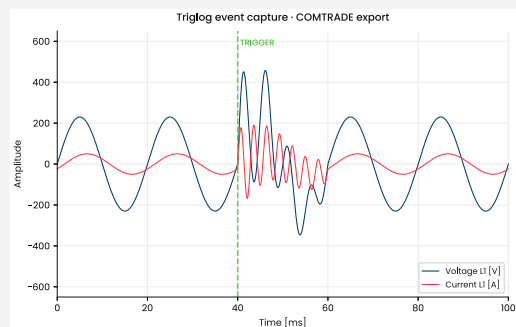
- Automated config — no manual file editing
- Reproducible configs across projects
- Faster project starts, fewer setup errors
- Cross-platform — Windows and Linux
- Field-tested with real users



TRIGLOG

Event-driven Data Acquisition

- 10 kHz sampling, no data loss
- Intelligent, event-driven triggering
- Direct COMTRADE export (IEEE standard)
- Multiple export formats
- Continuous real-time, no interruption



HARDWARE

ecore Master Controller v1

The ecore Master Controller is the production-ready hardware platform — usable as development board, test-bench controller, prototype, or in series production.

An AMD® Zynq® UltraScale+™ ZU9EG delivers the processing power, while three Gigabit Ethernet ports and eight expansion slots keep the system flexible for evolving requirements. Housed in a passively cooled industrial enclosure, it runs reliably without moving parts.

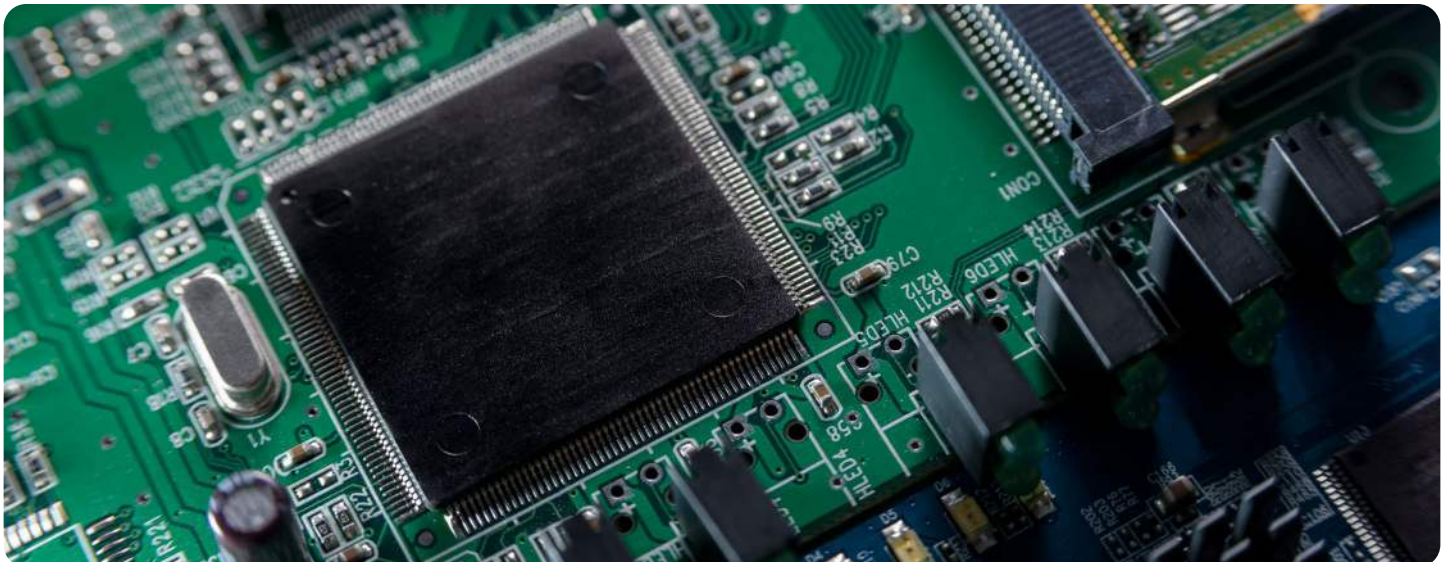


TECHNICAL SPECIFICATIONS

SoC	AMD® Zynq® UltraScale+™ ZU9EG
Memory	SD Card + eMMC
Power supply	24 V DC / 2 A
Network	3× Gigabit Ethernet, TSN-ready
Cooling	Passive (heatsink)
Temperature	Industrial range
Expansion	8× expansion slots
Mounting	DIN rail / cabinet mount

EXPANSIONS

- SIMULINK® Target
- Real-Time Tracing
- PLL Sync
- Soft PLC
- Single GbE Copper
- Single GbE Optical
- Quad GbE Copper
- BiSS/EnDat Encoder



Main products & expansion cards



ecore Software Reference Architecture

#4260629980169

Starter-Kit complete

Software Reference Architecture, Linux distribution, Simulink® Target, ELKE configurator, Triglog data acquisition. Runs on all AMD® Zynq® UltraScale+™ MPSoCs.



ecore Master Controller V1

#4260629980152

Hardware platform

Industrial-grade housing, 8× expansion slots, AMD® Zynq® UltraScale+™ ZU9EG SoC, passive cooling.



ecore Slave Controller V1

#4260629980176

Slave node

Distributed I/O interface, FPGA-driven, deterministic Master synchronization, sensor/actor periphery.



ecore Evaluation Board V1

#4260629980183

Evaluation platform

Trenz Electronic SoM-compatible carrier (TE-0820/0821), Hilscher netX 90 co-processor, full peripheral access.

AVAILABLE EXPANSION CARDS



Single GbE Copper

RJ45 · 1 Gbit · TSN-capable acquisition



Quad GbE Copper

4x RJ45 · 1 Gbit



Single GbE Optical

SFP · 1 Gbit · long-range



BiSS / EnDat Encoder

Encoder interface

APPLICATIONS

Where ecore performs

ecore is the perfect solution for applications, that where real-time performance, high availability and fast development cycles are important.



Frequency Inverter



Multi-Level Inverter



Robot Control



Automated Test Rigs



Sensor Data Fusion



High-End Measurement



Signal & Logic Analyzers



Autonomous Systems



LiDAR / RADAR / SONAR

Why ecore?

→ **Time-to-Market**

60,000 hours invested.
Be up to 3 years ahead.

→ **Costs Down — Sales Up**

No expensive HiL or licenses. Development, prototyping, in-loop tests in one system.

→ **Both Worlds in Parallel**

Hypervisor isolates Linux from real-time cores.
Hypervisor Latency <3 μs.

→ **Industrial Hardware Available**

Use as dev platform, in test benches, prototypes, batch production.

→ **Focus on What's Yours**

You build the application, we maintain the framework.

→ **Field-Proven**

ecore hardware and software is in series use today.



ecore Software Reference Architecture.
Real-time control, made simple.

Have questions? We're happy to provide more information.
Visit ebs-group.io/ecore or send us an email –
our ecore team is ready to discuss your project.

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