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Industrial Grade Linux With ISAR - Lessons Learned

Julian M. Schwing – 09.12.2025

Introduction Speaker

Julian M. Schwing

- Technical Account Manager at Ingenics Digital, focusing on Embedded Software & connectivity

- Background in Business Information Systems with specialization in Big Data & distributed systems

- Bridges customer requirements into the ISAR ecosystem from ongoing Linux projects

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Setting the Stage

Integrating ISAR in heterougenes customer projects apart from corporates and their respective needs

- First embedded Linux project almost 25 years ago

- 200 Developers

- 34 Research cooperations

- Supporting from Sensor to Cloud

Real-World Scenario
## Maritime Fuel Cell Telemetry Project

Requirements & Operational Constraints
- 6 fuel-cell modules per device
- 6.000 telemetry signals per second
- Long offline phases
- 10 – 15 years lifecycle
- Customer-centric maintainability
- Hardware-token service mode

Hardware & Platform Context
- Compute: TQ i.MX8
- Additional controllers (fuel-cell MCUs), connected via CAN
- Communication CAN-FD & TCP
- PKI with HSM-secured signing keys
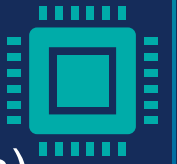
Security & Update Foundation
- Secure Boot (Dm-verity rootfs integrity)
- Secure Update (LIUF, custom implementation)
- Signed, OTA-ready update containers for SOC and connected MCUs
- Offline-resilient updates
- SBOM & vulnerability scanning (CRA-ready)

Why ISAR

Challenge

- Maintenance Overhead

- Partner & Developer Onboarding

- Harsh Environment

Yocto

customizable

ISAR

updatable

Debian

Benefits

- Reproducible builds
- Better maintainability (customer-friendly)
- Secure Boot & OTA foundation
- Robust for inter-mittent connectivity

How we integrated it
Secure Boot + CI/CD + OTA

ISAR + Platform Integration

- ISAR-based build layers
- Device Tree + Kernel integration (TQ i.MX8)
- i.MX8 specific bootcontainer
- Secure Boot
- dm-verity rootfs protection

CI/CD Pipeline

- Automated build + signing pipeline (Azure DevOps)
- Automatic SBOM generation
- One-click release via Easy Release Automation (ERA) → Open Source by us

OTA & Field Deployment

- A/B updates integrated into platform
- Robust OTA under limited connectivity (harbor-only sync)
- Fallback & rollback mechanisms
- Secure update via LIUF (custom implementation)

Lessons Learned

Open vs. Closed Source
- Open Source outlives patents
- Open Source ERA vs. proprietary LIUF

Cost & DevOps Optimization
- Azure pricing: optimize VM runtime
- Reduced number of repos lower maintenance costs
- Plan & optimize release workflows for the future

Collaboration & Communication
- Detailed data-flow diagrams improved alignment
- Clear technical understanding on customers side matters!

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Q & A

Thanks for your time.

Do you have any Questions?

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