MACHINEWARE

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2023 DESIGN AND VERIFICATION™ DVCON CONFERENCE AND EXHIBITION EUROPE 10 YEAR ANNIVERSARY

Virtual ECUs with QEMU and SystemC TLM-2.0

Lukas Jünger[1], Jan Henrik Weinstock[1], Munish Jassi[2], Megumi Yoshinaga[3], Hitoshi Hamio[3], Koichi Sato[3]

[1]MachineWare GmbH, Aachen, Germany

[2]Renesas Electronics Europe GmbH, Düsseldorf, Germany

[3]Renesas Electronics Corporation, Tokyo, Japan

accellera SYSTEMS INITIATIVE

CARSCOOPS

RECALL

Mercedes Recalls EQS And EQE EVs For Software Bug That Could Cause Sudden Power Loss

Mercedes must recall 8,281 EQ models as a result of a software glitch that has led two vehicles to lost propulsion in the U.S.

The Verge / Tech / Reviews / Science / Entertainment /

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VW's first mass-market EV suffers delay thanks to software struggles / Versions of the ID 3 will now ship in September with unfinished software

electrek

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TESLA

Tesla gets hacked – winning the hackers $100,000 and a Model 3

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> Recalls

24 Porsche Cayenne Recalled in the United States Due to Software Error

d: 16 Aug 2023, 16:01 UTC • By: Mircea Panait

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VW Group CEO Admits Audi Lags Behind Rivals, Software Issues To Blame

The automaker wants to speed up EV development.

Automotive News Europe

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May 11, 2023 09:15 AM

Volvo, Polestar delay flagship electric SUVs on software issues

Volvo CEO Jim Rowan blames "lumps and bumps" associated with rigorous testing of "mission critical software."

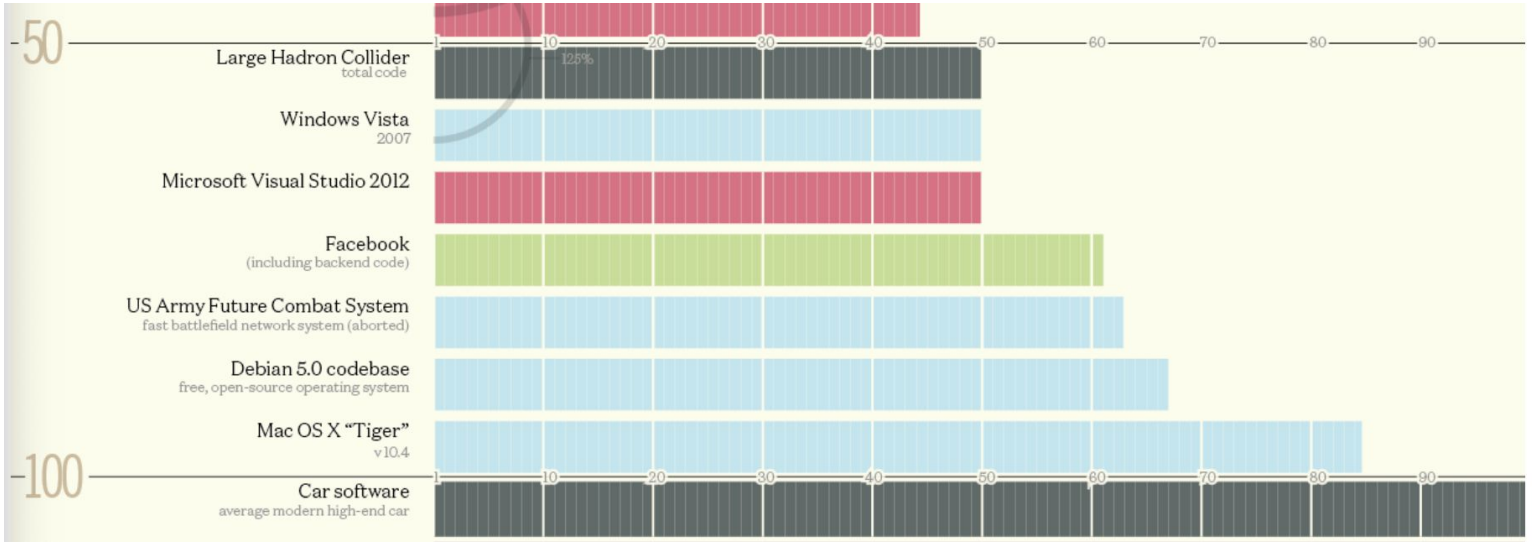
Reuters

SYSTEMS INITIATIVE

10 YEAR ANNIVERSARY

Motivation

- SW complexity is rising
  - Car: >100 Mio. lines of code
- Security & safety critical
- Quality is key

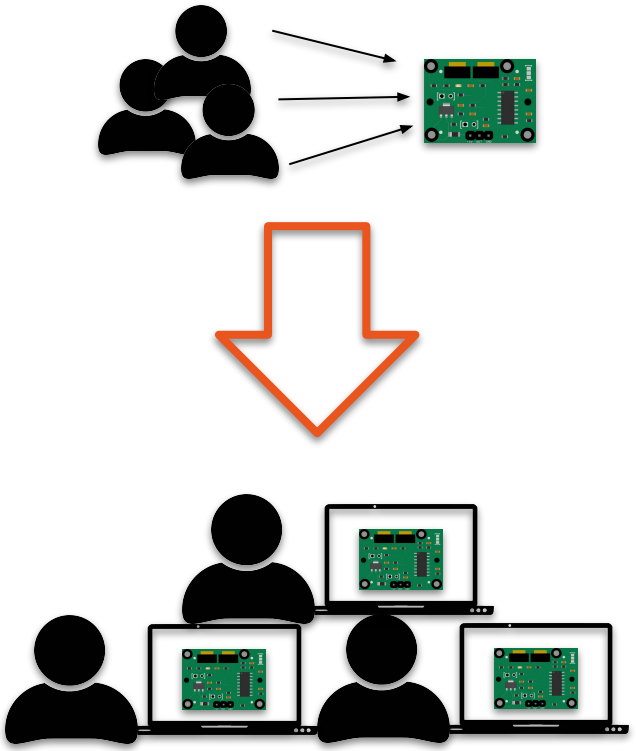


https://informationisbeautiful.net/visualizations/million-lines-of-code/

- Bad software is dangerous and expensive
  - Accidents, recalls, liability for hacks, maintenance
- Problem: Testing is
  - Hard to automate, hard to scale, limited by hardware resources

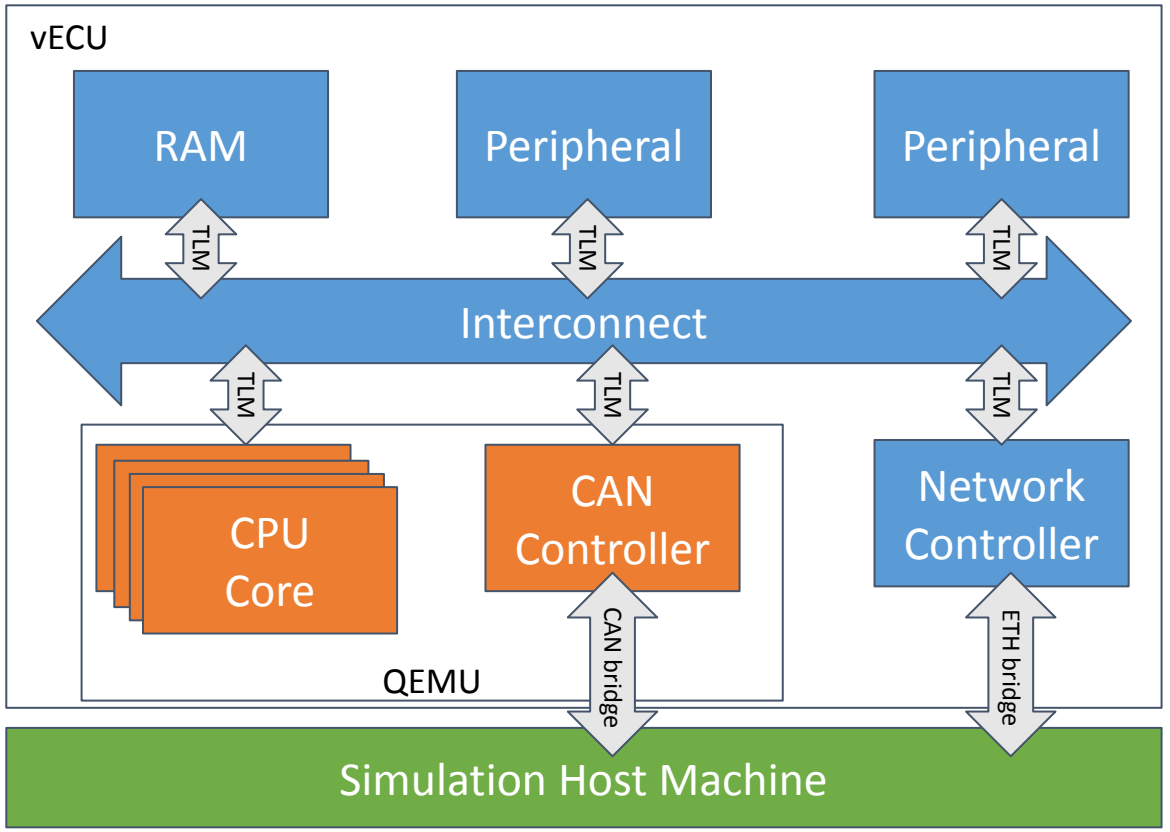
Virtual Platform / Level 4 vECU

- Virtual Platform: Full System Simulation
- Executes unmodified target binary
- Advantages over physical prototypes
  - Available earlier (shift-left methodology)
  - Full flexibility, deep introspection
  - Non-intrusive debug
  - Near endlessly scalable



vECU Architecture

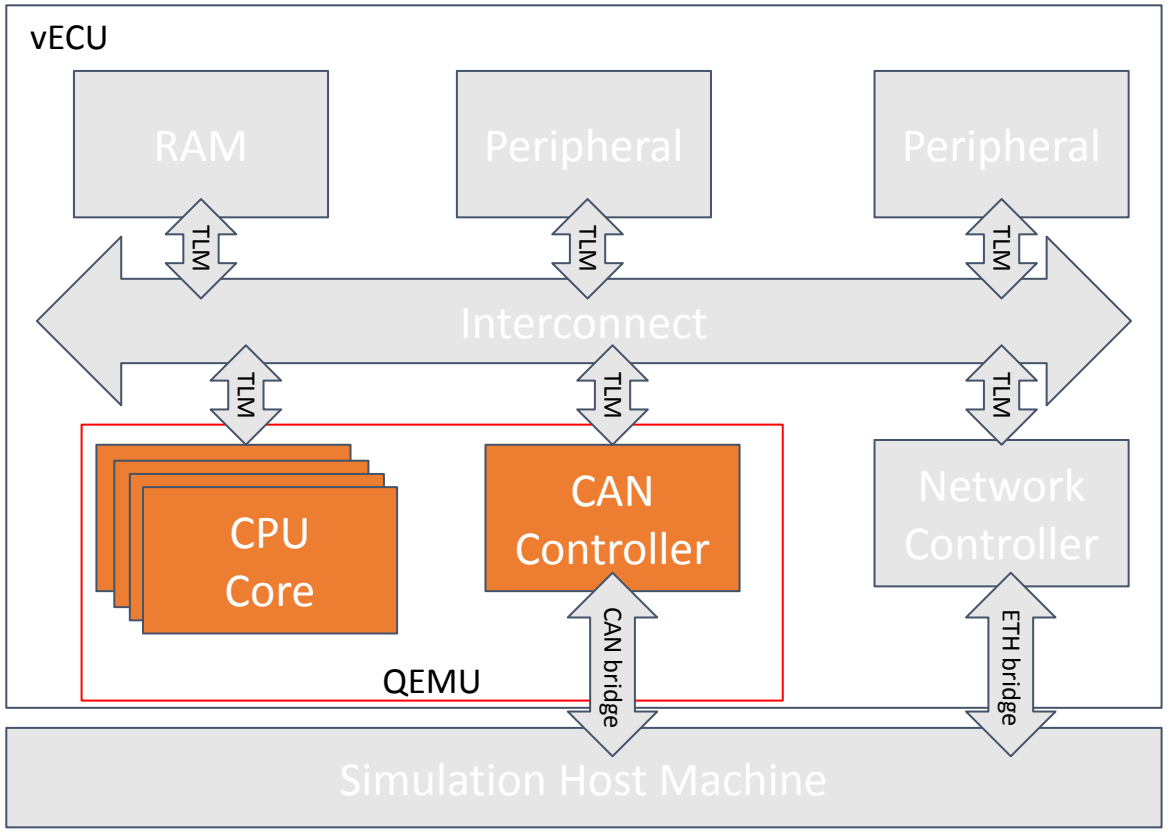
- Goal: Fast VP for SW verification
- QEMU + SystemC co-simulation
- QEMU for fast CPU subsystem
- SystemC TLM-2.0 peripherals for maximum reuse (VCML-based)
- Host network integration



QEMU

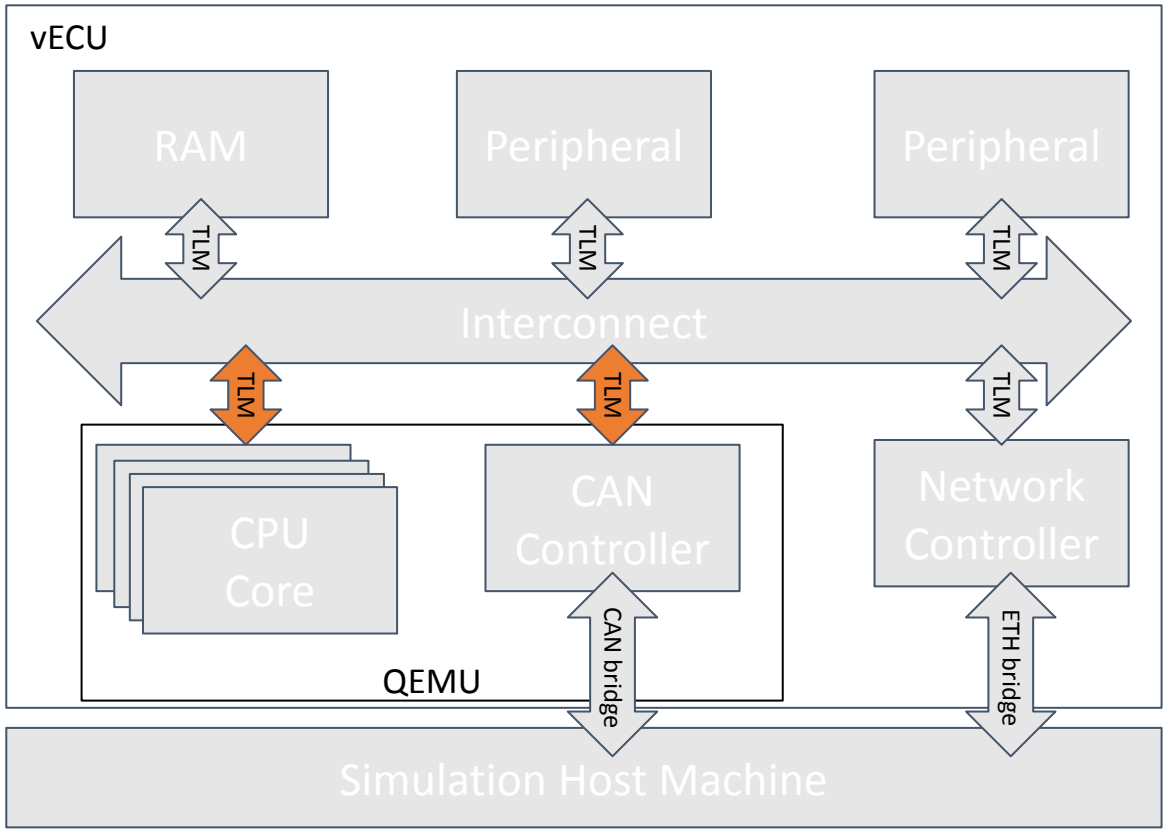
- Open-Source Full System

  (Sim-)/(Em-)ulator and Virtualization tool
- Fast'ish CPU and many peripheral models
- GPLv2 license
- Monolithic architecture
  - No standard interfaces, global memory view, …
- Written in C :(



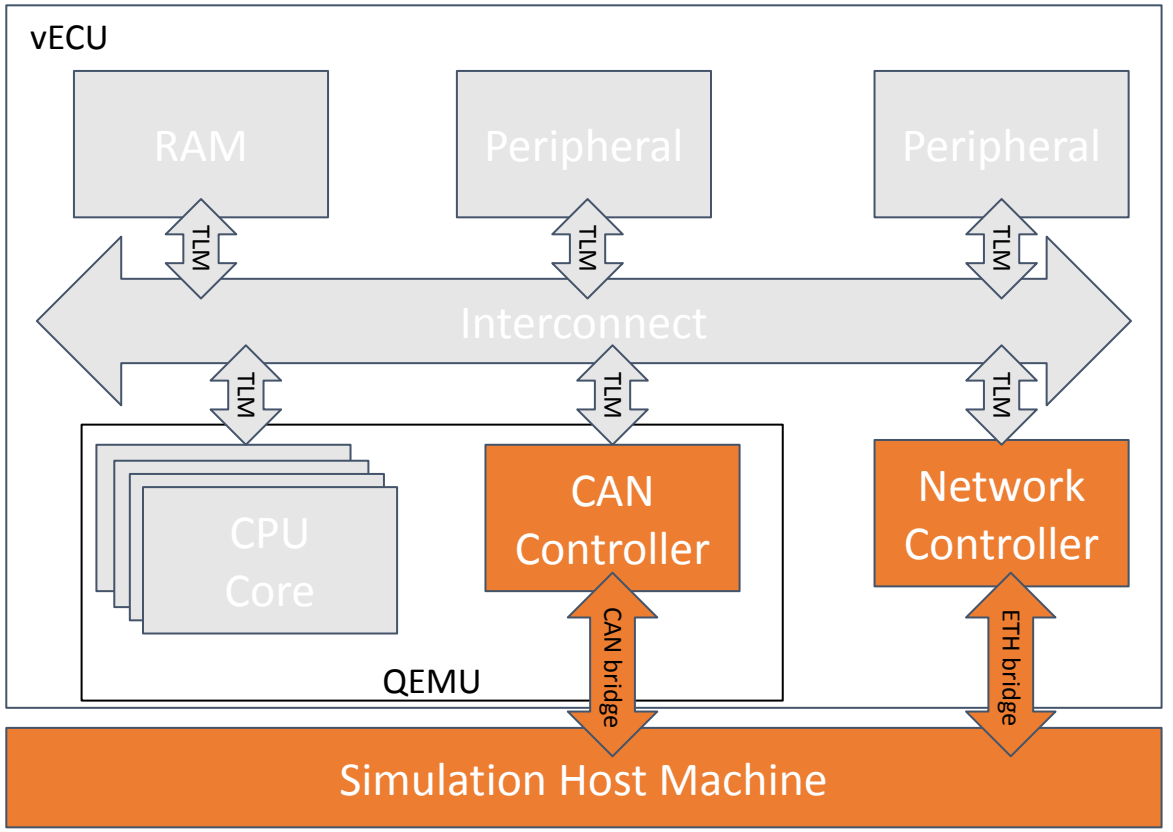
QEMU SystemC Integration

- QEMU in a SystemC Box
- QEMU + SystemC Co-Simulation
- Modularize QEMU models for reuse in Virtual Platform
- Add standard TLM-2.0 interfaces
- Integrates in MW VCML

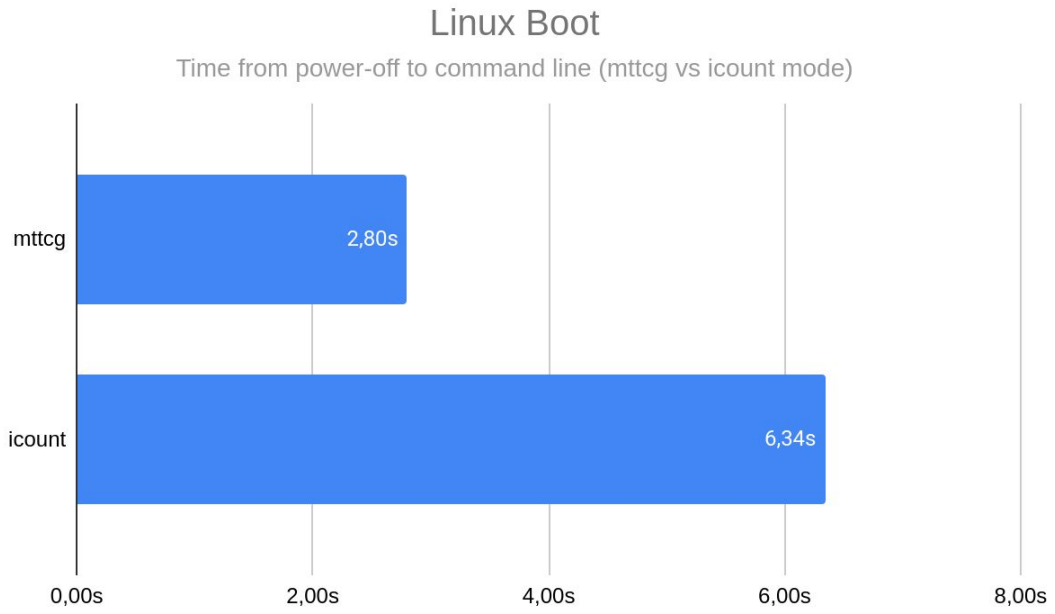


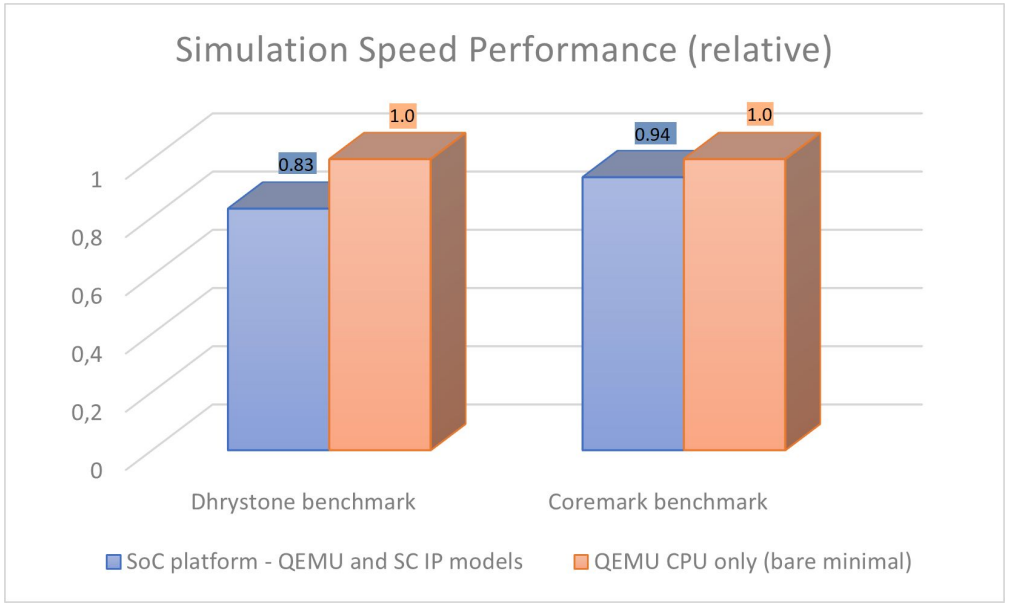
External Communication Interfaces

- Send / Receive data from host
- Integrate with Linux SocketCAN
  - Attach physical CAN device, restbus simulation, …
- Integrate with SLiRP, TAP devices
  - Access host network
- Open-Source bridges from VCML



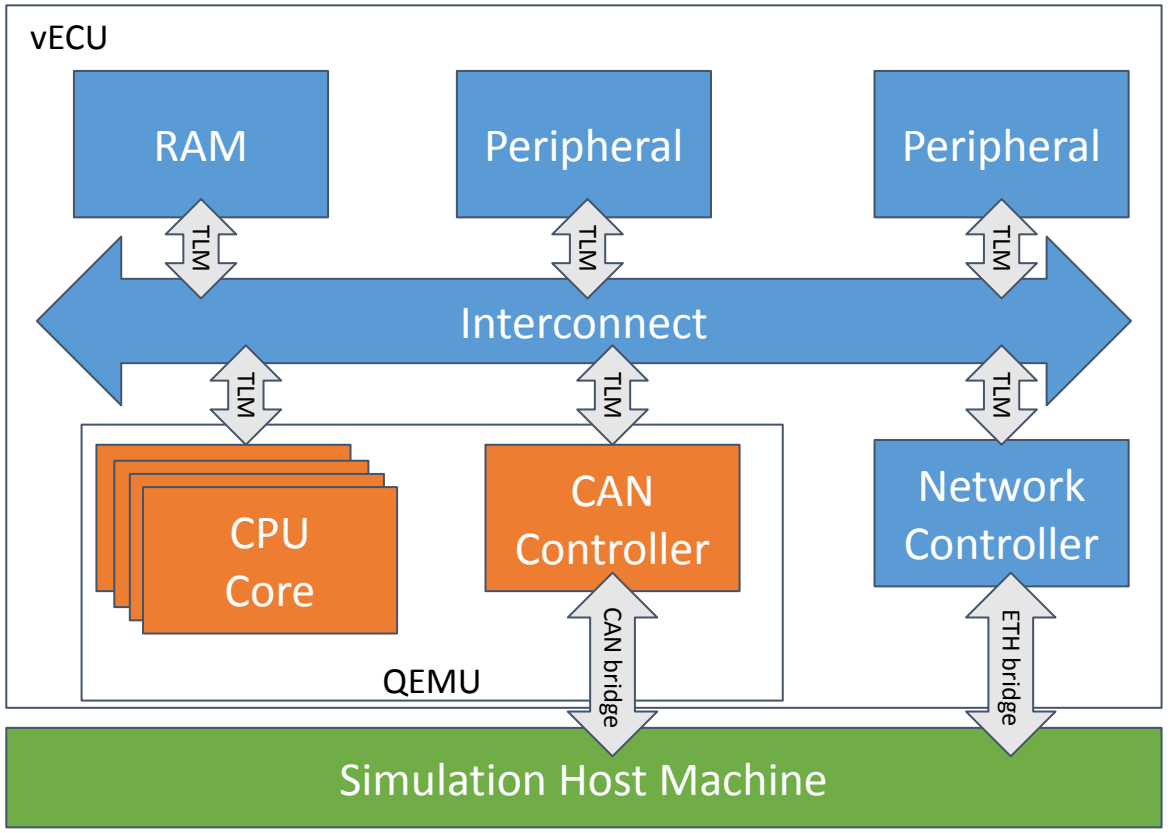
Benchmark Results





Open-Source / Free Software

- Disclaimer: I am not a lawyer and this is not legal advice
- QEMU is (mostly considered) GPLv2 license
  - Free as in freedom, not free of charge
- GPLv2 license requires source code access for SW user on request
- User can publish, modify, copy, redistribute program under GPLv2
- GPLv2 is infectious -> simulator must be GPLv2 compatible

Summary

- QEMU CPU models deliver decent performance
- QEMU - SystemC integration is a challenge
- VCML enables modularization of SystemC and QEMU models
- License needs to be considered