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Solving vendor lock-in in VME Single Board Computers through open-sourcing of the PCIe-VME64x bridge



10 October 2017

Outline

- What is the VME standard?
- What happened in 2015?
- Open-source VME bridge
- Conclusions

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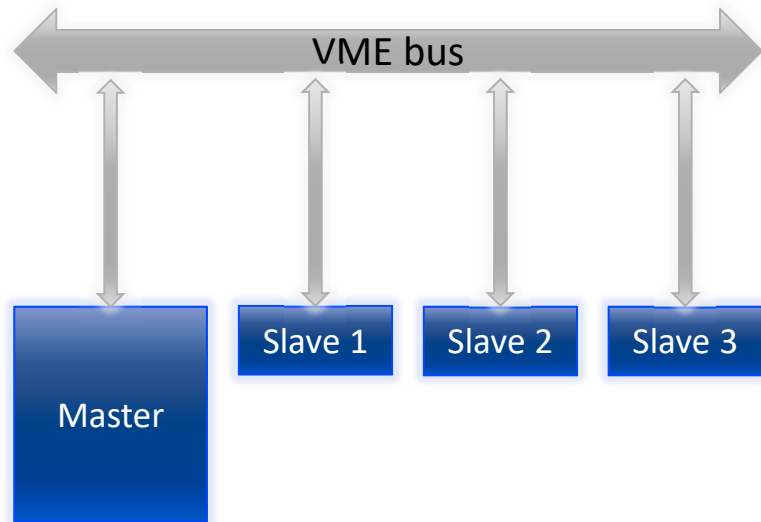
What is a VME standard

- Modular electronics from 1980s
- Master – Slave architecture
- Shared parallel bus
- Maximum rate 80MB/s



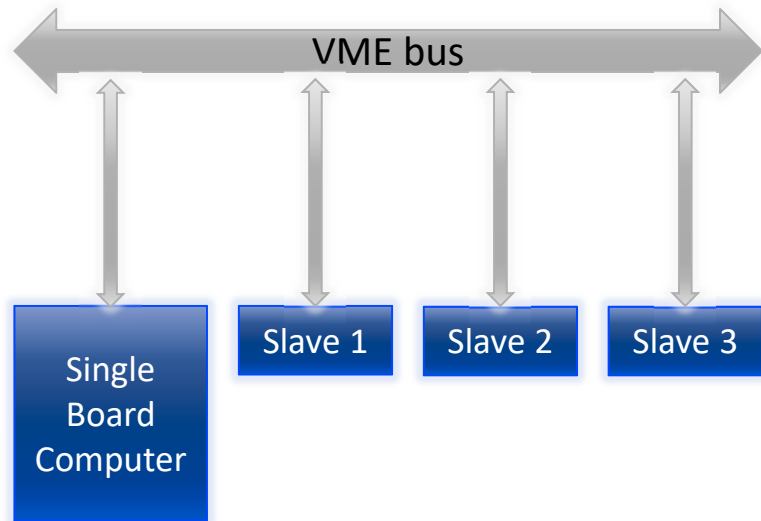
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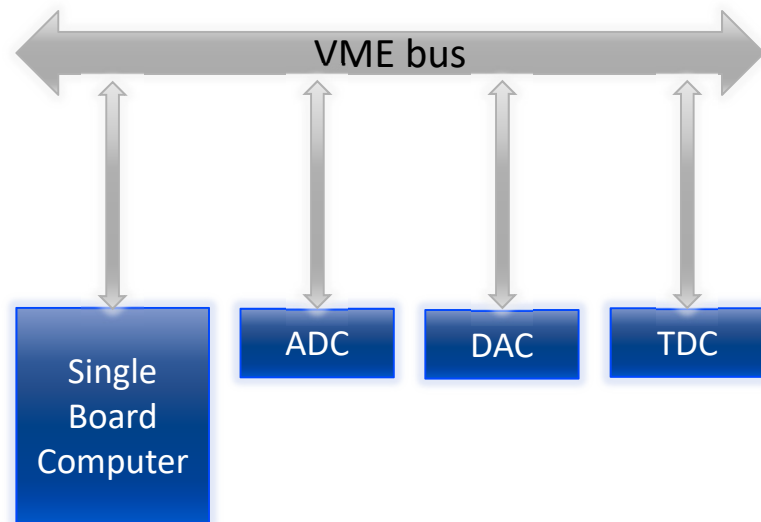
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What is a VME standard

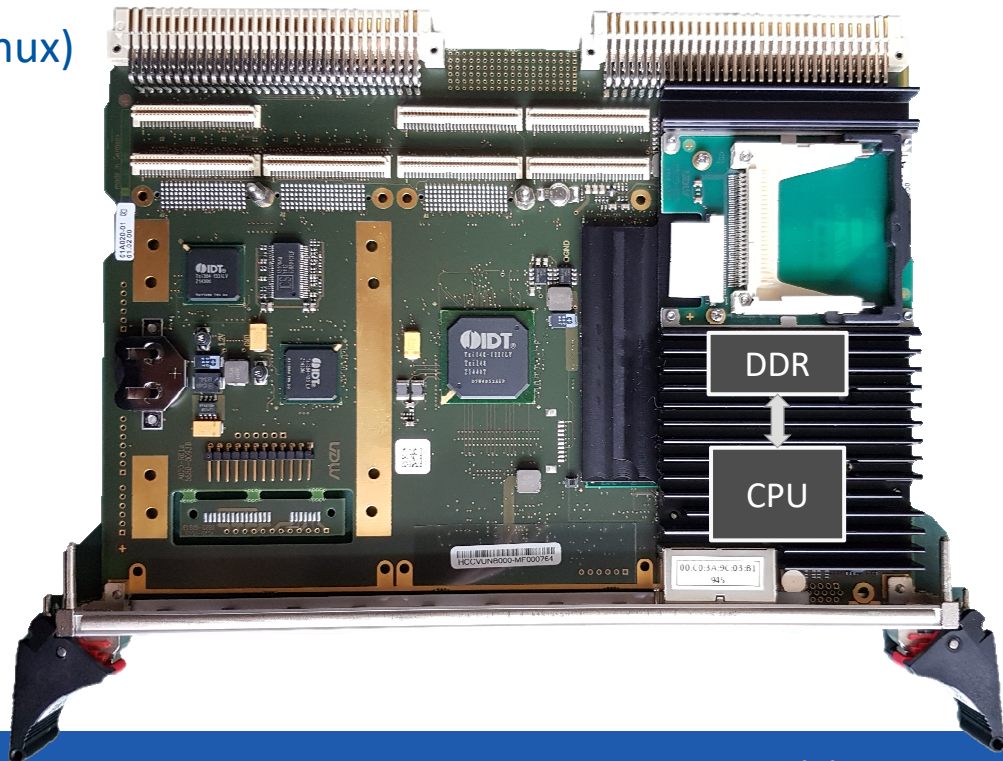
- Modular electronics from 1980s
- Master – Slave architecture
- Shared parallel bus
- Maximum rate 80MB/s
- Still widely used in research and military
- 900 VME crates in CERN accelerators
- 200 new crates to be deployed in 2019-2020



VME Single Board Computer

PC running an operating system (e.g. Linux)

- x86 / PowerPC processor
- DDR memory
- USB, Ethernet interfaces



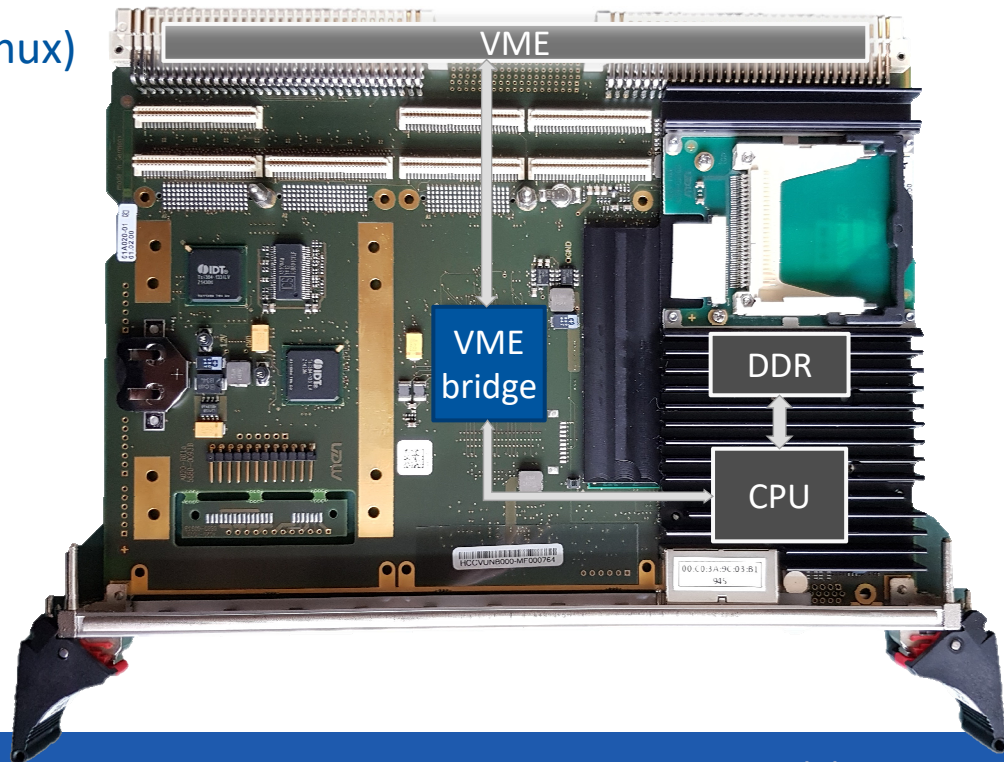
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Expanded with

- VME connector
- PCI/PCIe-to-VME bridge



Why is VME still alive?



Why is VME still alive?

- Already existing investment
- Long lifetime of electronics
- Custom designs for critical systems
- Sufficient performance



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IDT TSI148 story

- TSI148 is a PCI to VME bridge
 - was the de-facto standard found in many SBCs
 - including MEN A20 deployed widely at CERN
 - until IDT decided to discontinue it mid-2015
-
- SBCs used at CERN could not be produced anymore
 - and we continue getting requests from CERN users



CERN's call for tender

Possible options:

1. Secure enough stock of TSI 148 chips
2. Use Tundra Universe II
3. Implement an open-source FPGA bridge

The cheapest offer:



CERN's call for tender

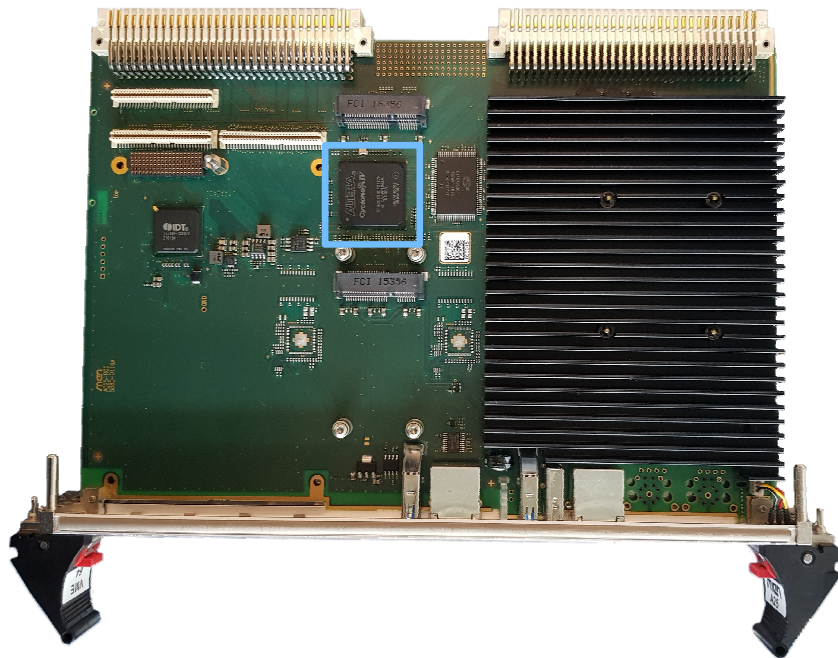
Possible options:

1. Secure enough stock of TSI 148 chips
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The cheapest offer: MEN A25



MEN A25 Single Board Computer



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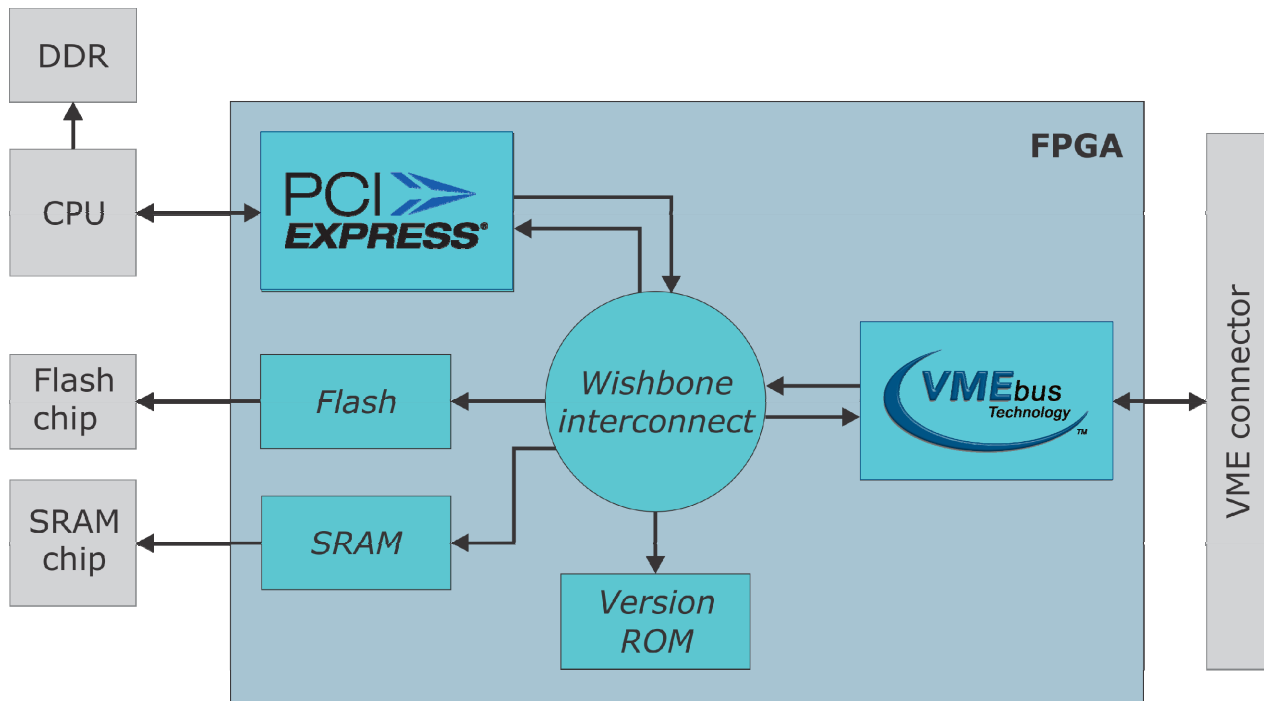
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- **Open-source VME bridge**
- Conclusions



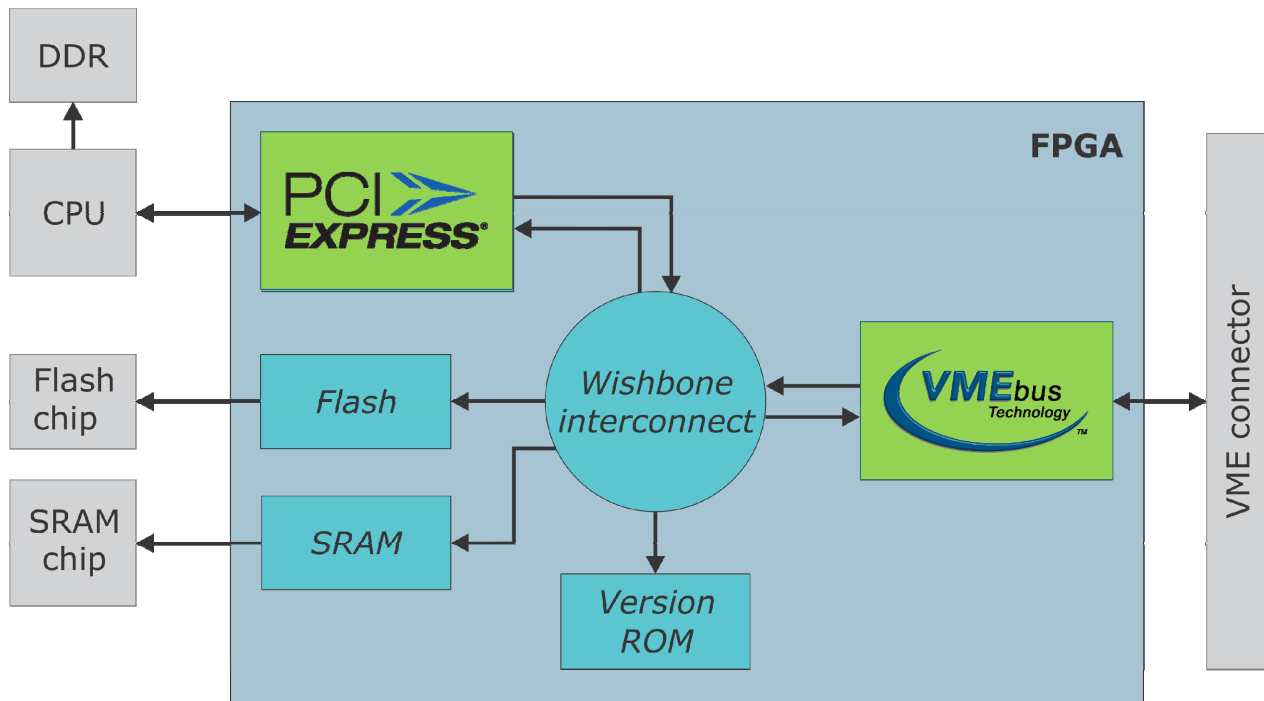
Bridge characteristics

- 30% of Intel Cyclone IV FPGA resources
- Supports:
 - VME single cycles
 - VME block transfers (DMA)
 - Geographical addressing
 - CR/CSR configuration space
- Does not support:
 - VME extensions for fast transfers (2eVME, 2eSST)

FPGA-based implementation



FPGA-based implementation



Bridge sources

VHDL published under GPL3-or-later license:

- Full VHDL sources of the design
- Set of VHDL testbenches

Software package published under GPL2-or-later license:

- Linux kernel drivers
- FPGA loader tool



Conclusions

- VME is still alive
 - Open-source VME bridge for new CERN deployments
 - Solves VME bridging problem for everyone
 - ... and forever
 - Anyone can produce a compatible SBC
 - Anyone can add new features
- Let's build a community around it!
<https://www.ohwr.org/projects/pcie-vme-bridge>