Fabric Machine: Accelerating Hyperledger Fabric Using FPGAs

Xilinx Research Labs, Singapore and USA

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Xilinx at a Glance

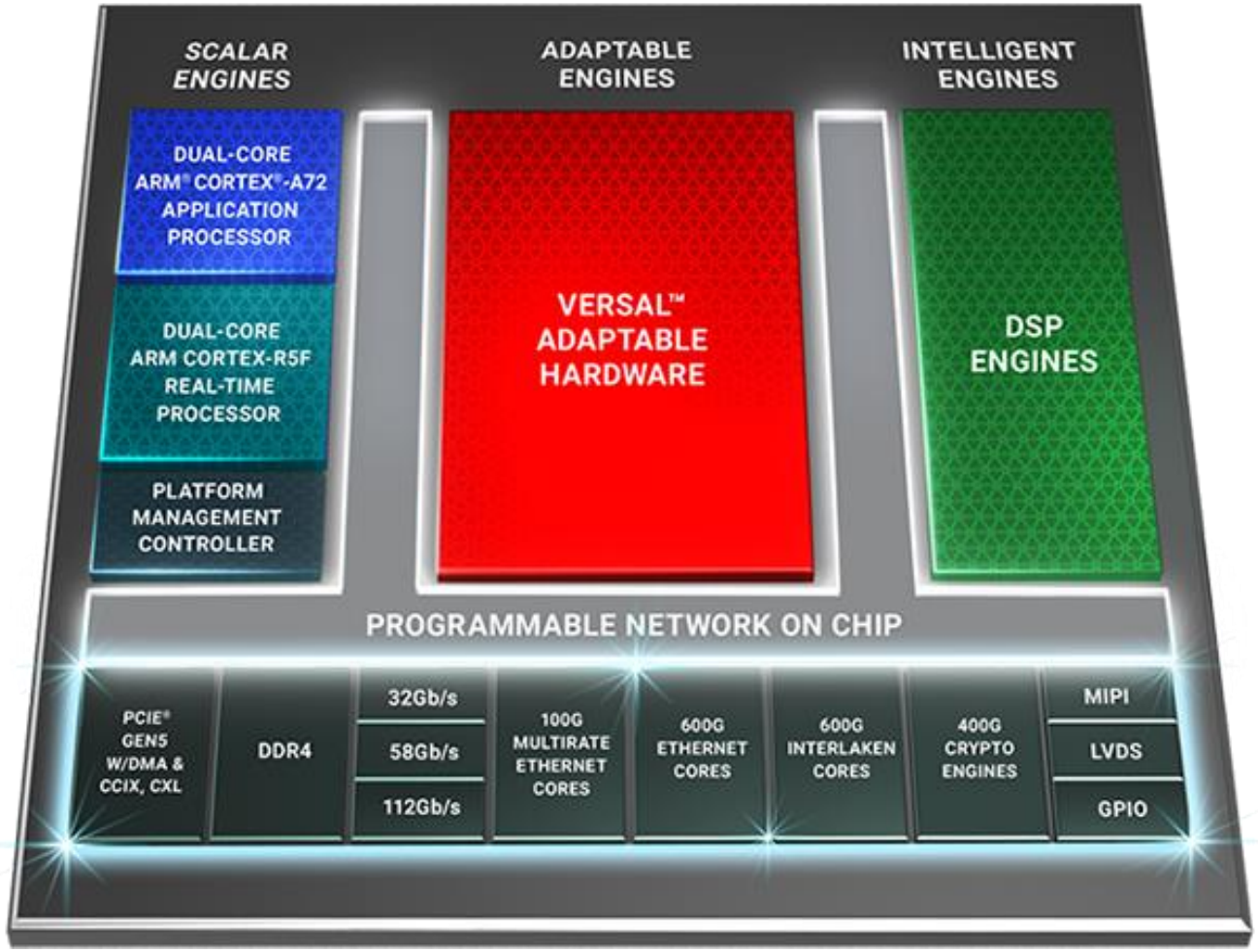
- Inventor of the FPGA (Field Programmable Gate Array)
- Now pioneering the ACAP (Adaptive Compute Acceleration Platform)
- Over 4,000 patents held

- Founded: 1984; Public: 1990; NASDAQ: XLNX

- Corporate headquarters in San Jose, USA
- Regional headquarters in Ireland and Singapore

- Around 4,900 employees worldwide
- More than 20,000 customers worldwide

Xilinx Programmable Acceleration Platform



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Acceleration Opportunities for Hyperledger

PROJECTED IMPACT

Compared to software-only

Transaction confirmation time:

- Reduced by 10x
- Predictable

Peer-to-peer network size:

- Increased by 10x
- No latency hit

Network/Protocol acceleration

PROJECTED IMPACT

Compared to software-only

Transaction rate:

- Increased by 10x
- Predictable

Transaction confirmation time:

- Reduced by 10x
- Predictable

Compute/Proof acceleration

PROJECTED IMPACT

Compared to software-only

Storage used:

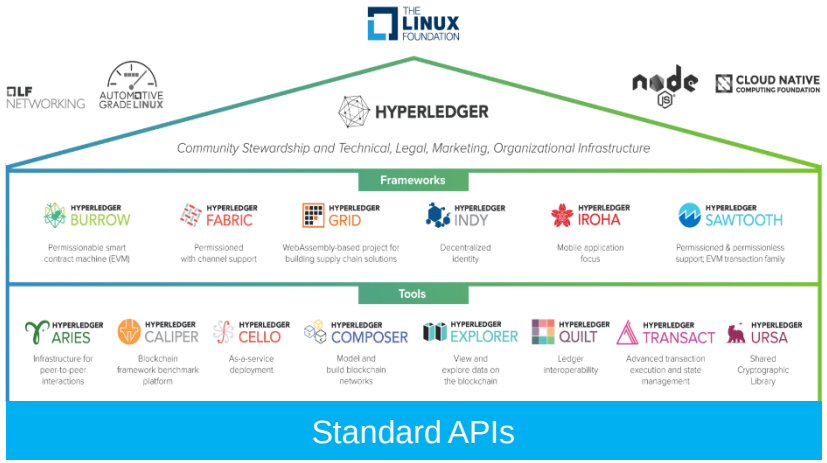
- Reduced by 10x
- No latency hit

Ledger access rate:

- Increased by 10x
- Secure

Storage/Database acceleration

Xilinx Hyperledger Concept



Xilinx Hyperledger API adapters

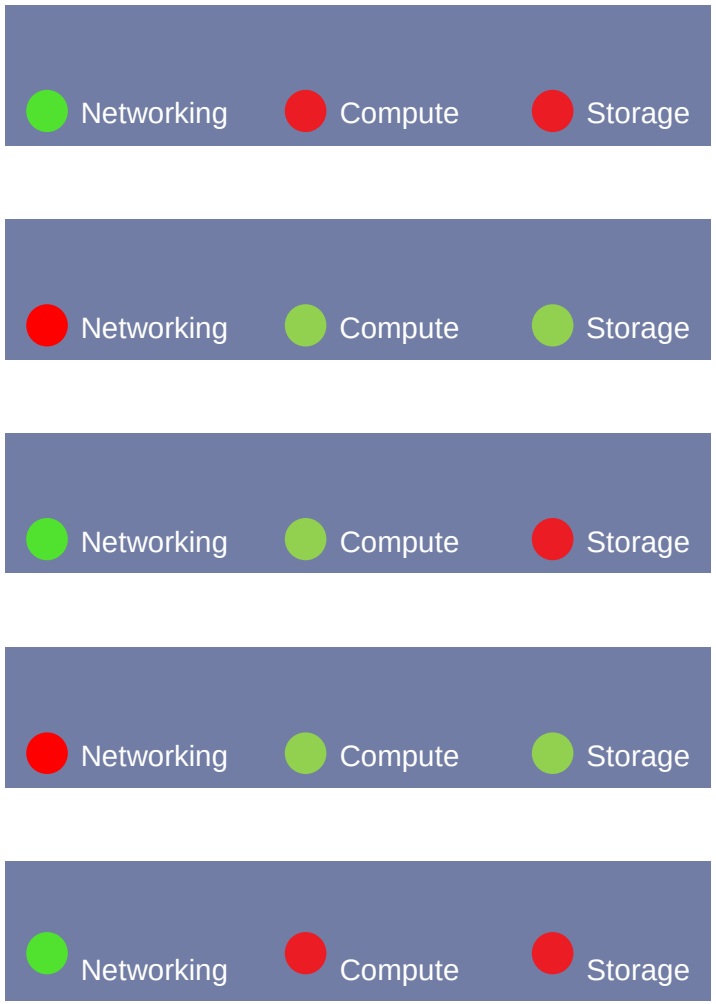
Programmability with user chaincode

Configurability with system accelerator plug-ins

Blockchain Machine overlay

Xilinx base shell overlay

Xilinx Alveo board



> Transaction steps:

1. User requests transaction
2. Transaction verified by nodes executing smart contract chaincode
3. Set of transactions formed into block agreed by nodes
4. Block added to all blockchain replicas
5. Transaction confirmed to user

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Fabric Machine: What?

- Goals
  - Build FPGA based hardware accelerators for Fabric
  - Hardware/software co-design setup
  - Improve performance metrics: transaction throughput, confirmation time, etc.

- Fabric Machine
  - Implements non-endorsing/validation-only peer (validation phase of Fabric) on network-attached Xilinx Alveo card
  - Integrated with Fabric 1.4.5

Fabric Machine: Why?

- Performance benchmarking of Fabric [1-4] points to validation phase as one of the main bottlenecks
  - Verification of many ECDSA signatures
  - Retrieving block/transaction data involves unmarshalling of many protocol buffers
  - State database accesses are typically slow

- Our solution: bottleneck operations are moved to hardware for accelerated execution
  - Block/transaction data is retrieved in hardware directly from the network interface
  - Efficient block-level and transaction-level pipeline in hardware

[1] P. Thakkar, S. Nathan, and B. Vishwanathan, “Performance Benchmarking and Optimizing Hyperledger Fabric Blockchain Platform,” in MASCOTS, 2018.
[2] C. Gorenflo, S. Lee, L. Golab, and S. Keshav, “FastFabric: Scaling Hyperledger Fabric to 20,000 Transactions per Second,” in ICBC, 2019.
[3] H. Javaid, C. Hu, G. Brebner, “Optimizing Validation Phase of Hyperledger Fabric”, in MASCOTS, 2019.
[4] G. Chung et al., “Performance Tuning and Scaling Enterprise Blockchain Applications,” in CoRR, arXiv: 1912.11456, 2019.

Fabric Machine: Current Status

- Proof of concept
  - Integrated with Caliper to run smallbank benchmark
  - Setup
    - One organization with 2 standard software peers (one endorser and one non-endorsing)
    - 1 Fabric Machine peer run on a server with standard NIC card and Xilinx Alveo-based NIC card

- 10x transaction commit throughput from Fabric Machine peer
  - When compared to standard software non-endorsing peer

Adaptable.
Intelligent.

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