XCORE®.AI

THE FAST, FLEXIBLE, ECONOMICAL CROSSOVER PROCESSOR FOR THE AIOT

A crossover processor for the artificial intelligence of things (AIoT), helping you to get to market fast, with products that stand out from the competition.

AIoT product proliferation creates an increasing demand for a flexible, performant processing core that offers short time-to-market. Demands around privacy and user-experience are pushing tasks from cloud to edge (on-device) processing and challenging the capabilities of traditional processors.

With xcore.ai, real-time inferencing, decisioning at the edge, signal processing, control and communications are wrapped up in a single chip. Product Designers no longer need to rely on a costly applications processor or a microcontroller with additional components.

xcore.ai combines AI acceleration, powerful DSP, connectivity and general-purpose compute in a low eBOM solution - ideal for developers working on smart products that enhance our everyday living.

FEATURE HIGHLIGHTS

The device has two "tiles." Each tile is a self-contained processor with 512 kByte single cycle SRAM. The tile has a scalar unit (up to 1600MIPS), a vector unit (up to 25,600 MMACS), and a floating point unit (up to 800 MFLOPS); 1 Mbyte tightly coupled SRAM, 3200 MIPS, 1600 MFLOPS, and 51,200 MMACCS across the tiles. The device has three integrated PHYs: a high-speed USB, a MIPI D-PHY receiver, and LPDDR1.

FLEXIBILITY

Supports 1.8V and 3.3V on each bank of I/O, allowing the exact mix of peripheral interfaces and connections for your system. With USB, MIPI RX and a software driven I/O structure supporting I2C, I2S, S/PDIF, SPI, UART, PWM, and many more, xcore.ai offers a single chip solution (replacing the need for multi-components).
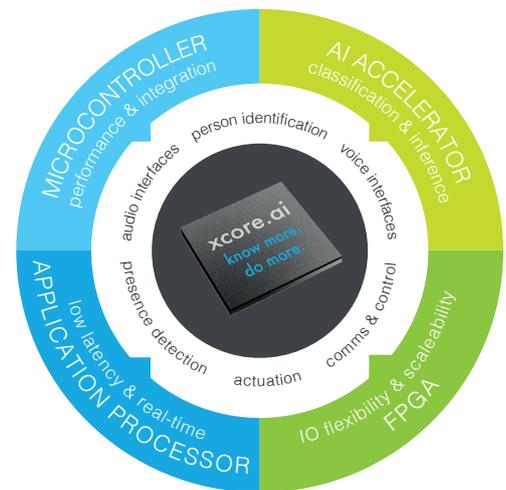
ON-DEVICE INTELLIGENCE

Convolutional (CNN) and Dense (DNN) Neural Network acceleration supports 32-bit, 16-bit, 8-bit and 1-bit vector operations. Instructions loading a vector from memory, multiplication and accumulation occur in a single clock cycle (achieving 51.2 GMACC/s peak, and 30GMACC/s sustained 8-bit vector arithmetic).

TOOL CHAIN

Industry standard tools enable accelerated applications. xcore.ai is fully programmable in C and C++, with optimised libraries for rapid prototyping and development. FreeRTOS support and deep learning framework TensorFlow-Lite ensures developers will enjoy an easy familiarity with the programming model.

COMPUTE

With up to 3200MIPS of compute, the fast and predictable xcore.ai can handle the most challenging edge-AI operations. With up to 8 FIR taps (32'bit) per clock cycle and 1 million 512 FFTs per second, it's ideal for voice, imaging and sensor processing applications.

MICROCONTROLLER — performance & integration
AI ACCELERATOR — classification & inference
FPGA — IO flexibility & scaleability
APPLICATION PROCESSOR — low latency & real-time

person identification · voice interfaces · comms & control · actuation · presence detection · audio interfaces

xcore.ai — know more do more

APPLICATIONS

SMART SPEAKER
AUDIO VISUAL
APPLIANCES
LIGHTING/SECURITY

HEALTH
FITNESS
CARE & DIAGNOSTICS
MONITORING

TRAFFIC & PARKING
ENVIRONMENTAL
PUBLIC SAFETY
MONITORING

SAFETY
TRACKING
MAINTENANCE
ENERGY MANAGEMENT

ASSET TRACKING
PREDICTIVE CARE
PEOPLE TRACKING
AUTONOMOUS (L1)
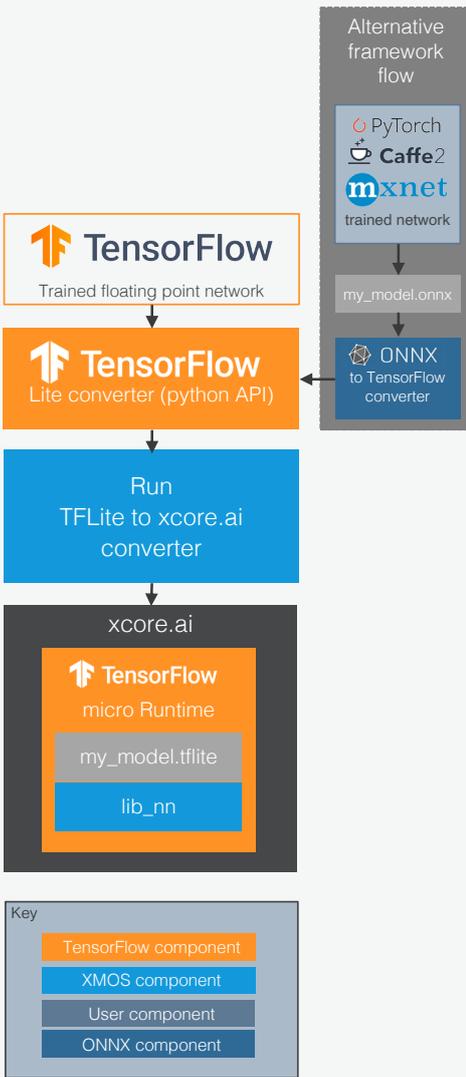
XMOS

DEVELOPMENT TOOLS

Standard programming tools:

- LLVM compiler suite
- GNU debugger
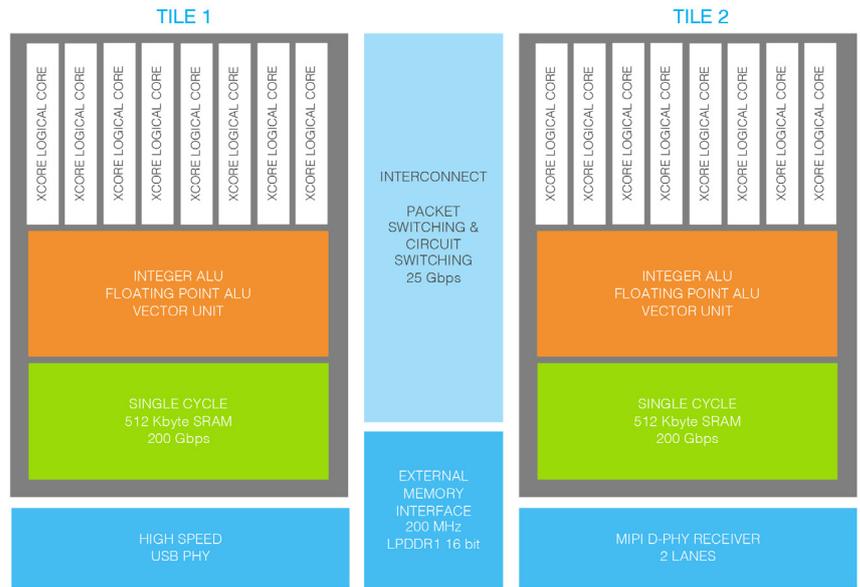- Make for building

Bespoke tools include:

- Mapper to link code and eliminate unused code
- Global optimiser
- Programmer for Flash, OTP and volume programming

TensorFlow Lite for microcontrollers enables high performance code for immediate compilation / modification to deliver optimised models.

Alternative framework flow

PyTorch
Caffe2
mxnet
trained network

my_model.onnx

ONNX to TensorFlow converter

TensorFlow
Trained floating point network

TensorFlow
Lite converter (python API)

Run
TFLite to xcore.ai converter

xcore.ai

TensorFlow
micro Runtime

my_model.tflite

lib_nn

Key
- TensorFlow component
- XMOS component
- User component
- ONNX component

BLOCK DIAGRAM

TILE 1

XCORE LOGICAL CORE (×8)

INTEGER ALU
FLOATING POINT ALU
VECTOR UNIT

SINGLE CYCLE
512 Kbyte SRAM
200 Gbps

HIGH SPEED
USB PHY

INTERCONNECT
PACKET SWITCHING & CIRCUIT SWITCHING
25 Gbps

EXTERNAL MEMORY INTERFACE
200 MHz
LPDDR1 16 bit

TILE 2

XCORE LOGICAL CORE (×8)

INTEGER ALU
FLOATING POINT ALU
VECTOR UNIT

SINGLE CYCLE
512 Kbyte SRAM
200 Gbps

MIPI D-PHY RECEIVER
2 LANES

CROSSOVER PROCESSOR SPECIFICATION

PACKAGE	7x7mm, 60-pin QFN 0.4mm pitch 14x14mm, 265-pin BGA 0.8mm pitch
COMPUTE	16 real-time logical cores across 2 tiles
MEMORY	2 x 512KB on-chip SRAM, extendable through an LPDDR1 interface or external flash
CONNECTIVITY	Up to 128 GPIO defined in software; port sampling rates up to 100MHz with respect to external clock; selectable I/O voltage 1V8-3V3 (package dependent)
AI	Vector unit with 256bit wide registers; operates in 32/16/8bit integer mode. Binarised neural network (XNOR) support
DSP	32x32 bit complex vector arithmetic, 32x32 ->64bit MAC instructions, and single precision floating point
PERIPHERALS	Built-in physical layers for high-speed USB PHY; Dual-lane MIPI D-PHY receiver; and PLL for application clock generation
SECURITY	8 kByte internal OTP

XMOS