brainchip
Event-based computing

akida pico Low Power Core

Akida Pico IP
Product Brief

The **Akida Pico** is an Edge AI acceleration co-processor or stand-alone core built on the **Akida™ Event-based processing platform.**

Akida Pico accelerates a set of highly optimized temporal event-based neural network models to create an **ultra energy-efficient**, and purely digital, event-based processing architecture**. Akida Pico** features built in capabilities to execute these networks without a host CPU, enabling stand-alone operation for always on ultra low power. **BrainChip**'s unique **MetaTF™** software flow enables developers to compile and optimize their chosen models for the **Akida Pico**.

The **Akida Pico** can be paired to wake up an MCU or CPU via low-power SPI interfaces to create very compact, ultra-low-power, portable and intelligent devices for wearables, remote sensors, always on wake-up devices, Healthcare, Consumer, Smart Home and AIoT applications. **The Akida Runtime software** manages network processing to fully utilize available resources and can automatically partition execution into multiple passes.

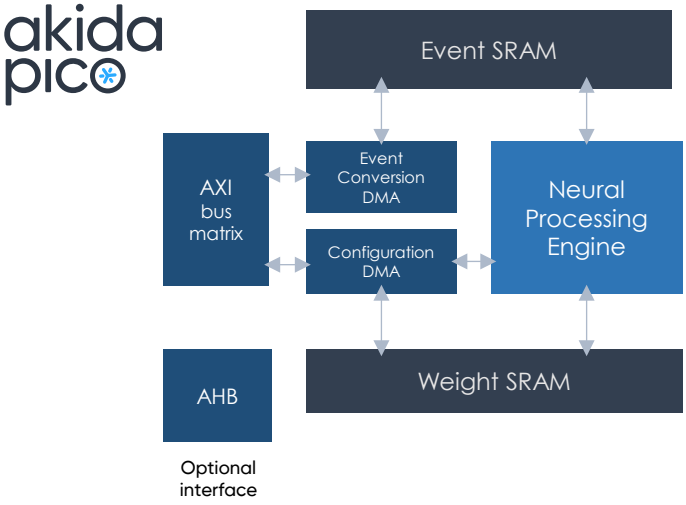
Key Benefits

- Ultra-low standalone NPU core uW to mW active power
- Supports power islands for minimal standby power
- Industry Standard Development Environment
  - TensorFlow/Keras and Pytorch APIs
- Reduced die area Cost
  - Base 158K gate configuration
  - Base 50K word local RAM can be minimized for use case(s)
  - 0.18mm² die area @ 22nm process

Applications

- Edge AI Speech and Audio Systems
  - Voice Wake Detect
  - Key Word Spotting
  - Speech Noise Reduction
  - Audio Enhancement
- Medical
  - Patient vitals anomaly detection
- Industrial Internet of Things
  - Industrial anomaly detection
- Smart Home
  - Personal voice assistant
- Sensor Integration
  - Combine with a wide variety of sensors

Akida Pico Block Diagram



Specifications

- Akida NPU Core
  - Single Neural Processing Engine
  - Minimal core for Temporal Event-based neural networks (TENNs)
- Core subsystems and interfaces
  - 4-bit and 8-bit precision arithmetic support
  - DMA with integrated event converter for 8-bit data
  - Configuration DMA for model weights
- Configurable On-Chip Local memory for temporary storage
- Industry standard interfaces
  - AXI-4 bus matrix master
  - Add SPI to directly receive data samples
  - Add SPI to Flash for network parameters
  - GPIO for software programmable interrupt to host.
- Clock frequency range:
  - 1-400 MHz (process/voltage dependent)
  - Static clock for clock gating

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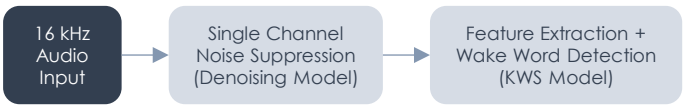
MetaTF is a complete **Akida** machine learning framework enabling the seamless creation, training, and testing of neural networks on the **Akida Pico Processor.** With **MetaTF**'s support for models created with **TensorFlow**/**Keras** and **Pytorch,** users avoid the need to learn a new ML framework while rapidly developing and deploying AI Applications for the **Edge**. Support for **ONNX** allows **MetaTF** users to leverage models developed in **BrainChip's TENNs** compatible framework.

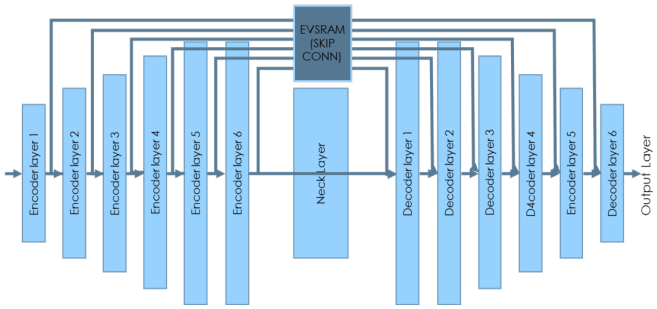
MetaTF supplies tools to convert a model with **floating point** weights and activations to a model with **low bit-width** weights and activations while maintaining model performance. These tools also convert **quantized models** trained using traditional deep learning methods to **event-domain models** for execution with low-latency and low-power on the **Akida Pico Processor.**

MetaTF provides the platform-agnostic **Akida Runtime** with a Hardware Abstraction Layer (HAL) for execution of models on **Akida** hardware. The **Akida runtime** also contains a software simulator for model evaluation without **Akida** hardware.

Audio Use Case Flow



Denoising NODE Data Flow



The **QuantizeML & Compilation** python packages provide tools to quantize Tensorflow/Pytorch models and convert models to the event domain for inference on the **Akida Event-based Processor Platform.**

The steps to generate an Akida compatible model include:

- **Create & Train** a Tensorflow/Pytorch model using standard development frameworks
- **Quantize** (PTQ) a trained Tensorflow/Pytorch model using the QuantizeML toolkit
  - Optional QAT to maintain maximum performance
- **Compile** a model to Akida format using the CNN2SNN toolkit
- **Model Library** for reference NNs with performance data

The **Akida Development Platform** is the foundation supporting multiple **AI Application development** and **deployment** scenarios for users with different levels of AI expertise and network model customization needs. **BrainChip** supports a range of AI application development platforms - all of which ultimately deploy on the **Akida event-based processing engine.**

Options for AI Application Development and Deployment on the Akida Platform

- **Low-code/No-code Tools** for Limited AI Expertise
- **Native MetaTF** for Customized AI Modeling
- **Turnkey AI Application Providers for** Optimized complete applications

Data Flow KWS & Biomed

KWS NODE Data Flow (Encoder only) BIDMC and Other Time series data