



Intelligent Edge AI: Efficient, Effective & Easy

AKIDA Neuromorphic Processor

Rob Telson

Vice President Worldwide Sales

Edge AI Vision Alliance Webinar

December 9th, 2021

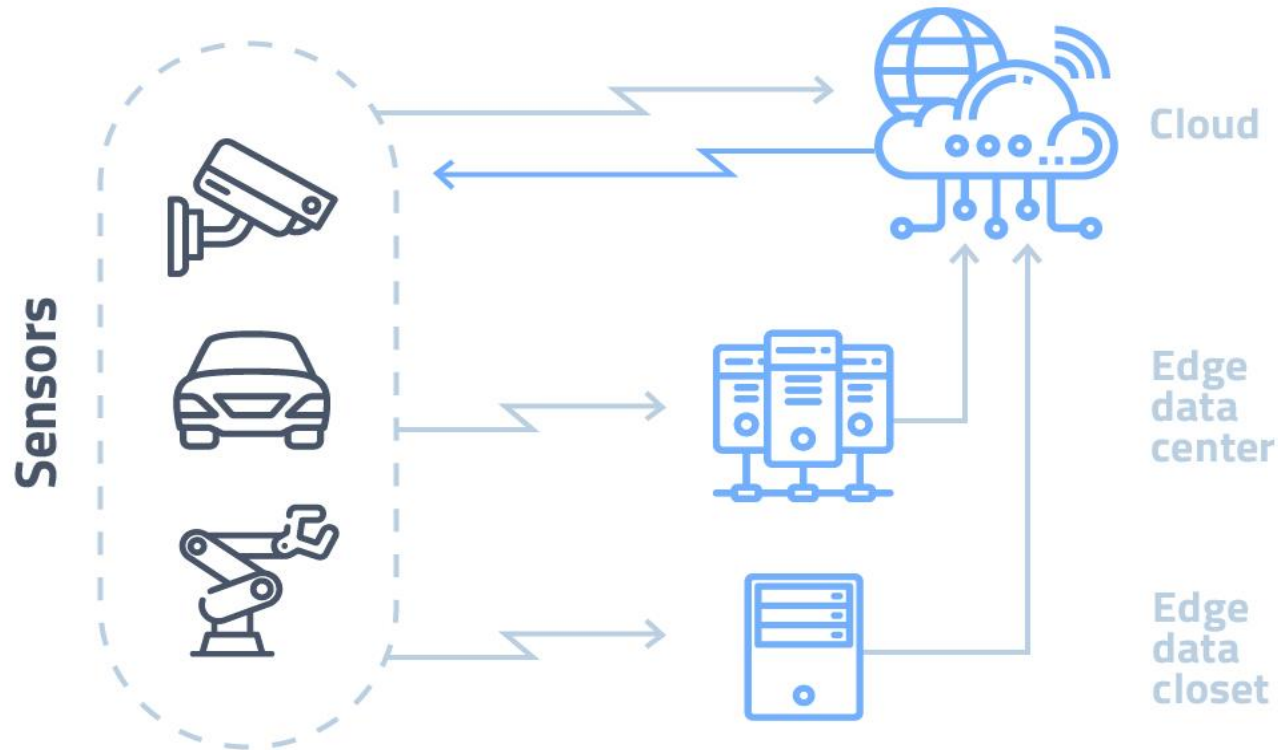
Todd Vierra

Director, Customer Engagements

Unlocking the Future of AI. This is our Mission.

This is a Major Problem:

90 Zettabytes of Data from the Edge to the Cloud in 2025



- *  Bandwidth competing for the same resources
 in other words, too slow
- *  Privacy and security threats
- *  Demand for autonomous learning
- *  Latency



About BrainChip – Founded 2013



- 15+ yrs fundamental AI architecture research & technologies
- 65+ data science, hardware & software engineers
- 17 Patents
- Publicly traded:
 - ASX: BRN.AX
 - OTCX: BCHPY
- Customer Engagements– Early Access, Proof of Concept, IP License
 - Automotive
 - Consumer
 - Healthcare
 - Imaging
 - Transportation



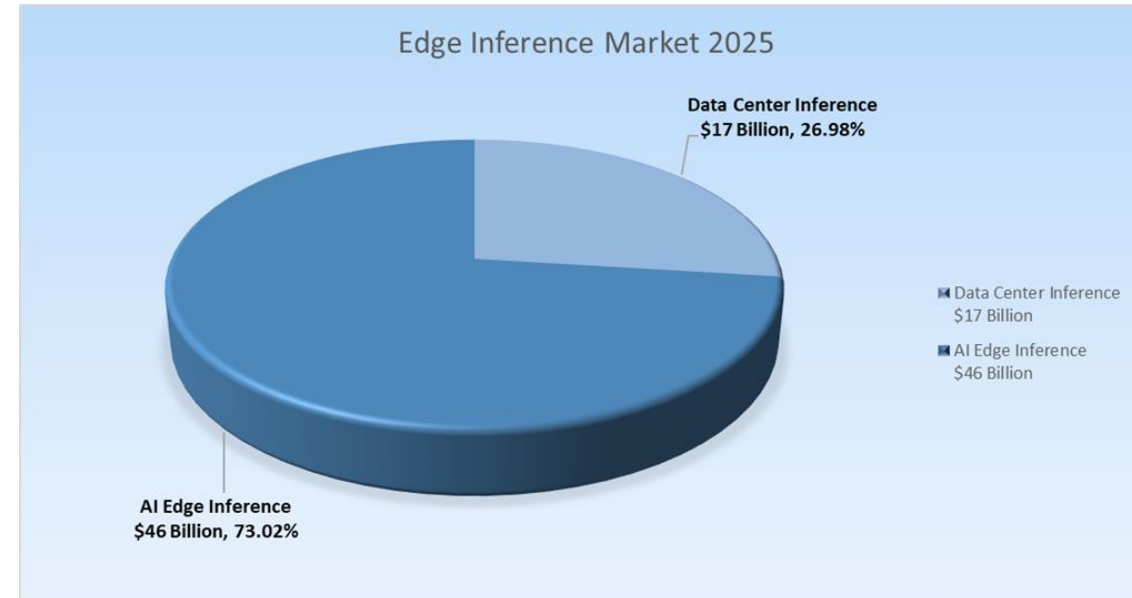
Solving the Problem on the Edge

Traditional cloud-based solutions are not constrained by model size or complexity

At the Edge, AI processing will face these constraints

Brainchip's Neuromorphic architecture efficiently optimizes and accelerates any type of CNN Network

\$63 Billion



**BrainChip targets the 46B Edge AI Inference market
By addressing the demand for:**

- Achieving low power requirements
- Device personalization
- One Shot Learning
- Processing AI on the device (Cloud Independent)

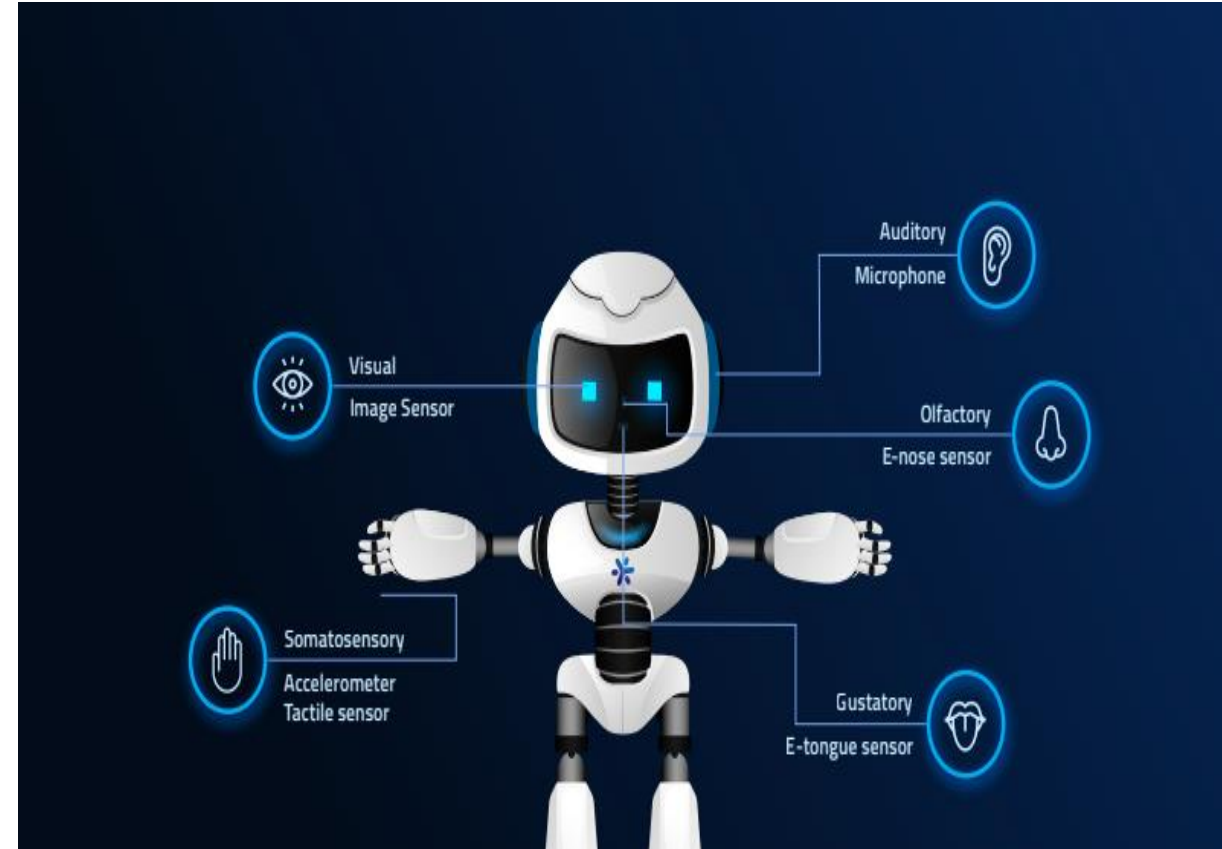
The BrainChip Advantage



Figure 1: Comparing the brain, neuromorphic chip, and GPU in AI inference mode

	Human brain	Neuromorphic chip	Deep learning on GPU
Power consumption	~20W	Micro to milliwatts	100s W
Processing speed	Milliseconds	Nanoseconds	Milliseconds
Efficiency (sparsity)	High	High	Variable
Learning rule	Local (we believe)	Local	Global
Event based processing	Yes	Yes	Less suitable

Source: Kisaco Research



Akida Business Models: *Development Kits are Available*



- Akida IP
- AKD1000 Chip
- Shuttle PC Development Kit
- Raspberry Pi Development Kit
- AKD Mini PCIe board



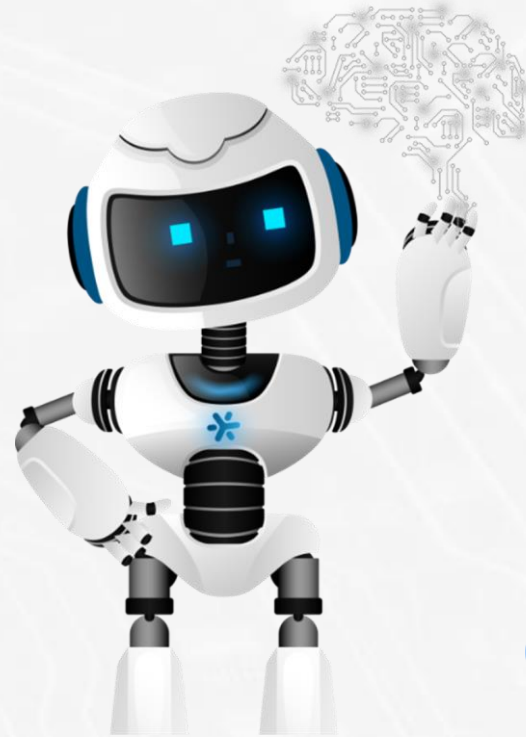
*Purchase: shop.brainchipinc.com
For more information contact
Sales@brainchip.com*

brainchip*

Akida™

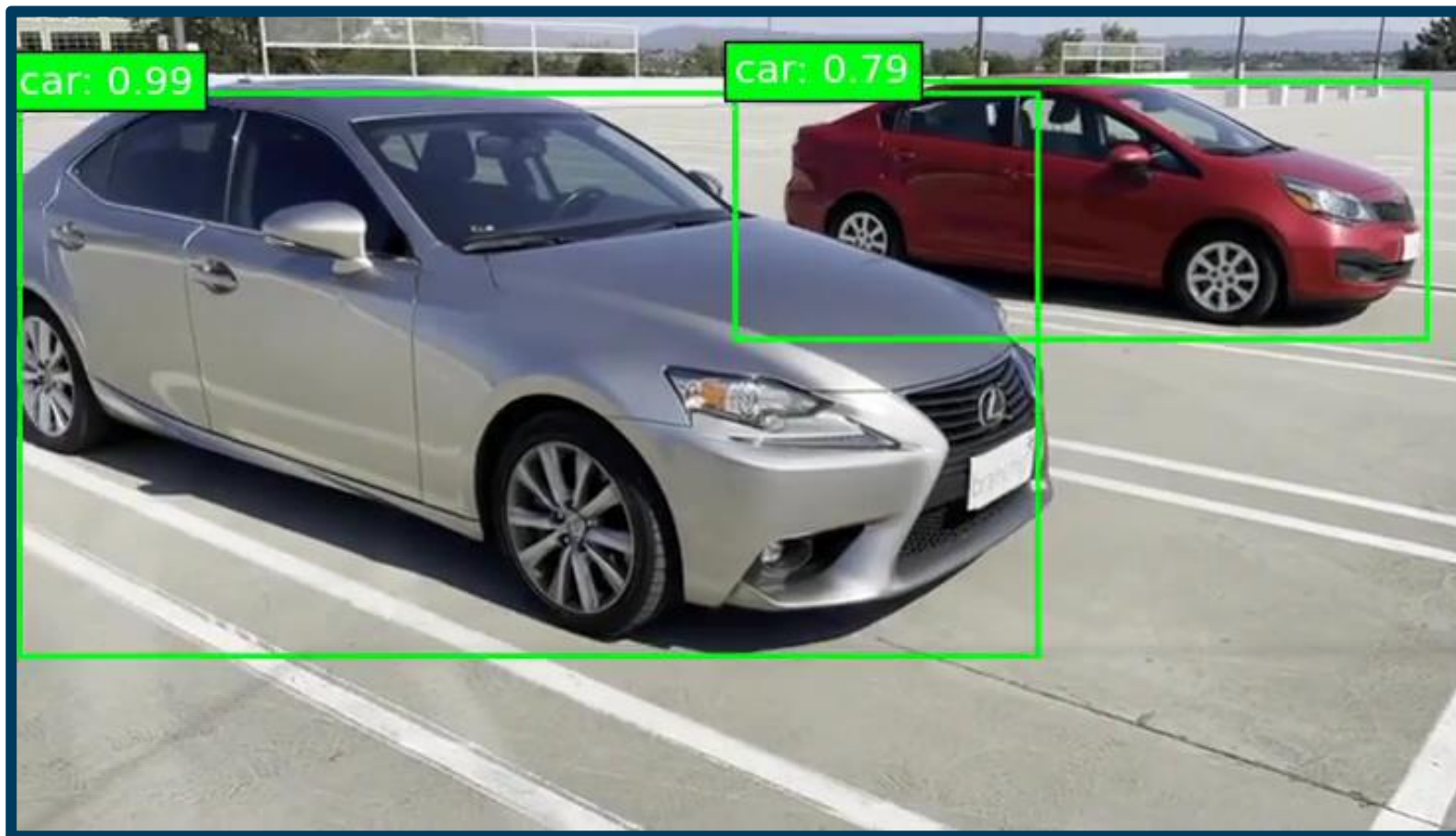
Object Detection

Person Detection



Revolutionizing AI at the Edge

Mobilenet SSD – Cars and People



Visual Wake and Face Recognition



Akida Visual Wake Word



Akida Face Recognition



Learn new people ^{with}

BrainChip's AKIDA Neuromorphic Design Principles



Distributed Computation

Computation spread across many cores (neural processing units – NPU)

Each NPU has its own dedicated computational engine and memory, which reduces data movement

Event-Based Processing

Non-zero activation map values are represented as multi-bit (1 to 4-bit) events

NPU only perform computation on events, not activation maps

Event-Based Communication

NPU communicate by sending events to each other over a mesh network without host CPU intervention

Neural network connectivity is configurable in the field

Event-Based Learning

AKIDA implements an on-chip, learning algorithm

No costly communication with cloud required

Akida: Software Development Environment and with Meta TF

Akida Software Development Stack

Akida Chip Simulator

pip install akida

Training tool (CNN2SNN)

pip install cnn2snn

Models

pip install akida-models



Meta TF

- Using Standard Tensor Flow environment
 - Installation manual
 - User Guide
 - API reference
 - Example/Workflows
- Need a network and Dataset
 - If you don't have one or know
 - Several free ones are in the Example section
- Get a head start
 - Convert your normal CNN to SNN following CNN2SNN flow in Examples

<https://doc.brainchipinc.com>

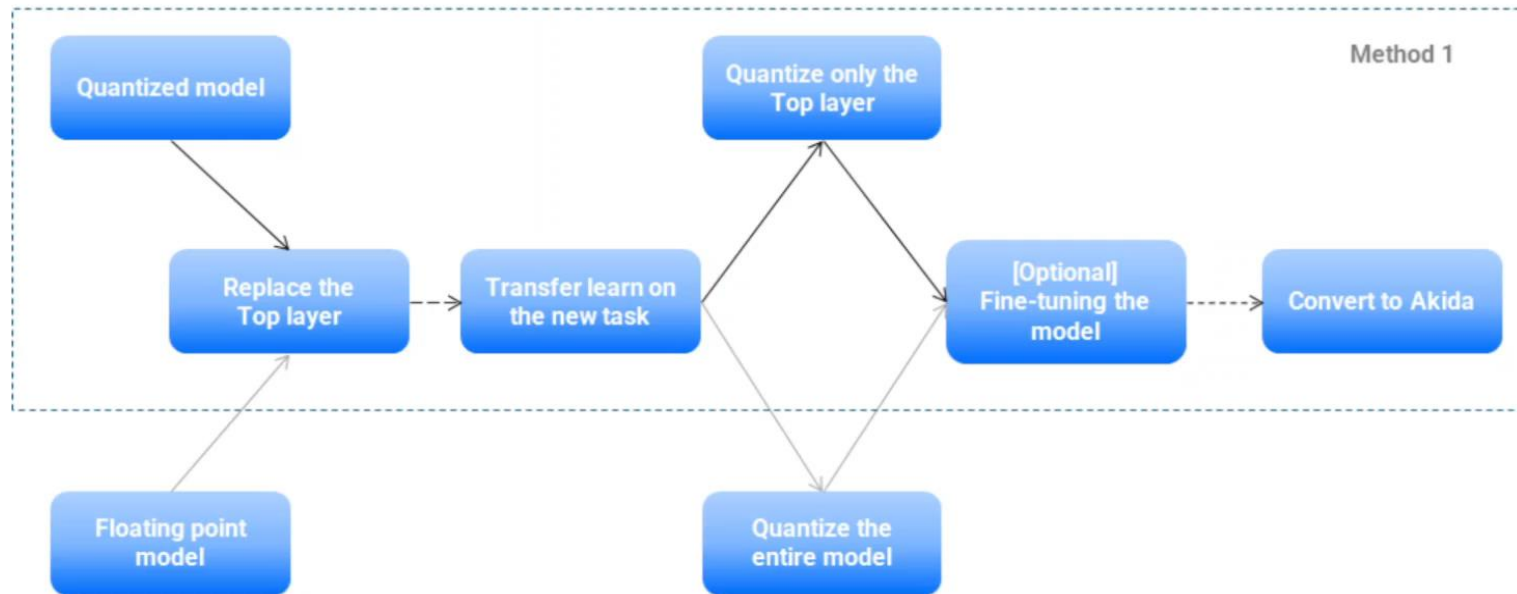
The screenshot shows a web browser displaying the BrainChip documentation site. The page title is "Overview" and the sub-header is "The Akida Neural Processor". The main content area contains text describing the Akida integrated circuit technology, its ultra-low power and high performance characteristics, and its ability to run traditional feedforward and deep learning CNN networks. A sidebar on the left lists navigation options: Overview, Installation, User guide, API reference, Examples, Changelog, Support, and License. Below the text, there is a block diagram of the SoC architecture. The diagram shows a central "M-Class CPU" connected to various components: "Data input interfaces" (PCI-Express 2.1 x2 Lane Endpoint, USB 3.0 Endpoint, I3S, I2C, UART, JTAG), "Conversion Complex" (Pixel-Spike Converter, SW Data-Spike Encoder), "On-Chip Processor" (M-Class CPU with FPU & DSP, System management, Akida Configuration), and "External Memory Interfaces" (SPI FLASH for boot/storage, LPDDR4 Program /Weights). Other components include USB 3.0, PCIe 2.1, I2S, I3C, UART, JTAG, SPI, and LPDDR4.



MetaTF: Framework Structure and Workflow Saves Time

Transfer Learning on Meta TF Akida model zoo

https://doc.brainchipinc.com/api_reference/akida_models_apis.html#model-zoo



MetaTF 2.0.5

Search docs

Overview

Installation

User guide

API reference

Akida Execution Engine

CNN2SNN

Akida models

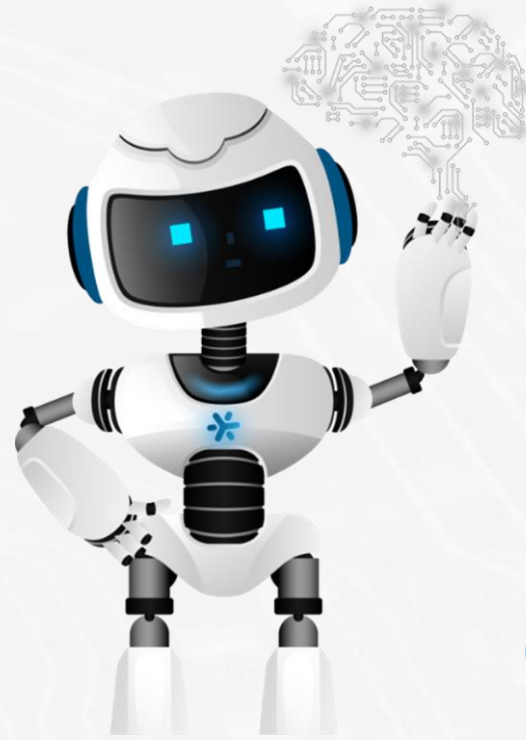
Examples

Model zoo performances

1 Python 3 | Idle

Mode: Command Ln 1, Col 1

brainchip*

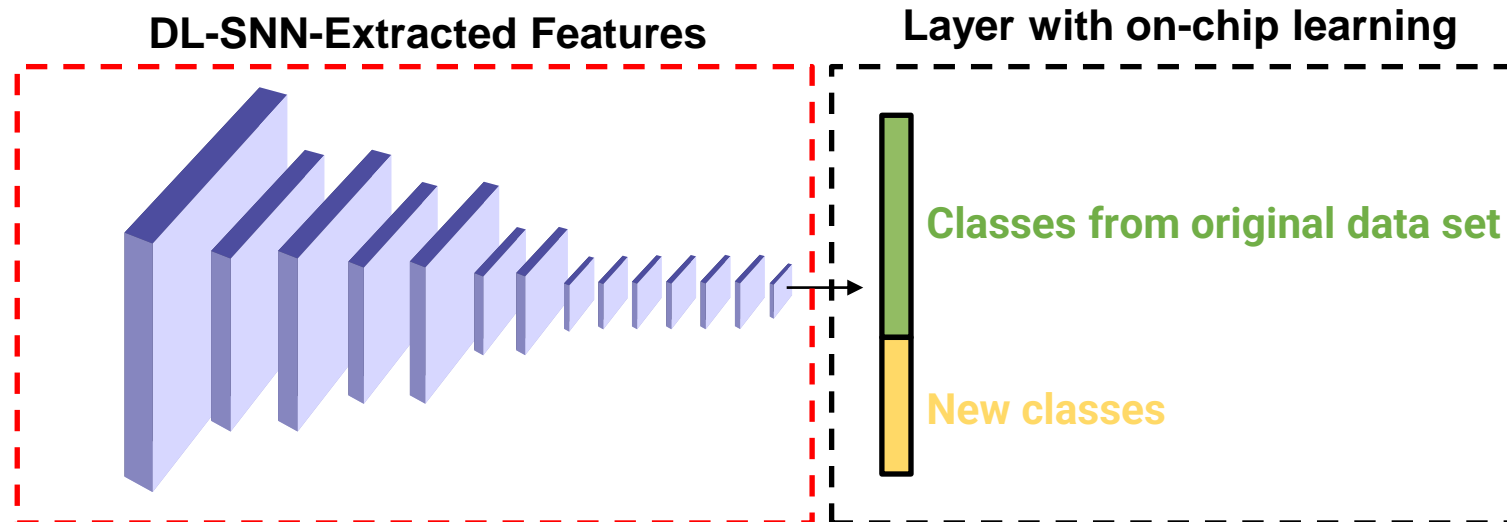


Akida™
Edge Based Learning

Revolutionizing AI at the Edge

Edge Learning with AKIDA™ On-Chip Learning

1. Train CNN feature extractor offline on original dataset
2. Replace last classifier layer with Akida layer capable of on-chip learning
3. Perform few-shot learning: learn from a few samples
 - a) original classes (green)
 - b) new classes (yellow) – should share similar features with original classes



- We have demonstrated edge learning for:
 - Object detection using MobileNet trained on the ImageNet dataset <https://www.youtube.com/watch?v=xeGAiWbKa7s>
 - Keyword spotting DS-CNN trained on the Google Speech Commands dataset <https://www.youtube.com/watch?v=vOEY2NICjVY>
 - Hand gesture classification on a custom DVS events dataset <https://www.youtube.com/watch?v=Rin5RGTHiOk>

Object Classification: Time for a Beer?



Activities python3.6 May 25 14:46 Akida Live Demo

Akida Edge Learning



Corona Premier ^{1 shot}

Learn new class ^{3/10} Corona Premier

The image shows a screenshot of a software interface for Akida Edge Learning. At the top, the title 'Akida Edge Learning' is displayed in a dark blue font. Below the title is a central video frame showing a bottle of Corona Premier beer on a white surface. The bottle is the primary focus, with its label clearly visible. Below the video frame, the text 'Corona Premier' is shown in white, with a small '1 shot' label next to it. At the bottom of the interface, there is a dark blue bar containing the text 'Learn new class' followed by a progress indicator '3/10', and a light blue bar containing the text 'Corona Premier'. The background of the interface is a dark grey with a faint, light-colored circuit board pattern.

ImageNet Mobilenet V1 Edge learning at High Speed



Akida Edge Learning

Car vs Bike: BMW Sauber F1 vs BMW S 1000 RR



0:06 / 2:15

Pit Crew ^{1 shot}

The image shows a video player interface. At the top, the text 'Akida Edge Learning' is displayed. Below it, a video frame shows a race track scene with a motorcycle and a Formula 1 car. The video player includes a progress bar at the bottom showing '0:06 / 2:15' and a play button. The text 'Pit Crew' is overlaid at the bottom of the video frame, with a small '1 shot' indicator next to it.



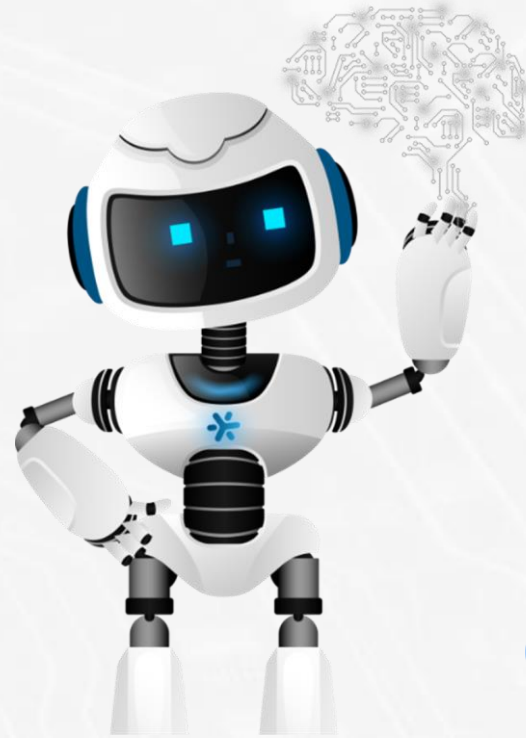
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Akida™

Facial Recognition

Keyword Spotting

Visual wake



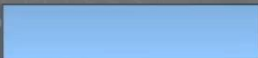
Revolutionizing AI at the Edge

Smart Automotive - In Cabin Experience

Akida Face Recognition

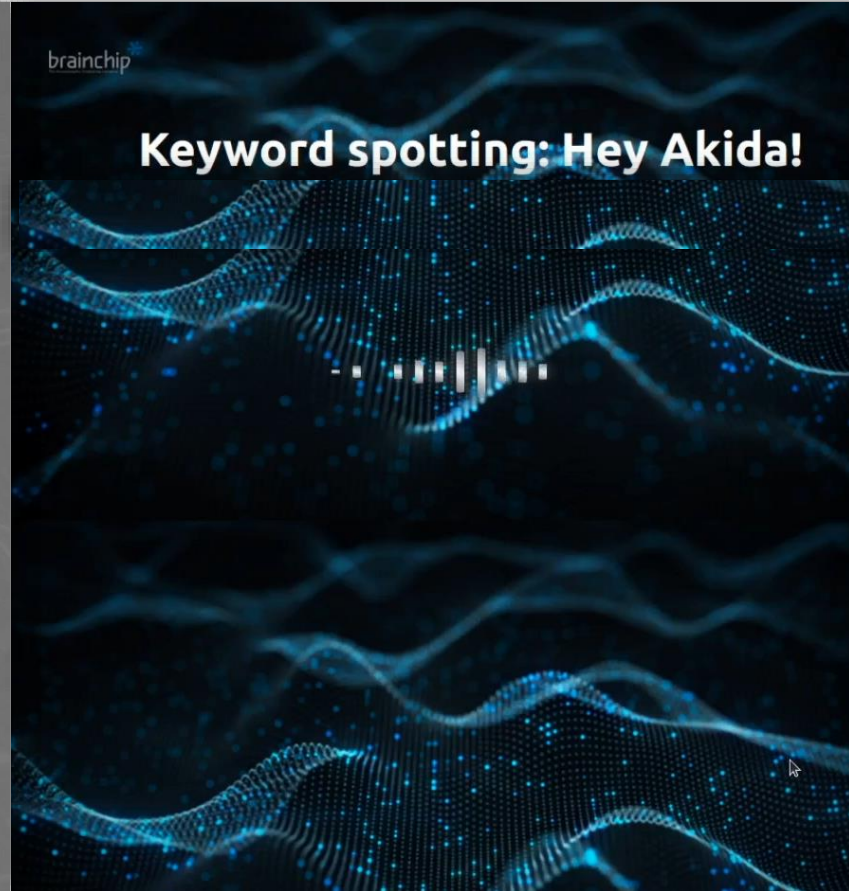


Learn new people ^{3/10}



brainchip

Keyword spotting: Hey Akida!

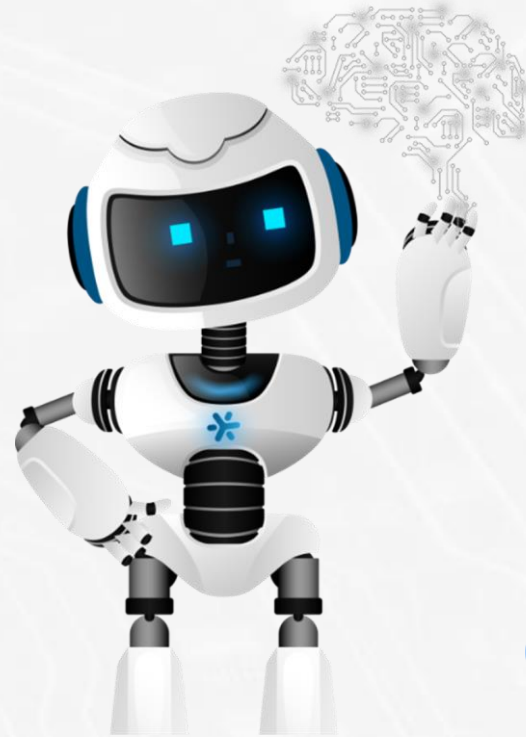


Akida Visual Wake Word



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Akida™
Tactile Sensing



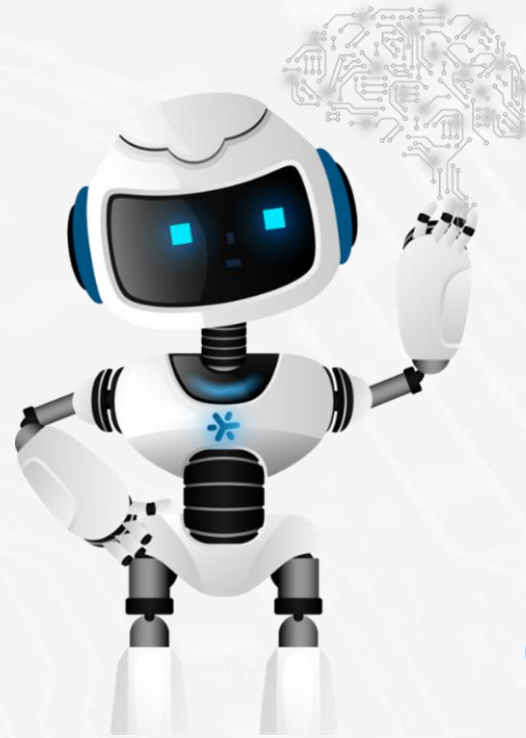
Revolutionizing AI at the Edge

ST-MNIST



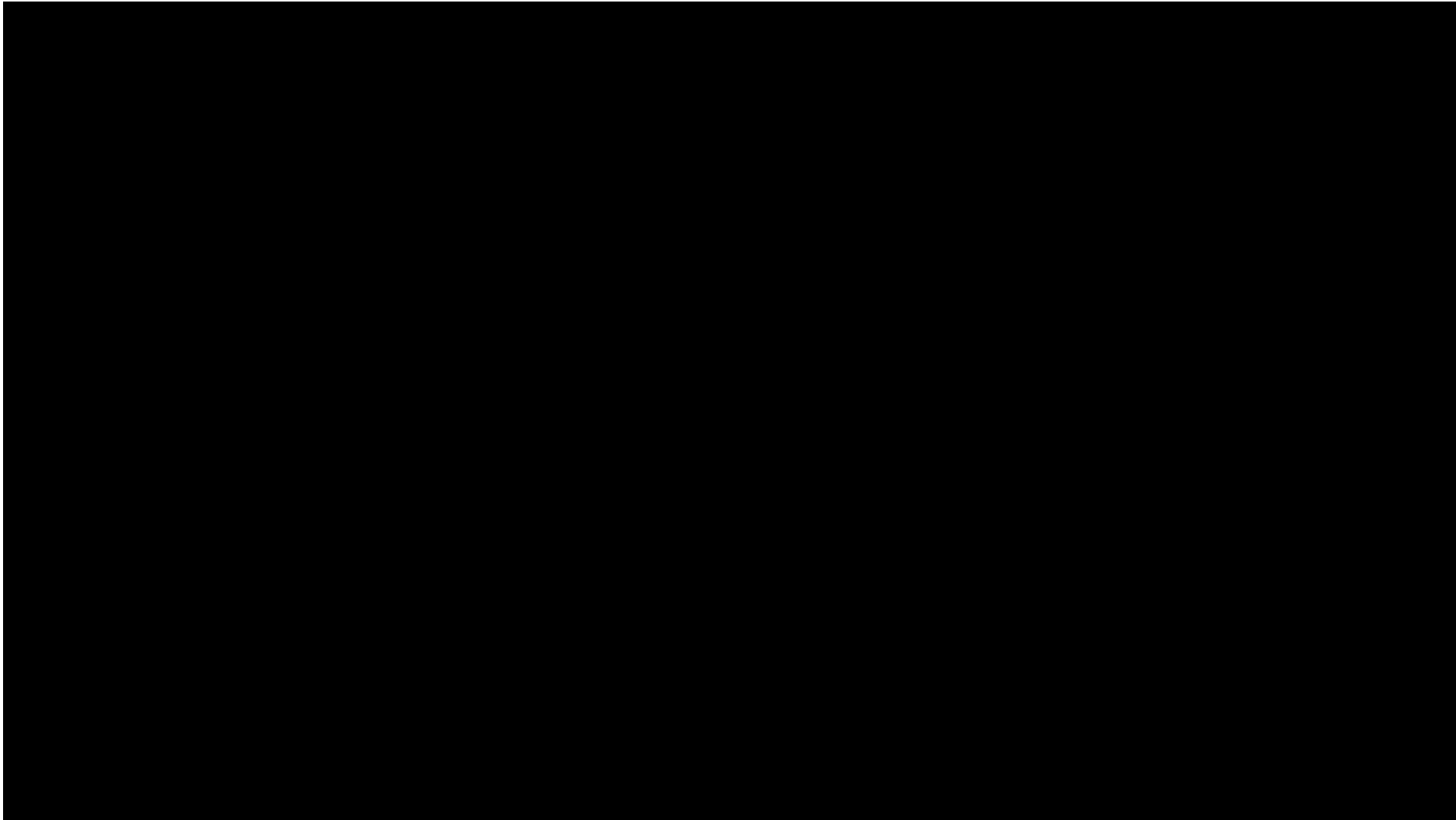
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Akida™ Gustatory Wine Tasting



Revolutionizing AI at the Edge

Akida Wine Tasting Demo



Akida Neuromorphic Processor and IP

Data Processing

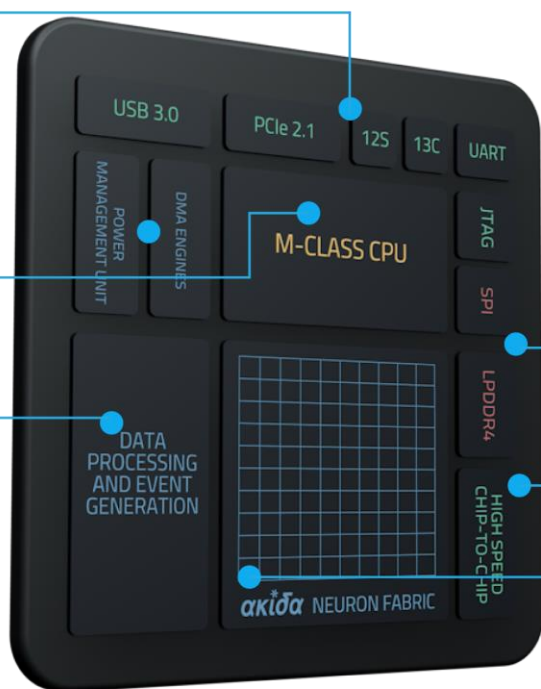
- Pixel-Event Converter
- SW Data-Event Encoder
- Any multivariable digital data
- Sound, pressure, temp., others

On-Chip Processor

- M-Class CPU with FPU & DSP
- System Management
- Akida Configuration

Data Input Interfaces

- PCI Express 2.1 x2 Lane Endpoint
- USB 3.0 Endpoint
- I3S, I2C, UART, JTAG



External Memory Interfaces

- SPI FLASH for boot/storage
- LPDDR4 Program/Weights

Multi-Chip Expansion

- PCIe 2.1 2 lane root complex
- Connects up to 64 devices

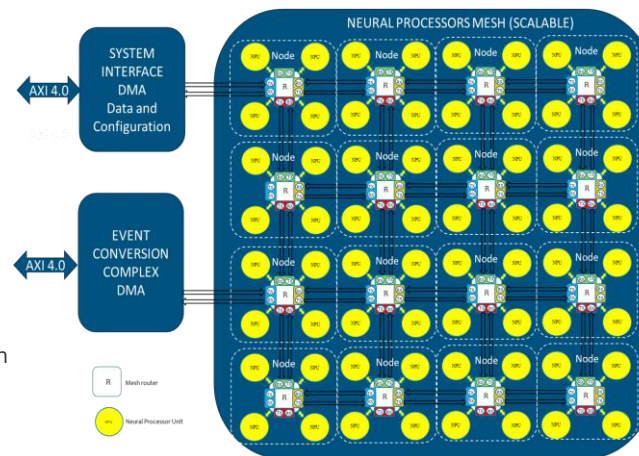
Flexible Akida Neuron Fabric

- Implements 80 NPUs
- All Digital logic with SRAM (8MB)
- Also Available as Licensed IP Core
- First Implementation: TSMC 28nm



Process Independent IP

- Standard CMOS
- Event Based NPU
- Configurable SRAM Memory
- On Chip Communication



IP Configurable Number of Nodes

- IP Deliverables
- Dev Tools
- Test Suites
- Documentation

BrainChip- This is Our Mission



- Traditional AI is compute intensive
- Traditional AI solutions are not the future for Edge AI environments
 - Too much irrelevant data is being processed
 - Consuming too much power
 - Too many dollars are being spent in the wrong areas
- The key is not to process more data faster
- **Process Relevant Data Efficiently with Accuracy**
- Neuromorphic Computing is the next generation of AI
 - Processing the most relevant data: smarter, faster and most economical
- BrainChip is first to market and is leading the way!

This is our Mission

We don't make the sensors

- We make them smart

We don't add complexity

- We eliminate it

We don't waste time

- We save it

We solve the tough *Edge AI* problems

- Others do not or cannot solve



Empowering Product Creators to Harness Edge AI and Vision

The Edge AI and Vision Alliance (www.edge-ai-vision.com) is a partnership of 100+ leading edge AI and vision technology and services suppliers, and solutions providers

Mission: To inspire and empower engineers to design products that perceive and understand.

The Alliance provides low-cost, high-quality technical educational resources for product developers

Register for updates at www.edge-ai-vision.com

The Alliance enables edge AI and vision technology providers to grow their businesses through leads, partnerships, and insights

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edge ai + vision
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Intelligent AI Everywhere This is our Mission

www.brainchip.com