BrainChip Akida: A Game Changer in AI Computing for Cybersecurity

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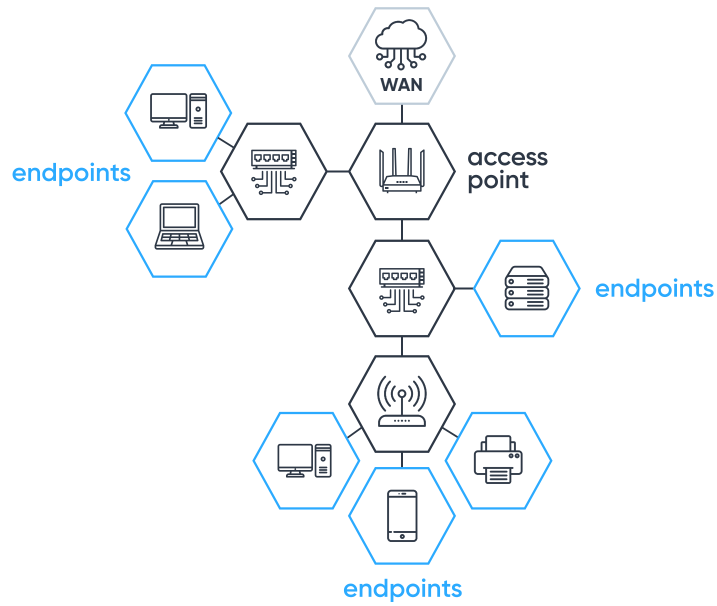
Introduction

BrainChip Akida: Revolutionizing AI at the Edge

Welcome to the future of AI processing with BrainChip Akida. The Akida neuromorphic AI platform brings brain-inspired computing to the forefront, offering unmatched efficiency for edge AI applications.

- **Efficiency Redefined:** Achieve up to 98.4% cyberthreat classification accuracy with Akida 1 at 4 bits, higher with Akida 2 at 8 bits resolution that also significantly reduce power, weight, and cost.
- **Innovative Neuromorphic Computing:** Powered by Spiking Neural Networks (SNNs), Akida delivers real-time insights faster and more efficiently than traditional processors.



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Chapter 1
BrainChip Akida: Revolutionizing Real-Time Cybersecurity Applications with event-based AI processing

Neuromorphic computing is quickly emerging as a cutting-edge solution for high-performance computing (HPC) applications, particularly in cybersecurity, due to its ability to provide accuracy while operating at a fraction of the size, weight, power, and cost (SWaP-C) of GPU based solutions, enabling integration of this advanced technology into a whole new range of products. The BrainChip Akida architecture stands out among ML processors for its unique edge AI/ML capabilities and its competitive performance in real-time threat detection.

In this white paper, we investigate the impressive benchmark results of BrainChip's AKD1000 chip, compare its performance to Intel's latest neuromorphic offering, the Loihi 2 chip, and outline the specific cybersecurity benefits of adopting Akida for high-stakes environments in embedded systems.

Neuromorphic Computing in Cybersecurity: The Need for Change

Modern cybersecurity systems require immense processing power to detect and respond to threats in real-time, especially in HPC environments such as those operated by government, cloud and enterprise providers.

Traditionally, full-precision GPU-based systems have been used to achieve the high accuracy required in these domains. However, GPUs come with significant SWaP demands, making them impractical for lightweight, real-time applications at the edge.

Neuromorphic systems like the BrainChip Akida provide an alternative, offering comparable accuracy to GPUs while significantly reducing SWaP requirements. Earlier work[1] using neuromorphic computing as a potential solution for real-time cybersecurity in HPC environments showed promising results, achieving up to 93.7% accuracy in multiclass classification (eight attack types and one non-attack type class).

With the availability of the Akida 1000 chip and Intel's release of the Loihi 2, it became possible to conduct more detailed benchmark analyses, yielding up to 98.4% accuracy on a revised dataset[2].
This level of precision matches the state-of-the-art in cybersecurity classification, making Akida a highly attractive option for cybersecurity applications.

Benchmark Results[2]: Akida 1000 vs. Loihi 2

To provide a clearer understanding of the neuromorphic landscape, benchmark tests were performed using the University of New South Wales (UNSW) TON-Internet of Things (TON-IoT) dataset, which includes nine attack classes. The BrainChip Akida 1000 and Intel Loihi 2 were tested on identical network architectures to evaluate their performance in terms of accuracy, power consumption, and model size. Brainchip has released subsequent versions of the Akida platform that have higher accuracy based on eight bits inferencing. Below is a detailed comparison of the two chips, highlighting the strengths and weaknesses of each.

Benchmark category	BrainChip Akida 1000	Intel Loihi 2
Accuracy	98.4%	90.2%
Power consumption	1 W	2.5 W
Model size reduction	75% reduction	72.4% reduction
Inference speed	Moderate	Faster due to batch processing
Throughput	High for streaming data	Superior for batch processing
SWaP-C advantage	Substantial	Moderate

Accuracy and Precision

The BrainChip Akida 1000 achieved an impressive 98.4% accuracy in classifying nine traffic types, surpassing the 90.2% accuracy attained by Intel's Loihi 2. This high level of accuracy was achieved through optimized data preprocessing, enhanced ANN-to-SNN conversion processes, and improvements in data scaling.

Intel's Loihi 2, using its Lava framework, fell short of Akida 1000's accuracy due to challenges in handling the wide range of attacks in the dataset. Loihi 2 struggled particularly with distinguishing non-normal traffic, especially in detecting specific attack types such as denial of service (DOS), where its accuracy dropped to 52%.

Class type	BrainChip Akida 1000 accuracy	Intel Loihi 2 accuracy
Normal traffic	99.3%	99%
Denial of Service (DOS)	95.4%	52%
Injection attacks	96.7%	78%
Reconnaissance attacks	94.2%	82%

SWaP Profiles and Power Efficiency

One of the primary reasons neuromorphic systems like Akida are so desirable for cybersecurity is their ability to deliver high performance with low power consumption. The BrainChip Akida 1000 chip consumed just one watt during its inference phase, using a 28 nm process, compared to Intel Loihi 2's 2.5 watts at a more advanced process technology. This power efficiency makes Akida ideal for applications in which power and weight are major constraints, such as edge router, enterprise, home and wireless access networking products. Its applicability also extends to mobile devices that are controlled wirelessly and need native cyber-protection against cyber-hijacking, such as cars, robots, UAVs and other autonomous devices that can create physical risk and potential liability.

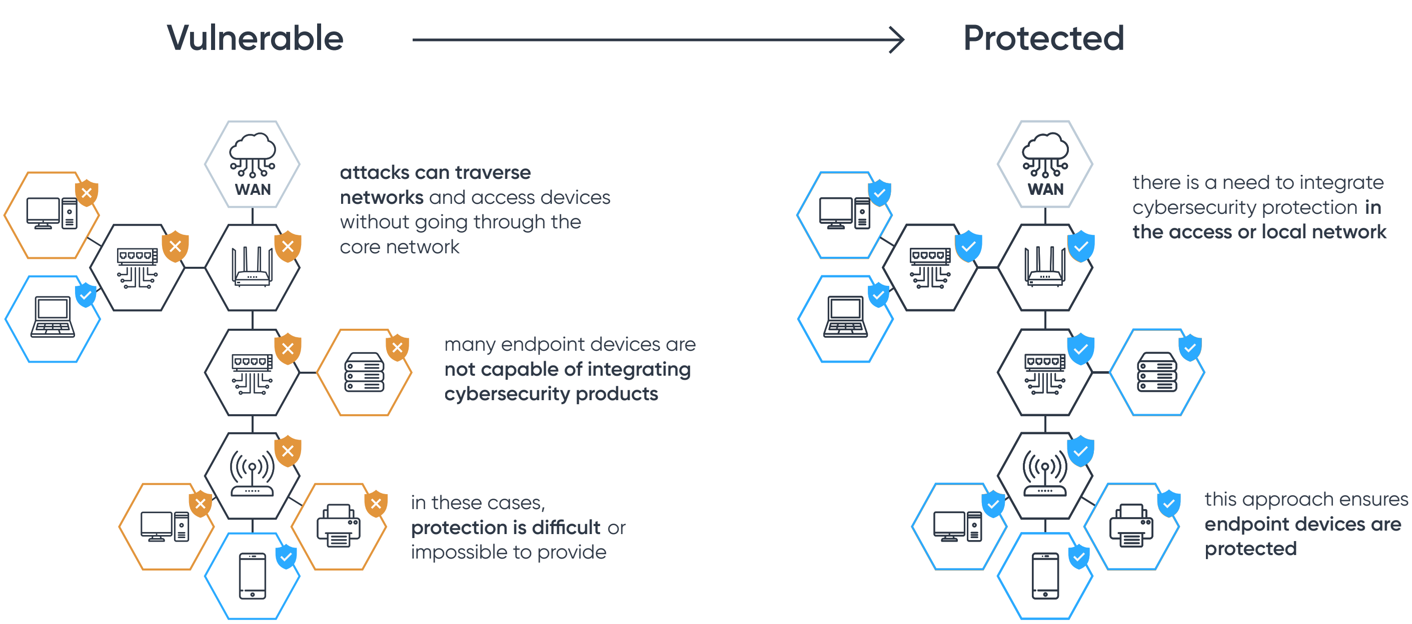
Additionally, Akida 1000's small size and reduced power draw enable it to operate effectively in embedded systems, where traditional GPU solutions would be far too bulky with high power requirements that can often require a fan.

Model Size and Memory Optimization

Both BrainChip Akida 1000 and Intel Loihi 2 showed remarkable reductions in model size, with Akida trimming its model by 75%, compared to Loihi 2's 72.4%. This reduction is particularly valuable in cybersecurity applications, where smaller, more efficient models can lead to faster decision-making and lower latency.

The Akida 1000 chip further benefited from improved quantization schedules and a more effective hyperparameter tuning process, which minimized accuracy loss during model conversion.

These steps allowed Akida to execute its SNN model on-chip, providing real-time data analysis and enhanced power efficiency.



Chapter 2

Cybersecurity Benefits of BrainChip Akida

The Akida 1000 chip is a game-changer for cybersecurity, particularly in real-time threat detection and response for embedded systems. Its performance and low SWaP profile make it ideal for edge computing applications where latency, power consumption, and computational load are critical concerns. Here are some key cybersecurity benefits of deploying BrainChip Akida:

1. **Real-Time Anomaly Detection:** Akida's ability to classify up to nine different types of network traffic with 98.4% accuracy means it can detect and block a wide range of cyber threats in real-time, making it particularly suited for dynamic, high-traffic environments such as industrial control systems, smart cities, and military applications.

2. **Energy-Efficient Operation:** With a power consumption of just one watt, Akida 1000 is highly efficient compared to traditional GPU-based solutions. This makes it ideal for deployment in resource-constrained environments like unmanned aerial vehicles (UAVs), Internet of Things (IoT) devices, and remote sensing systems.

3. **Scalability for Large Networks:** Akida's neuromorphic design enables it to process large volumes of network data while maintaining low power consumption. This scalability is crucial for cybersecurity in HPC environments where traditional systems may be overwhelmed by the sheer volume of traffic.

4. **Enhanced Data Security:** By integrating Akida chips into network infrastructure, organizations can reduce their reliance on cloud-based analytics, which are often vulnerable to external attacks. The ability to process data locally at the edge enhances overall system security by minimizing exposure to network-based threats.

5. **Optimized for Edge AI:** Akida's SNN architecture, combined with its low-power consumption, makes it perfectly suited for edge AI applications. It can be deployed in a wide range of platforms, from UAVs monitoring sensitive data to autonomous vehicles that need to detect cyber threats in real-time without relying on external infrastructure.

Conclusion

Why BrainChip Akida is the Future of Cybersecurity

The BrainChip Akida 1000 chip is a leap forward in event-based computing, combining power efficiency, scalability, and real-time processing to deliver state-of-the-art cybersecurity solutions. Its benchmark results, outperforming Intel's Loihi 2 in accuracy, power consumption, and model size, solidify Akida's position as a superior choice for organizations looking to deploy efficient, real-time threat detection on lightweight, low-power platforms. Brainchip has a newer architecture, Akida 2, that supports higher precision inference and more advanced neural network architectures, including transformers and their proprietary TENNs temporal enabled state space models.

As cybersecurity demands increase, particularly in embedded and edge environments, the Akida chip is well-positioned to meet the challenge, offering robust protection against emerging threats while maintaining the flexibility needed to scale across diverse platforms. Whether integrated into UAVs, industrial control systems, or IoT devices, BrainChip Akida represents the future of low-power, high-accuracy cybersecurity.

References

1 Zahm, W., T. Stern, M. Bal, A. Sengupta, A. Jose, S. Chelian, and S. Vasan. "Cyber-Neuro RT: Real-time Neuromorphic Cybersecurity." Procedia Computer Science, vol. 213, pp. 536–545, 2022

2 Wyler Zahm, George Nishibuchi, Aswin Jose, Suhas Chelian, Srini Vasan. CSIAC 2024: Volume 8 Issue 2 – CSIAC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