HOW EMBEDDED MRAM ENABLES DECENTRALIZED AI MARKET

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I. DECENTRALIZED AI MARKET INTRODUCTION

Artificial Intelligence (AI) is recognized as the 4th industrial revolution of advanced technology world. The existing AI market is mainly controlled by tech giants, which offer cloud-based AI solutions and Application Program Interfaces (APIs). This model assumes little control of users over the AI products and such a centralized model could lead to the monopolization of the AI market. This could then cause unfair pricing, a lack of transparency, interoperability and limited participation of smaller companies in AI innovation. Thus, the emergence of a decentralized AI market, born at the intersection of blockchain, on-device AI and edge computing/Internet of Thing (IoT) is developing.

Decentralized AI market means AI, IoT and Blockchain technology working together for a better connected, efficient, and more secure world. AI is closely related to AI-based edge computing that allows complex AI algorithms to run on IoT devices like sensors, security cameras, drones or autonomous vehicles. Another recent trend in the AI market is the development of decentralized networks built on the blockchain. By definition, centralized proprietary solutions cannot be exposed to many users in the decentralized network. If the goal is to run a fully autonomous AI agent making smart managerial decisions and distributing profits, decentralized AI on blockchain is the way to go. Blockchain is a digitized, decentralized ledger of all transactions. The transactions are replicated across multiple computers and linked to each other to make any tempering with records virtually impossible.

II. EMBEDDED MRAM & other emerging NVM

AI requires memory-centric computing for better processing power and to be more energy efficient. Magnetic Random-Access Memory (MRAM) appears to be the most promising emerging Non-Volatile Memory (NVM) technology when compared to SRAM, eFlash, and ReRAM in terms of energy efficiency, endurance, speed, extendibility, and scaling[1]. Table 1 highlighted the differentials of MRAM to other memory candidates.

At this year's CES show in Las Vegas[2], there were many AI enabled and controlled IoT-based products enhancing an increasing number of consumer devices and services. Also, major memory and storage companies demonstrated how they intend to enable the next generation of non-volatile memory and storage. IoT with Embedded MRAM indeed attract intensive development due to better energy efficiency, extendibility and scaling[3]. Figure 1 showed power consumption of AI MRAM IoT device. Many well-known universities such as MIT and Stanford U are working on reducing power consumption and potential grid failure[4]. If IoT have both embedded AI and embedded MRAM, the sensors can start reasoning, learning and even talking to each other – bringing the intelligence level of the internet to higher grounds with lower power consumption.

III. DECENTRALIZED AI & EMBEDDED MRAM – ENABLED SOLUTIONS

The concept of decentralized AI is simple. Imagine a data store that has no specific owner. All the involved parties can contribute to it while at the same time every one of them can use it to train their AI algorithms. Since everyone is using the store to train their algorithms, they all have a stake in keeping the data clean. The challenge with decentralized AI is creating a store that isn't owned by a single party. One innovative solution is the use of blockchain, the distributed ledger that underlies cryptocurrencies. Blockchain uses cryptography to prevent the tampering of data and is transparently visible to everyone. Anyone can audit the data contained on the blockchain.

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AI applications require fast access to data and are very compute intensive. Scaling for very large datasets, as AI applications require, could be a potential problem eg power issue, fast reliable memory, and security control etc. But we're seeing solutions emerge to these problems. Embedded MRAM, a promising energy efficient with low power consumption, and a highly scalable and tolerable secure memory chip design, would enable the best solution for the decentralized AI market needs.

IV. SUMMARY

Artificial Intelligence (AI) gets layered over the IoT platform while the data from external sources flows through the Blockchain platform. Even the data exchange within the IoT network can happen over Blockchain to ensure traceability and recording of all transactions. Multiple IoT networks can exchange data while the power of AI will get exponentially enhanced with more data. The trinity of these technologies if enabled with embedded MRAM memory technology will not only help increase energy efficiency but also help faster and securer businesses delivering better customer and technology service. As of now, Blockchain technology appears to be the most promising solution for the internet security issue[5].

IoT, AI and Blockchain can complement each other well (see Figure 2). Embedded MRAM can help blockchain technology for AI and AI IoT needs. Blockchain-based platforms are emerging as one of best options to securely connect artificial intelligence with IoT at the network edge.

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Table I MRAM and other memory

Fig. 1 Power for AI MRAM IoT device

Memory / Category	MRAM	eFlash	SRAM	ReRAM
Technology node manufacturability	28 → 22 → 12 → 7 or 5nm?	40 nm	28, 22, 16, 12, 7nm	40 → 28 → 22nm
Power consumption				
Area (chip size)				
Reliability				
Overall				

Power @100MHz*	16 bit	32 bit	64 bit
Read power, mW	3.9	7.8	15.6
IoT power usage (1%), uW	39	78	156

Fig. 2 AI/IoT/Blockchain examples