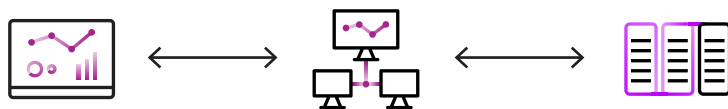# Winning the race to the IoT edge

The IoT edge — enabling the connected enterprise

With billions of industrial IoT devices expected to be connected to the cloud, the IoT edge will bridge enterprise and industrial systems in markets such as factory automation, oil refineries, smart cities, video security, health care and many others[1].

IoT edge solutions will bring compute and artificial intelligence (AI) closer to the source of the data, incorporating new software paradigms and introducing new business models that will inspire traditional OEMs and IoT platform providers to develop strategies to win the race to the IoT edge.

Real-time sensing
- Data ingestion
- Position/condition
- Metadata

IoT edge
- Data aggregator
- Protocol converter
- Data normalizing
- Local storage
- Machine learning inference

Enterprise data center
- Big data
- Training/AI
- Cloud storage
- Expert insights

Evolving architectures

IoT edge solutions will continue to evolve as compute and storage demands are expected to increase, leading to a need for:

- Data aggregation and connectivity in real-time
- Multicore processor systems that support deep learning inference and higher compute requirements
- Embedded local storage for on-premise data management
- New software middleware and APIs to support containers for microservices

As a result, memory size for code and data will increase to support new software cloud agents, middleware, and edge management. Processors will require higher DRAM performance with wider bus width for more efficient machine learning execution. And embedded storage size will increase as more endpoints are managed by a single edge device.

Low power DRAM are critical for AI accelerated solutions

AI chipsets are specialized hardware components designed to accelerate AI operations. Typical architectures contain CNN (convolutional neural network) and parallel compute processing engines to analyze massive amounts of data for on-chip analysis. One study[1] indicates a global AI chipset market size of up to US$267B by 2032 (CAGR of 31.4% 2022-2032).

Memory is keeping up with AI accelerated solutions by evolving with new standards. For example, LPDDR4x (low-power DDR4 DRAM) and LPDDR5x (low-power DDR5 DRAM) solutions have significant performance improvements to prior technologies.

LPDDR4x has data rates of 4.2Gbps, while the LPDDR5 offers 50% increase at 6.4Gbps. In addition, the LPDDR5x offers even more performance at 8.5Gbps. On power consumption, LPDDR5 offers 20% better power efficiency than the LPDDR4. These are significant developments that will improve overall performance and will match the latest processor technologies.

[1]https://finance.yahoo.com/news/global-artificial-intelligence-chipsets-market-100000893.html

[1]The global edge computing market size was valued at US $4.68 billion in 2020 and grew to US $6.29 billion in 2021, with projections of revenue generation of US $61.14 billion by 2028.
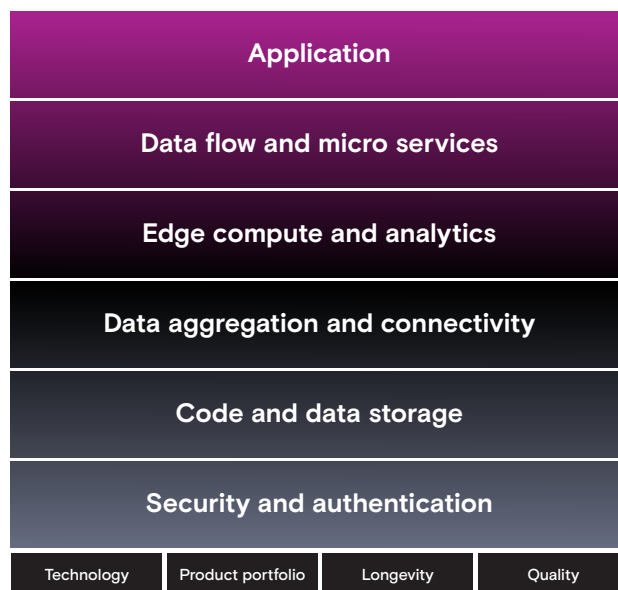–Grand View Research

micron

The many layers of the edge

Edge systems contain several functional layers that address unique operations, varying workloads and system requirements. Each of these will need the compute resources to execute these functions. The right selection of memory and storage will play an essential role to support these functional and system architectures.

Micron intelligence accelerated at the IoT edge

As a leader in industrial and automotive applications, Micron offers a broad range of memory and storage solutions to support the essential demands of the IoT edge:

- High-performance DRAM/LPDRAM and modules for compute and deep learning at the edge
- Broad NOR/NAND portfolio for code and data storage versatility
- Multichip package (MCP) solutions for space-constrained applications and cellular IoT modules
- Industrial-grade e.MMC, PCIe NVMe™ flash storage SSD and SD/microSD solutions for on-premise storage

Application
Data flow and micro services
Edge compute and analytics
Data aggregation and connectivity
Code and data storage
Security and authentication

Technology	Product portfolio	Longevity	Quality

Edge functions
- Microservices
- Local historian
- Edge analysis
- Aggregate with time function
- IP and data on device
- Code and data protection

Memory requirements
- Industrial-focused portfolio
- Intelligent partitioning
- High-performance wide bus width
- Leading interface standards support
- Configurable security

Micron offers the edge essentials

DRAM solutions
- DDR4/DDR5 and LPDDR4: market-proven, best system cost/performance tradeoff and long-term support
- LPDDR5x: data rates up to 8.5Gb/s; improved power efficiency; up to x64 bus width-packaged solutions enable high bandwidth interface for AI/ML workloads
- Variety of DRAM modules from high-performance SODIMMs to high-density LRDIMMs

Industrial-grade embedded storage
- Micron 2100AI, 2100AT 3D TLC SSDs
- SLC partitioning; Trusted Computing Group (TCG) Opal self-encrypting drives (SED)-compliant
- 64GB–1TB densities, BGA and M.2 form factors: 2100AI: Tcase –40°C to 95°C operating temperature 2100AT: Tcase –40°C to 105°C operating temperature

NOR/NAND portfolio
- SLC NAND with adaptive FTL: on-die ECC, industrial temperature range, OTP data protection
- Xccela© flash: x8 (Octal SPI) SDR/DDR JEDEC xSPI standard compliant; up to 2Gb full-featured flash, supports direct code execution and parametric data storage with up to 400MB/s reads, reducing pin count 5x compared with parallel NOR devices
- e.MMC with internal NAND management for simplifying development
- Up to 1.5TB uSD removable storage optimized for industrial applications

Multichip packages (MCPs)
- Broad range of NAND MCP, e.MCP density combinations
- Low 1.8V power; small package size/ball count solutions
- Vertical stacking at die level; minimize BOM for simplified manufacturing and cost savings

Micron