Powerful Infrastructure for Edge database analytics

Harness intelligence at the network edge to go where the data takes you

Practical applications of 5G are accelerating the adoption of network edge technologies. With edge computing, some portion of storage and compute resources is moved out of the central data center and closer to the source of the data. This is usually through on-premises edge servers and compute platforms, with edge devices that extend compute to places it could never go before (see Figure 1). For most of these intelligent edge applications, data management and database analytics are critical functions.

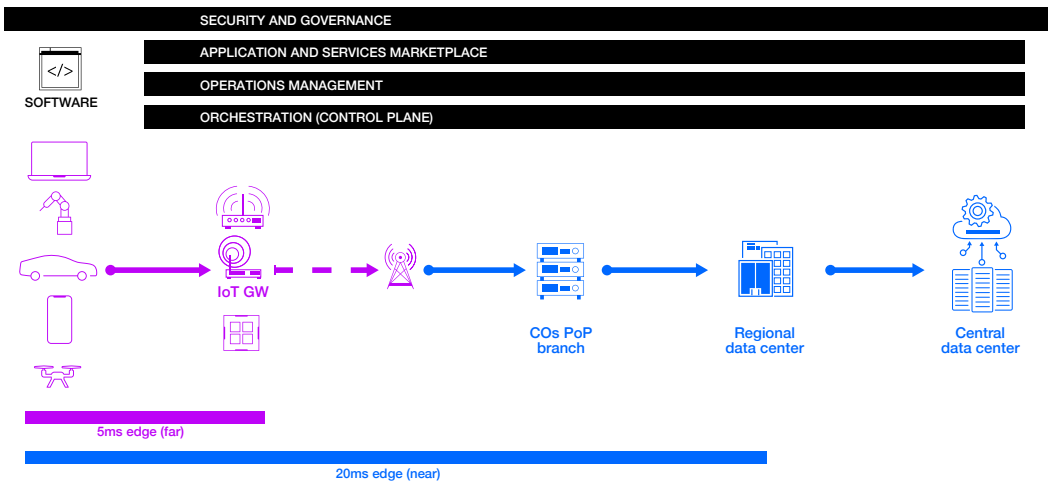

Figure 1: Omdia edge computing frameworks (used by permision).

Challenges met on next-gen edge architecture

Since the intelligent edge is relatively new, not all hardware and devices can store data or perform complex processing — yet. By 2025, 75% of data will be generated, analyzed and processed outside of traditional data centers at the intelligent edge[1]. This highlights the early decisions IT managers and system integrators must make on network distribution, workload orchestration and data security.

The needs of this cloud-to-edge infrastructure are a long-time focus of Micron innovation. A recent survey asked: "What are the most difficult challenges your organization has encountered when deploying and managing edge computing infrastructure (including servers, storage and networking)?" (see Table A)

Table A

#	Chosen as a top three by	The challenge (includes servers, storage and networking)
1	43.8%	Security and privacy
2	27.3%	Bandwidth constraints
3	21.5%	Lifecycle management
4	20.0%	System performance
5	19.6%	Footprint constraints
6	19.2%	Storage capacity
7	18.1%	Policy management
8	16.9%	Scalability
9	15.4%	Latency
10	11.9%	Limited physical access

Table A: Survey from 451 Research, part of S&P Global Market Intelligence[2]: The most difficult challenges of deploying and managing edge computing

The business value of data is unleashed at the edge

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Businesses are making decisions at the network edge more and more. This ebook, written by the experts at Omdia and commissioned by Micron, covers the innovation that has enabled data capture and processing to expand out of server farms. New business processes are springing up at remote locations where computing devices could never have been placed before. The critical element: responsive, flexible, next-gen IT infrastructure.

In the resulting Top 10 challenges list, Micron memory and storage technology helps mitigate eight of the 10:

- **Security and privacy:** Extremely robust SSD 256-bit encryption: data is essentially unreadable without proper credentials and Micron's unique Secure Execution Environment[3].
- **Bandwidth constraints:** DDR5 Server DRAM offers 2x the data rates of DDR44. Micron's NAND leadership keeps driving higher storage bandwidth — up to 77% higher in the latest generation[5].
- **Lifecycle management:** Micron Storage Executive enables control of an SSD's self-monitoring, analysis and reporting technology (SMART) attributes. The estimate of total bytes written (TBW)[6] on our SSDs enables useful lifespan management.
- **Systems performance:** Multi-access server DRAM improves even virtualized RAN and ORAN networks.
- **Footprint constraints:** Highly dense 176- and 232-layer SSDs deliver massive capacities in small, dense form factors.
- **Storage capacity:** The Micron® 9400 NVMe™ SSD offers the industry's largest commercially available SSD capacity of 30.72TB[7].
- **Scalability:** Empowered by server DDR4 or DDR5 DRAM, hosting analytics in the edge accelerates scaling up and out.
- **Latency:** Server DRAM drives system latency down. The Micron 7450 SSD delivers QoS latency at or below 2 ms, and it's consistent to 99.9999%[8].

Mitigating the high cost of data transport and more

Capturing and processing data closest to where it's needed helps to reduce the high costs of transporting all the zettabytes of 5G and intelligent edge information back to the cloud or central database. Edge computing itself also helps reduce network costs and transmission delays, mitigates the effect of service failures and bandwidth constraints, and improves control of sensitive data.

The key: Reducing geographic distance to reduce latency

Speediness is the number one attraction for this edge infrastructure. Positioning edge servers as close as possible to the sources of the data and pushing the intelligent edge ever further away from the cloud/enterprise data center is mostly about reducing latency. Organizations that capture the edge data and act on insights in near-real time gain competitive advantages. Content development networks (CDNs) reduce latency to deliver "instant access" to the users of their JavaScript, images and downloadable products.

Edge compute is vital to database analytics

Of the two main types of edge servers, CDN edge servers mostly hold cached versions of static content from the cloud. But edge compute servers enable functionality at the network edge. Distributed enterprises have pushed computing infrastructures beyond what traditional IT can handle (see Figure 2). Workloads such as edge data base analytics, data processing for 5G networks and internet of things (IoT) applications call deeply on infrastructure to unleash the true potential of the edge.

Why and where edge data base analytics

In the early days of edge devices, sensors would send all protocols and data back to the cloud — or just aggregate, process and forward. Network constraints, high latency and the high cost of data transmission challenged this model. Now, after performing edge analytics and data management, some remote actions are taken in near-real time. Then analysis to filter the data sends only meaningful historical information back to the cloud/data center for post-collection ad hoc analysis and reporting.

The ability of edge compute servers to certify, aggregate, store and analyze data at the network edge empowers smart cities, telemedicine, precision agriculture, advanced driver assistance systems (ADAS) and more. Edge database analytics are used to:

- Monitor industrial equipment and manufacturing processes, including real-time IoT alerts
- Track defects, inefficiencies and production downtime
- Optimize how resources are consumed, such as gasoline, electricity, water, etc.
- Improve safety with real-time visibility of equipment sensors and/or control systems

Edge architecture will become more complex

High performance and increasing memory footprint

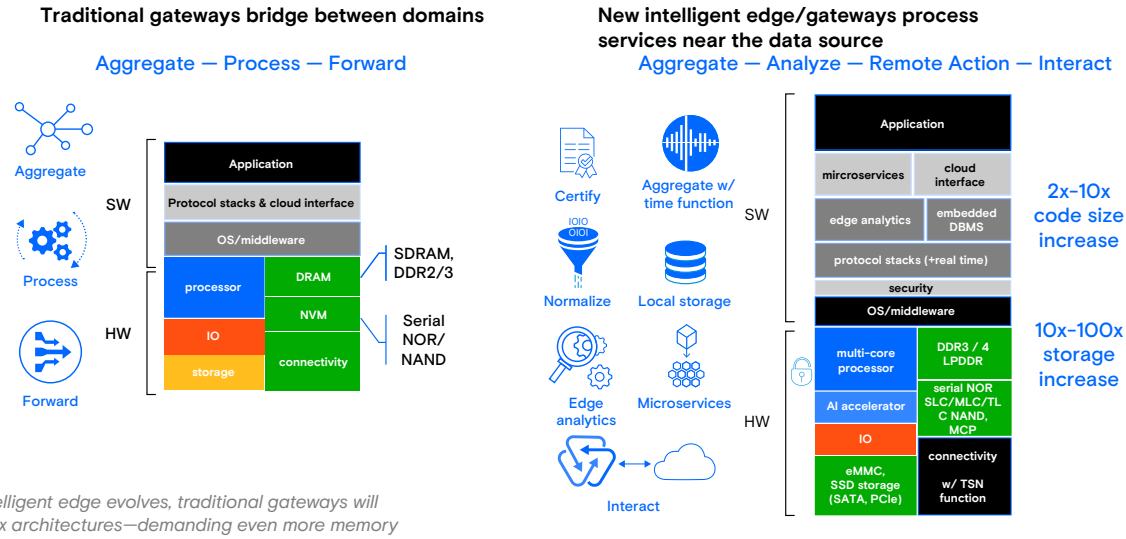
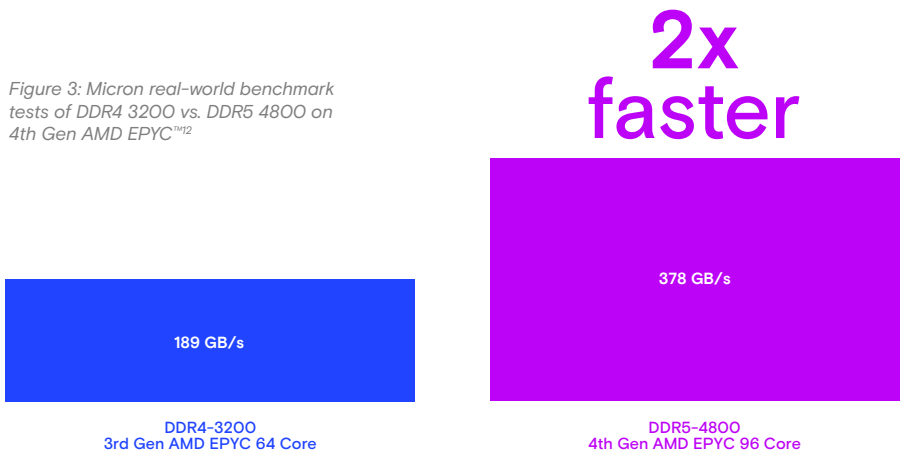


Figure 2: As the intelligent edge evolves, traditional gateways will give way to complex architectures—demanding even more memory and storge.

Figure 3: Micron real-world benchmark tests of DDR4 3200 vs. DDR5 4800 on 4th Gen AMD EPYC™[12]



Micron's proven portfolio for edge

From silicon to system, Micron creates the memory and flash storage that power the data center and make workloads faster, more reliable, more efficient and more cost-effective. In addition to edge servers, our LPDDR4 and LPDDR5 technology provides intelligent endpoints with low power and small footprint memory. We also offer varieties of edge storage, whether raw NAND, or managed NAND with the controller embedded, up to our NVMe SSDs and NAND embedded in multi-chip packages (MCP).

For multi-core processors of edge gateway servers that must draw greatly on server memory, Micron® DDR4 Server Memory is a mainstream DRAM leader, delivering power savings, performance enhancement and density. Blazing-fast Micron® DDR5 Server Memory feeds rapidly growing processor core counts with memory bandwidth and capacity, plus enables 2x the data rates of DDR4[4] (see Figure 3).

For edge server storage, the Micron® 7450 NVMe™ SSD offers the industry's broadest range of PCIe® Gen4 SSD form factors[9] and enables several storage use cases, including boot, cache and main data storage. Flexible data center performance also cements the new edge infrastructure. Here, the new Micron® 9400 NVMe SSD outperforms competitors up to 2.3x in mixed workloads[10] and improves power efficiency up to 77%[11].

Real-world example: Supply chain leader using IoT

On its 16,000 acres, Utah Inland Port Authority (UIPA) transfers cargo in/out of inland markets for about 40% of America's GDP. UIPA houses its edge-based servers and storage in a mobile trailer, near the IoT-based sensors and gauges that monitor truck and rail movement, connected with a private 5G network. The lower latency combined with edge analytics enables real-time management of a complex supply chain. Future plans: Deploy UIPA edge management to hundreds of locations to support the anticipated thousands of sensors, cameras and gauges coming.

Why Micron for your intelligent edge

Micron understands IT and internet of things (IOT) industry challenges, from the factory floor to the corporate headquarters. Our wide array of memory and storage capacity, density, form factor, power efficiency, interface technology and thermal/environmental metric options help meet data challenges from the edge to the cloud.

We will help you innovate for the intelligent edge with our broad portfolio of industry tested memory and storage solutions.

For more information on edge database analytics, visit online at: Micronpg.com/datacenteredge

Sources:

1. Gartner: "What Edge Computing Means for Infrastructure and Operations Leaders" – https://www.gartner.com/smarterwithgartner/what-edge-computing-means-for-infrastructure-and-operations-leaders
2. 451 Research, part of S&P Global Market Intelligence, "Market Intelligence, Voice of the Customer. Charts & Figures Use Cases 2022: Edge Infrastructure and Services," August 2022.
3. The Micron Secure Execution Environment is an isolated security processor within the SSD controller. Security statement is estimate only, actual value may vary, and based on data from https://www.thessistore.com/blog/what-is-256-bit-encryption. No hardware, software or system can provide absolute security under all conditions. Micron assumes no liability for lost, stolen or corrupted data arising from the use of any Micron products, including those products that incorporate any of the mentioned security features.
4. Under memory-intensive workloads, DDR5 is designed to deliver 1.87x the bandwidth from double burst length, double the banks and bank groups, and significantly higher speed than DDR4, as established by JEDEC, an independent organization that develops open standards for the microelectronics industry.
5. Micron 232-layer NAND delivers 2.4 gigabytes per second (GB/s) I/O speed and enables NV-LPDDR4, a low-voltage interface that delivers per-bit transfer savings of more than 30% compared to prior I/O interfaces. More at https://investors.micron.com/news-releases/news-release-details/micron-ships-worlds-first-232-layer-nand-extends-technology
6. Actual SSD lifetime will vary by workload. Total bytes written (TBW) calculated assuming drive is 100% full (user capacity) with workload of 100% random aligned 4KB.
7. The Micron 9400 NVMe SSD has a capacity of 30.72TB. Comparisons are made based on other leading PCIe Data Center U.2/U.3 NVMe SSDs based on data center market share as noted in the Forward Insights SSD Supplier Status Q2/22 report and available data. 1GB = 1 billion bytes, formatted capacity is less.
8. Micron 7450 SSD delivers 2ms and below 99.9999% read latency, measured up to queue depth = 32 for 4KB, 100% random, 70% read workload.
9. Based on similar use SSDs with NVMe available on the open market as of March 2022, the Micron 7450 SSD offers the broadest range of form factors, including U.3, M.2 and E1.S; U.3 is available in both 15mm and 7mm. All combined with Micron's leading 176-layer NAND.
10. Performance measured using 7.68TB SSDs at queue depth (QD) — 256 with FIO (additional details on FIO are available here: https://fio.readthedocs.io/en/latest/).
11. This is for the Micron 9400NVMe SSD. 77% efficiency improvement is vs the Micron 9300 SSD. Efficiency is defined as performance per watt.
12. Single socket 3rd Gen AMD EPYC CPU 7763 with Micron DDR4 3200 MHz system is capable of 189 GB/sec. Single socket 4th Gen AMD EPYC CPU 9654 with Micron DDR5 4800 MHz system is capable of 378 GB/sec.