



Smartphone Innovation Surge Fueling Demand for Higher Capacity, Purpose-Built Internal Memory and Storage

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DANIEL NEWMAN
Principal Analyst + Founding Partner

RON WESTFALL
Sr. Analyst + Research Director

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Introduction

The growing popularity of mobile connectivity through smartphones has been rapid and broad across the global consumer and business market landscape. In the last year, [60% of global internet traffic](#) came from smartphones, compared to only 37% from desktops. Smartphone use is surging due to convenience, the ability to support more useful tasks through apps, increased user-friendliness, and cost-effectiveness compared to laptops and desktops. Applications, such as metaverse, AR/VR, and AI experiences, are expected in our smartphones, and purpose-built, high-bandwidth, low-latency memory and storage semiconductors are pivotal to enabling these next-generation experiences.

Consumers are demanding personalized mobile experiences, and the mobile ecosystem is delivering by providing next-level user experiences fueled by 5G and AI innovation.

The mobile ecosystem has been the conduit in enabling connection globally. By the end of 2021, 5.3 billion people had subscribed to 2G/3G/4G/5G mobile services, representing 67% of the global population. That figure consists primarily of mobile network operators selling mobile connectivity for calls and data communication. In 2021, mobile technologies and services, including 2G/3G/4G/5G mobile infrastructure, mobile devices, applications, and support services, generated \$4.5 trillion of economic value added, representing 5% of the global GDP. This figure is expected to grow by more than \$400 billion by 2025 to nearly \$5 trillion as countries increasingly benefit from the improvements in productivity and efficiency across the consumer and business realms (according to the GSMA).

Mobile semiconductor technology is underpinning the expanding reach and society-wide impact of worldwide mobile connectivity. [According to data from Modor Intelligence](#), the mobile phone (e.g., smartphone) semiconductor market was valued at \$44.9 billion in 2020 and is expected to reach \$69.3 billion by 2026, at a CAGR of 7.49% between 2021 and 2026.

From our perspective, understanding the expanding influence of the global mobile ecosystem, including the mobile semiconductor market, provides the foundation to examine the megatrends defining and shaping the evolution of today's mobile connectivity and explore Micron Technology's critical role in that equation.

The Major Trends Driving Massive Capacity and High-Performance Memory and Storage in Smartphones

This paper examines the major trends driving massive capacity and high-performance memory and storage in smartphones while evaluating Micron's memory and storage portfolio. We'll dive into why we believe the company is well-suited to delivering the high capacity, greater bandwidth, low-latency memory solutions, and high-capacity, blazingly fast storage solutions required to fulfill the unique memory/storage demands across the entire mobile ecosystem. These demands span OEM smartphone manufacturers, system-on-chip (SoC) vendors, and mobile applications, particularly in 5G and AI environments.

The top trends driving the need for greater performance and higher capacity in mobile memory and storage include:

- Mobile gaming
- Social media and short-form video
- Immersive experiences & metaverse
- AI-enabled mobile apps
- 5G standalone network builds

Let's explore these macro trends and the critical role mobile memory and storage plays in each:

Mobile Gaming. End users are spending more time gaming on their smartphones, making mobile gaming integral to global mobile business growth. [According to data from Newzoo](#), 2.8 billion of the world's 3 billion gamers played on a mobile device, compared to 1.4 billion gamers playing on a PC and 0.9 billion on consoles. As such, we anticipate that mobile games will drive greater demand for low-power

mobile dynamic random-access memory (DRAM) and managed NAND to meet broader global uptake as well as LPDRAM-enabled graphics and enhanced managed NAND capabilities to augment photorealistic and virtual reality innovations. Micron recently launched LPDDR5X memory for smartphones, which is the fastest LPDRAM in the industry. It supports speed grades up to 8533 Mbps, enabling instantaneous gaming load times and refresh rates that are to par with typical gaming PC consoles.

User-Generated Short-Form Video. The size of camera sensors used in smartphones and other mobile devices can cause limitations in capturing images. Sensor size determines how much light the camera has available to create an image and, as such, the camera's exposure balance, dynamic range, and image clarity. Smartphones require computational imaging (video and photography) technology that provides AI-integrated software engines and digital computation built into SoCs. When users open the camera application on their smartphone, the environment, lighting, and subject of the imagery are analyzed and stored in a memory buffer before they tap the record button or shutter. These capabilities are essential to social

media content creation and consumption, such as sharing short-form videos across popular apps. For example, **82% of marketers** say they repurpose content across social media channels. What's more? Short-form videos are the top social media format used by 54% of social media marketers, followed by livestreaming, live audio chatrooms, and user-generated content. TikTok users, for example, **on average, spend 95 minutes per day in the app** consuming short-form video content. And 83% of users have posted a video on the app. It's clear that short-form content is king.

Immersive User Experiences & Metaverse. Increasingly, we see smartphones playing a vital role across newer cases that use virtual reality (VR), augmented reality (AR), and extended reality (XR) capabilities that provide immersive experiences. We see these scenarios generating greater demand for super-fast memory and high-capacity storage capabilities. In addition, consumers, such as the gaming community, fuel the demand for immersive experiences and metaverse capabilities. As a result, we see increasing demand for 3D asset pipelines that import customer data (CAD and 3D) for rendering on mixed-reality devices.



AI-enabled Mobile Apps. 5G wireless technology now enables the high-speed processing, low-latency, high-bandwidth, and vast storage capabilities that can deliver intelligence breakthroughs across mobile devices which have a society-wide impact. For instance, smartphones now support AI assistants and engines that can understand human interactions including user preferences, environments, situations, and unique data. We see the mobile ecosystem accelerating the use of smartphones as the conduit to AI engines and capabilities, unlocking an expanding array of mobile applications including chatbot, speech recognition, image recognition, and language translation for consumers. Businesses are prioritizing mobile app capabilities such as auto-monitoring of manufacturing processes, autonomous vehicles, drone management, and automation of 5G network operations and business processes.

Considerations and Benefits: Micron Technology's Mobile Memory and Storage Portfolio Strengths

As we evaluated Micron's mobile portfolio, key strengths were immediately evident. We believe Micron Technology's deep heritage and company-wide DNA in developing memory and storage semiconductor solutions are well-suited to meet the unique challenges of the 5G era. Specifically, this applies to fulfilling the mobile ecosystem demands of the megatrends we identified. Let's examine why we see Micron excelling in these key megatrend application areas:

Mobile Gaming. Smartphone manufacturers require on average 12GB of LPDDR technology in their smartphones to provide the requisite photorealistic graphics and lag-free streaming capabilities for mobile gaming. Specifically, we believe Micron's mobile DRAM and managed NAND storage solutions, which are embedded into smartphones, are critical in taking mobile gaming experiences to the next level and service. These solutions will also serve as a critical entry point to gaming metaverse and metaverse-like applications.

Social Media and Video. Micron's smartphone memory, LPDDR5X provides 8533 Mbps maximum data rates, up to 50% improvement in night mode photo resolution, and up to 35% faster shoot time compared to previous-generation LPDDR5. We view these memory capabilities and impressive speeds as vital to enabling computational imaging. Such capabilities enable the dynamic, high-resolution video and images key to enhancing social media experiences and supporting business video applications, including mobile video security.

Immersive Experiences & Metaverse. We see Micron's internal smartphone memory and storage as integral to powering evolving metaverse applications. Specifically, Micron's LPDDR5X DRAM addresses evolving memory requirements for AI and 5G by providing a 50% increase in data access speeds and more than 20% power efficiency compared to previous generations (according to Micron). Micron LPDDR5X enables 5G smartphones and other devices to process data at peak speeds of up to 8533 Mbps, which is critical for easing 5G data bottlenecks in the support and delivery of immersive experiences.

AI-enabled Mobile Apps. From our perspective, Micron has developed powerful LPDRAM memory to transport high volumes of data through smartphone SoCs at very fast speeds—coupled with the low latency that AI needs to perform optimally and low power in the DRAM needed to extend battery life. This low power is critical as users increasingly multitask with data-intensive, battery-draining mobile apps yet expect their smartphones to last all day. Micron's LPDDR memory delivers the speed and capacity needed to feed AI engines built directly into mobile processors. These processors rely on high data rates from Micron's internal LPDDR memory solutions to power the smartphone's ML and AI capabilities. We view Micron's embedded memory solutions as key to powering the distributed AI engines required to enable smartphone application innovation, especially throughout 5G SA environments.

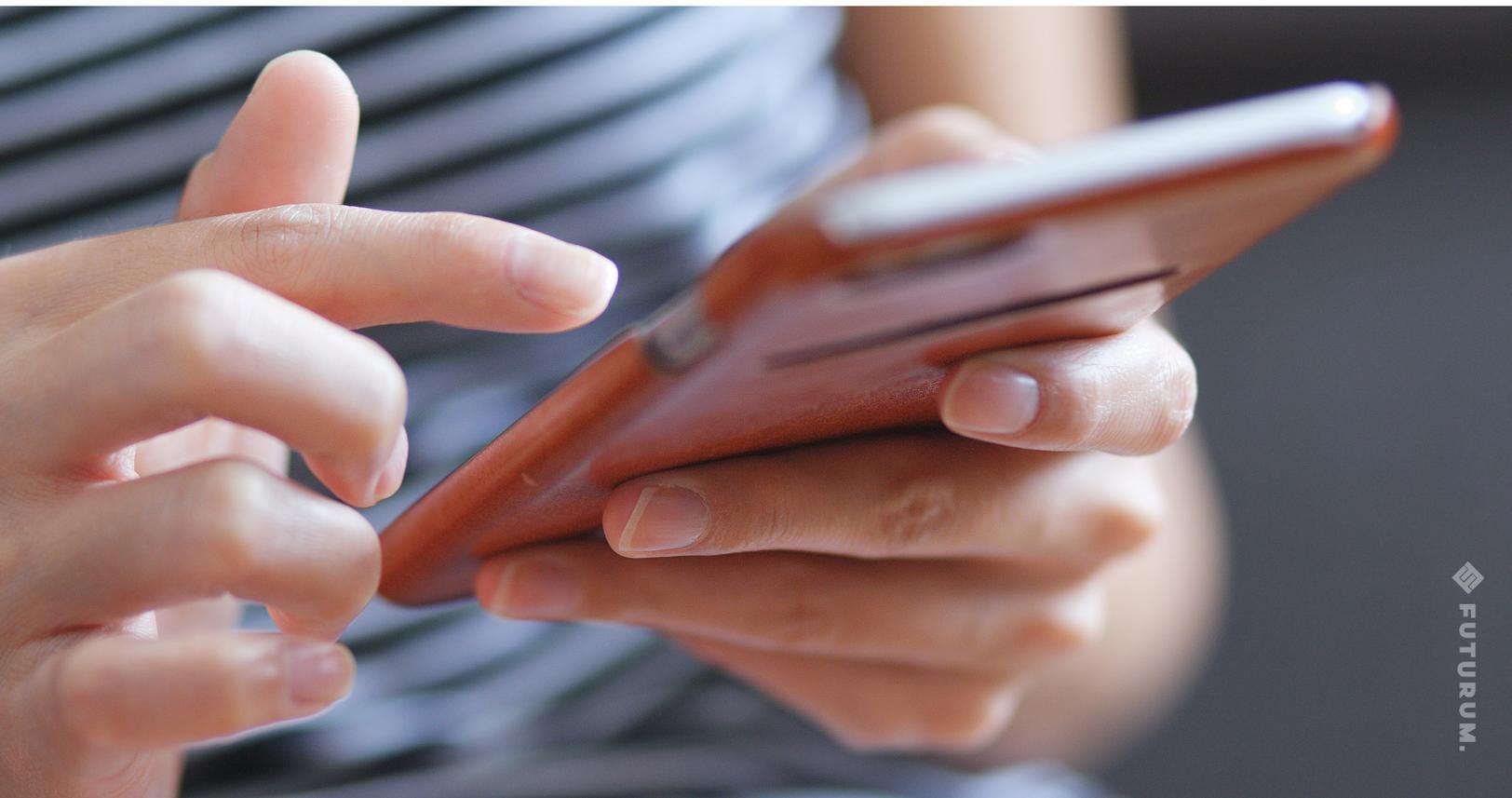
5G Standalone Networks. Micron’s mobile memory portfolio meets the unfolding requirements of 5G standalone networks as operators advance their transitions from 4G/LTE and 5G non-standalone networks. Micron LPDDR5X’s fast data rates provide up to 33% faster performance than previous-generation LPDDR5 — providing virtually unparalleled mobile memory to help drive the transition to 5G. LPDDR5X also delivers up to 24% more power efficiency than previous-generation LPDDR5 memory allowing users to create, share and enjoy their mobile experiences longer between daily charging.

For instance, mobile videographers and photographers can use these LPDDR5X advances to tap into new capabilities such as swiftly transferring 4K/8K video and other large media files to support end-to-end workflows and improve business outcomes. The new advances also provide enough bandwidth to combine mobile-based viewing with emerging features such as AR/VR, 360-degree video and higher-resolution cameras that are also well-suited for Industry 4.0 applications such as video security, smart manufacturing, digital twins, and network slicing.

Conclusions and Takeaways

The rapid proliferation of 5G mobile connectivity and AI applications marks smartphones’ cascading growth worldwide. From our viewpoint, Micron is very well-positioned to provide leading-edge memory and storage solutions that are high bandwidth, low latency, and offer massive capacity to global smartphone OEMs for use in their devices. Micron offers depth and breadth of memory and storage solutions that are purpose-built to serve all tiers of the smartphone ecosystem, from flagship, high-end and mid-range smartphones.

In our assessment of Micron’s mobile portfolio, we see these mobile ecosystem benefits as encompassing enhanced mobile gaming experiences, substantial improvement in smartphone video and social media capabilities, immersive experiences and metaverse, AI-enabled mobile applications, and acceleration of 5G and AI use cases.



Important Information About This Research Brief

PUBLISHERS:

Daniel Newman
Founding Partner + Principal Analyst
Futurum Research

Shelly Kramer
Founding Partner + Principal Analyst
Futurum Research

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CONTACT INFORMATION

Futurum Research, LLC | [futurumresearch.com](https://www.futurumresearch.com) | 817-480-3038 | info@futurumresearch.com

Twitter: [@FuturumResearch](https://twitter.com/FuturumResearch)

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