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Promise of 5G Requires New Approaches to Mobile Memory

The next-generation 5G mobile network promises a future of ubiquitous, ultra-high-speed wireless connectivity, offering throughput up to 50 times faster than existing 4G networks. 5G latency -- the delay between your request for data and when your mobile device receives it -- will be at least 5 times better than 4G latency. 5G will unlock incredible possibilities for multimedia and video experiences, as well as other innovative user experiences. But in order to take advantage of these dramatic changes, mobile devices need a much more sophisticated memory subsystem to keep up with the speed and storage requirements without increasing power or footprint.

While most of the industry agrees that 5G has the potential to transform the mobile experience, many handset manufacturers and ecosystem players may not fully understand what is required in hardware and software to take full advantage of the ultra-fast network. The high bandwidth of 5G will deliver several exciting usage models to the mobile user, such as real-time UHD video streaming, virtual reality, immersive gaming, and edge computing. However, these advancements create new challenges that must be addressed within the framework of the mobile handset platform.

HIGH-SPEED MULTIMEDIA AND VIDEO DRIVE MEMORY AND STORAGE REQUIREMENTS

Today's mobile devices are not equipped to handle the upcoming barrage of memory and storage requirements that high-bandwidth multimedia and video will demand. For example, in the existing 4G/LTE environment, most users wouldn't even consider streaming UHD content or attempt to share their immersive gaming session. However, with 5G's promise of 3.6Gbps data speeds, these richer multimedia experiences become a reality. What users may not realize is that when streaming content, their mobile device is actually performing "file caching" in the background, temporarily buffering the video and reading/writing into memory. This scenario requires both increased memory size and improved storage performance; the device's memory subsystem must have the ability to read and write as fast as the network, otherwise a performance bottleneck is created.

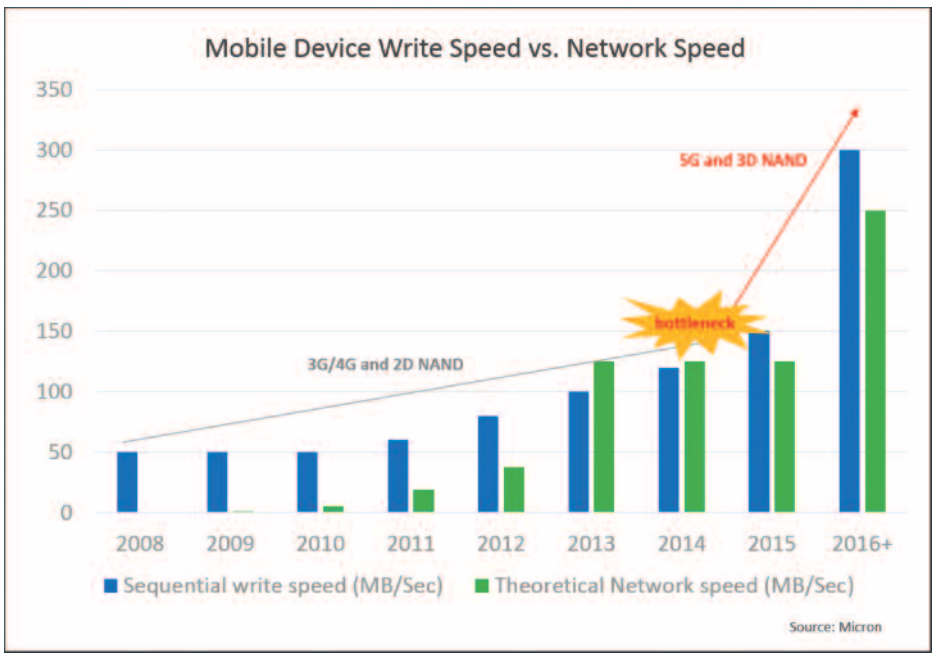
MOBILE RAM – MOVING BEYOND 4GB

We are asked frequently how much RAM is necessary for mobile devices. Until recently, a typical mobile handset had 1 or 2GB of RAM. Now, as the size of operating systems and display resolutions increase, many of the higher-end smartphones are including up to 4GB of RAM. Manufacturers understand that the more RAM the device has, the more of a performance buffer it creates, and the more applications and multimedia tasks can be "parked" as background processes. The trend towards higher resolutions and better pixels drives the need for dedicated RAM (for example, playing back native 4K content at 30fps requires a minimum of 3GB of RAM). And, as 5G delivers on its promise for real-time, multi-feed video collaboration, imaging applications will require dual-facing cameras and high-density pixel imagers that drive increased compute and storage requirements.

OVERCOMING THE FLASH STORAGE BOTTLENECK

Of course, the amount of accessible RAM is only half the challenge. Connecting to a 5G network with blazing fast downloads will inevitably create the need for faster and higher capacity storage. The "2D" planar NAND flash memory that is used in nearly every mobile device today is nearing its practical scaling limits, which poses a major storage challenge for the industry. As we move to 5G, the mobile industry needs flash technology solutions that scale with higher densities, performance, and reliability.

In 2015, a joint industry initiative announced 3D NAND technology, a revolutionary memory innovation that stacks layers of data storage cells vertically with extraordinary precision to create storage devices with three times higher capacity[1] than competing NAND technologies. Because capacity is achieved by stacking cells vertically, the individual cell dimensions can be considerably larger. This enables more storage in a smaller die area, bringing significant cost savings, low power usage and high performance to a range of mobile consumer devices.



From a performance perspective, 3D NAND offers a significant boost in read/write bandwidth speeds, which is critical to keep up with potential 3.6Gbps data download speeds. We believe that 3D NAND flash storage is critical for future devices. After all, what good is an ultra-fast 5G network if your device's read/write performance can't keep up?

In terms of power efficiency, 3D NAND features new sleep modes that enable low-power use by cutting power to inactive NAND die (even when other die in the same package are active), dropping power consumption significantly in standby mode. And because more electrons are packed into the same space vs. today's planar counterpart, there is a lower chance of data loss which typically occurs during reboot or device overheating. All in all, we believe that 3D NAND is the flash storage solution that is critical for future mobile devices.

THINKING AHEAD: EMERGING MEMORY INNOVATIONS

While adding RAM capacity and enabling new technologies like 3D NAND are critical in the short term, new industry innovations are needed to solve upcoming mobile challenges. One such innovation is 3D XPoint™ technology, which was announced in 2015.

3D XPoint technology is an entirely new class of non-volatile memory that can help turn immense amounts of data into valuable information in real time. With up to 1,000 times lower latency and exponentially greater endurance than NAND, 3D XPoint technology can deliver game-changing performance for a variety of mobile applications. Because 3D XPoint memory is byte addressable, there are possibilities for it to handle both data storage and near-processor execution workloads in a single persistent memory system, enabling entirely new architectures.

3D XPoint can be a game changer for the mobile industry, but it will require significant ecosystem partnerships to ensure success.

RE-ARCHITECTING FOR 5G OR WHATEVER COMES NEXT

It's important to remember that for all of the exciting capabilities of 5G, there is still a lot of work to do within the mobile industry to make it a reality. Regardless of 5G's timeline, the innovation in smartphone capabilities is not standing still. It is certain that resolutions will get higher, cameras will get better, and multimedia will become even richer in the handset. For this reason, it is critical that mobile devices employ a better, faster and more sophisticated memory and storage subsystem to enable the expected experience.

[1]Capacity difference based on comparison between Micron 384 Gb TLC 3D NAND die and other industry 3D NAND TLC