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Seventy Years of Magnetic Disk Drive Technology.

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The first hard disk drive, the IBM RAMAC, was shipped in September 1956. It was the size of a couple of refrigerators, contained fifty 24-inch diameter disks and stored information at an areal density of 2000 bits per square inch. Although ten years ago, the industry was widely perceived as facing a fundamental limit at 36 Gbit per square inch (Gbps) in the form of superparamagnetism, current disk drives provide areal densities in excess of 130 Gbps and capacities of 750 Gbytes. Although the original projections of superparamagnetism were correct, by changing the way the devices were scaled and, ultimately by changing from longitudinal to perpendicular recording, it has been possible to circumvent superparamagnetic effects. Our current understanding indicates that it may be possible to extend the areal density by yet another factor of 400 from present densities, if advanced technologies such as heat assisted magnetic recording and bit patterned media are implemented. Assuming this proceeds at the recent rate of 40 percent increase in areal density per year, we would reach roughly 50 Terabit per square inch (Tbps) in about 2026, 70 years after the development of the first disk drive. To achieve this, however, the industry will need higher sensitivity giant magnetoresistive sensors, high efficiency near-field transducers powered with surface plasmons and self-assembled or nano-imprinted magnetic particle arrays for media. In this presentation, the author will briefly describe the history of recording on magnetic disk drives, then describe the potential for future growth and some of the physics and materials problems that need solution in order to realize this full potential.