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Data Center Hyper Growth. It's Not What You Think.

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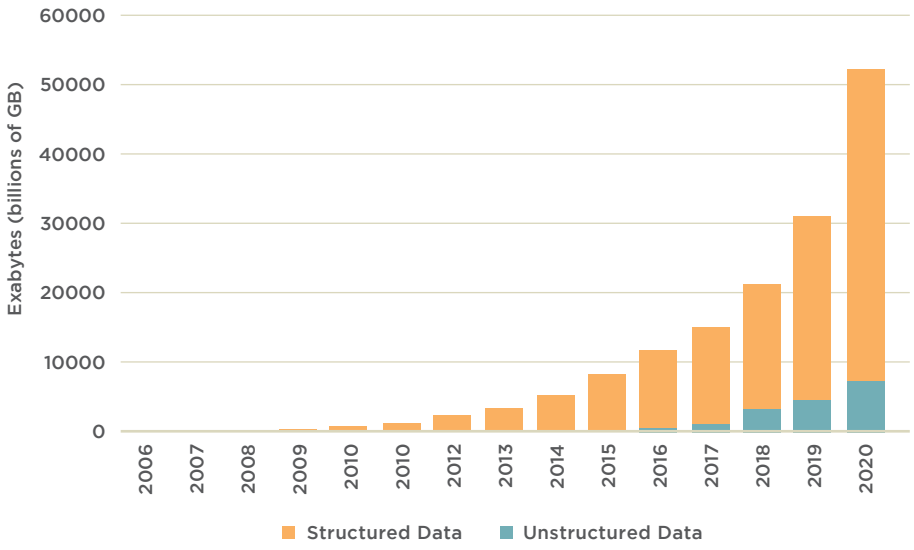
Amazon and Microsoft are prominent among corporations building hyperscale data centers to support still expanding public cloud-based web services businesses. Already, there are 171 hyperscale data centers in the US, and expansions in Dallas and Atlanta have recently been announced. Given projects such as those, you might think that data center is a growth business. You'd be wrong.

- **>> Physical plant is not growing much**
- **>> For years, data growth has been absorbed by technical advances in storage media**
- **>> A rapid migration to NAND is underway**
- **>> Data transfer advances represent the new horizon in capacity expansion**

A data center is a climate-controlled, access-controlled building housing servers and communications devices. In early data center days, bigger corporations built and maintained their own data centers, while those with lesser computing needs used small, local shared facilities. Companies small and large have been migrating away from using their own servers to using massive cloud facilities.

The Cambrian Explosion... of Data



Source: EE Times

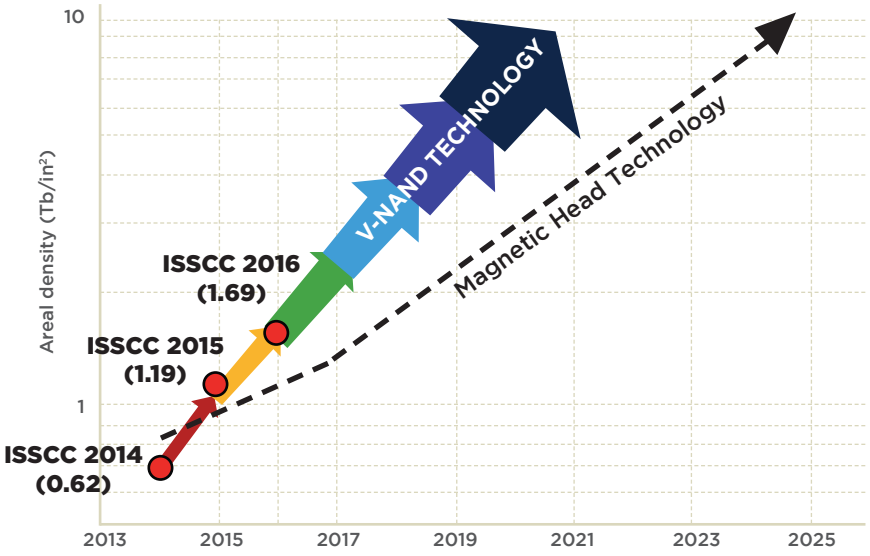
Although the change from private to public data centers has been significant, the net change in data center square footage isn't much. According to estimates, the US has 1.94 billion square feet of data center space in 2018. This figure is flat year-over-year and up at a 4% average annual rate over the last five years. Just as square footage growth is minimal, the electrical power usage for data centers has changed even less. Power consumption by data centers has grown at a 2% rate over the last five years; it represents 2% of total US electrical consumption.

So, with 4% square footage growth and 2% power consumption growth, one could say that data centers aren't really growing much on a physical basis. However, looking at exabytes of data stored in these facilities, the growth rate was 41% in 2016 and 37% in 2017. Said another way, the amount of data stored in the domestic data centers has nearly doubled in the last two years without the physical space or power demand changing much. IDC expects data to double every year for ten years starting now.

Big Advances in Data Density

Storage media has advanced over time from tape drives, to hard disks, to solid state. The industry has a measure, called Areal density, which indicates the amount of bits that a storage medium can pack into each unit of surface area. Said differently, Areal density is the amount of gigabits stored per square inch. Tape drives became obsolete about the turn of the century. Their best recorded Areal density in production was 0.84 GBit/in2. Optical disks replaced tape drives, and they continue to be in use today. CD's, DVD's, and now Blu-Ray disks are all optical storage media. Their best Areal density is 12.5 Gbit/in2, almost 15 times more than tapes. Hard disks developed concurrent with optical disks, and their storage density dwarfs that of optical disks. The best hard disks store 1340 Gbit/in2, and development of that media continues as hard disk storage capacity has increased by 60% over the last two years. Many data centers utilize hard disks today, and the continued expansion of hard disk Areal density matches up with exabyte growth pretty well.

While hard disks have been the data center workhorse for many years, they are currently being replaced by NAND flash-based storage arrays. The Areal density of NAND eclipsed that of hard disk storage sometime in 2016. NAND storage now max-es out at 1690 Gbit/in2 in density, about 25% greater than the best hard disks. That difference is sufficiently significant that most new data center storage is NAND configuration today. The shift to NAND storage is so decisive, in fact, that construction of hyperscale data centers is believed to be causing a memory shortage in early 2018.



*IDEMA - ASTC Technology Roadmap (http: //www.idema.org)

Source: ASTC, Samsung

Data Transfer is the New Frontier

NAND, a solid state drive (SSD), has better storage density than hard disk, however, it comes with some input/output complications. Data transfer speeds from a disk depend on how fast the disk can move under a head. Think of this like a needle on a turntable. In this fashion, data is transferred to a data center server using a protocol named SATA. SATA can transfer data at a rate of 3.0 gigabits per second. NAND architectures are not built to respond to greater velocity at the head. Instead, NAND requires increasingly efficient queries. NAND storage is migrating to a transfer medium called Non-Volatile Memory Express or NVMe. NVMe-based drives have throughputs as high as 16.0 gigabits per second, over 5 times faster than SATA-based configurations.

Conclusion

Despite public attention to new hyperscale data centers, overall data center supply has increased only slightly in recent years. Although physical plant has not expanded, domestic data centers have been able to house nearly 40% annual increases in bit storage. Technical achievements in hard disk drives have shouldered most of that load, and a transition to NAND-based storage is expected to provide the continuing boost to capacity going forward. Data is forecast to grow at advancing rates in the coming years, and a new transfer media is set to enable that data to be stored within the four walls of the data center fleet. JAG sees hyper investment opportunity among NVMe SSD companies.

ABOUT JAG

JAG Capital Management is an independent, 100% employee-owned registered investment advisor headquartered in St. Louis, Missouri. The firm provides portfolio management services for institutions, individuals, investment advisory firms and corporations. In addition to managing the JAG Large Cap Growth mutual fund, equity and fixed income separate accounts are also offered.

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