REPORT REPRINT

Beat gravity by processing data within storage, says NGD Systems

TIM STAMMERS

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Data has gravity, so sometimes it's best to process it in place, rather than move it. That principle of in situ processing underpins NGD Systems' NVMe drives, which can host third-party code on ARM processors within the drives themselves, and therefore radically boost performance for AI and other use cases, the company says.

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Emerging applications such as AI need ever-faster infrastructure, and this fact is driving the development of new technologies and architectures. Startup NGD Systems has developed NVMe flash drives that can process data in situ, and therefore avoid the latency-inducing need to move data to the memory in a host server. This is the same principle that is set to drive rapid growth in so-called 'edge' computing but applied at a deeper level. Because data has gravity, bring the processing to the data – not the other way around.

NGD's second-generation Catalina NVMe flash drives can run third-party code on multiple ARM cores within the drives themselves, in an instance of Linux. According to the company, this in situ processing delivers a dramatic reduction in processing time, when running open source Facebook AI Similarity Search (FAISS) image similarity search code from Facebook on the drives. And because the collective processing power of multiple drives scales up with their aggregate storage capacity, image load and processing times remain unchanged regardless of the data size.

Despite the in situ processing and ARM cores, NGD says its drives are physically compact and it claims to be shipping the world's only 16TB U.2 NVMe flash drive. Separately to the in situ processing, the devices also operate at low power, reducing the cooling requirement and TCO in compute-intensive and big-data environments, according to NGD. The company says that over a dozen proofs of concept are in progress, involving both AI and non-AI applications, at Microsoft and other companies. Later this year, NGD will ship a third generation of its drives, which will deliver even more scale and performance, according to the company.

THE 451 TAKE

NGD is not the only vendor that has declared plans to base products on the concept of in situ data processing. Nevertheless, the startup currently faces very little direct competition and this may be because of challenges implementing the concept. NGD itself says its system-on-a-chip expertise has allowed it to succeed where others have failed by creating a drive that incorporates significant and consistent in situ processing power at a competitive price. We presume that at present, NGD's drives will appeal only to sophisticated IT shops because of the need to redistribute application code across the new processing resources. However, the company says the number of PoCs for its technology is growing. The range of applications involved is encouraging and show that although AI is the primary candidate application, it is not the only one.

COMPANY BACKGROUND

Formerly known as NxGnData, NGD was founded in 2013 and is based in Irvine, California. The company says it has raised $22m from two VC rounds and received a prestigious SBIR grant from the National Science Foundation. NGD's three co-founders have a strong track record in flash drive engineering and worked together at STEC, a company that at one stage was a very successful pioneer of datacenter flash drives and that was bought by Western Digital (WD) in 2013.

NGD's CEO and founder Nader Salessi led the engineering department at STEC before taking a similar role at WD. NGD's CTO and co-founder Vladimir Alves led system-on-a-chip design at STEC and WD and has published over 30 scientific papers and has several patents. NGD's co-founder and EVP of product development Richard Mataya led engineering teams at WD, STEC and Memtech SSD, another flash drive pioneer, and is the author of multiple storage patents.

STRATEGY

NGD's customers are targeting applications that need very fast access to data or are data-intensive and can be parallelized. NGD is not yet naming production customers but says that over a dozen organizations are conducting PoCs. These include two projects at Microsoft, one involving image similarity and the other involving IoT or edge computing. Multiple CDN companies are investigating the use of NGD's drive in encryption key and data stream management. French telco Orange and a growing number of government agencies are conducting PoCs, as are autonomous car developers and a European online bookings company, according to NGD.

NGD says that although some hyperscale operators have themselves been developing on-drive computing, this does not rule out the prospect of sales to those organizations. On a related note, Microsoft's Denali flash drive specification should not be confused with NGD's efforts. Denali does not bring application compute into flash drives and instead disaggregates processes that are entirely related to the drive itself.

NGD shipped its first NVMe drives in 2017 and followed up with second-generation devices in 2018. Both those devices were powered by FPGAs, which included ARM cores. In Q4 this year, NGD plans to release third-generation NVMe devices, which will instead each be powered by an ASIC with embedded ARM cores. The company says the ASIC reduces costs, improves performance and scale and was developed using its system-on-a-chip expertise. The company says that at some stage in future, it could create similar drives powered by storage-class memories such as Intel and Micron's 3D XPoint.

PERFORMANCE

NGD's in situ computing promises to speed applications by eliminating the need to move data across an NVMe bus into a host server's memory before it can be processed. Instead, the data is read into the ARM cores in each NGD drive, over what NGD says is a native NAND flash interface. NGD stresses that this underpins its claimed boost to overall application performance, rather than the processing within the drive itself being faster than in a host server.

While NGD says some conventional flash drives may outperform its devices when copying data across an NVMe bus to a host, none match the boost to overall application performance achieved when computing is completed in situ, on an NGD drive, with no mass transfer of data being required. Quite separately from in situ computing, NGD also says the QoS inherent in its flash translation layer (FTL) results in consistent performance and latencies.

For any infrastructure and application, the only certain way to determine performance is by testing a specific setup. For its part, NGD cites performance across servers fitted with its drives and running the FAISS open source image similarity code. When FAISS ran on host Xeon processors, and used NGD drives only to store data, it took 391 seconds to complete a simple 3m vector analysis. When the FAISS code was instead run within the NGD drives, the same vector work was completed in just one second. Equally importantly, when running in situ, load times and processing times remained entirely constant across multiple dataset sizes, because of the inherent scaling of in situ processing.

NGD says it also plans to release performance numbers that compare its in situ computing performance with conventional third-party drives that do no in situ processing. As for any flash drive, the NGD drives also handle FTL and management tasks such as wear leveling and garbage collection. The company stresses that those tasks are handled by separate processing circuits that are entirely separate from the ARM cores, so that there is no resource contention. Some other attempts to create flash drives with in situ computing have suffered from resource contention, according to NGD, compromising their ability to process data in situ.

HOSTING THIRD-PARTY CODE

The four 64-bit ARM cores in each NGD drive host Ubuntu Linux. NGD supplies an SDK for in situ computing that includes a GUI and CLI, requires only minor modifications to applications, according to the company, and helps users compile code to point to the host agent instead of the storage target. If an application cannot be compiled to run on ARM and Ubuntu, it can be run in containers. One PoC is doing exactly that because it involved code originally written for Red Hat Linux and containerizing that code was quicker than rewriting it for Ubuntu. Overall, about a third of the current PoCs are running containers.

Reading and writing data to the NGD drives is entirely NVMe-compliant, and indeed is completed by separate subsystems in the drive. Because they are NVMe drives, the NGD devices need no custom drivers or OS kernel updates.

HIGHER CAPACITIES, LOWER TCO

High-capacity flash drives impose lower footprints than other drives in terms of physical size, power consumption and heat output per TB of data stored. As a bonus that is separate from in situ computing, NGD says its drives impose an even lower footprint than other high-capacity devices. For some customers, this quality is more attractive than the in situ computing. A couple of the current PoCs are not using the in situ compute and are simply using NGD's drives as conventional flash drives with low footprints, according to the company.

Compute-intensive environments need low-footprint drives because of power, cooling and space limits. The lower the footprint, the less likely that those limits will drive up costs. For example, power limits within servers may prevent them being fully populated with NVMe flash drives, driving up the number of servers needed to handle an application. NGD says this why it claims the lower footprint of its drives leads to lower total cost of ownership (TCO) than others.

NGD says it achieved its low footprint by slashing the amount of DRAM in its drives. All enterprise flash drives include DRAM, which is used as a cache to boost performance and to store metadata. However, DRAM is volatile or non-persistent, and as a result consumes significant amounts of power. DRAM chips also occupy physical space that could otherwise be used for flash chips that would boost the drive's storage capacity. NGD says it has broken the 1:1 rule of thumb for enterprise drives, in which 1GB of DRAM cache is needed for every 1TB of working flash capacity. It says that by creating a patented 'Elastic FTL,' it has reduced the ratio to 1GB of DRAM for every 8TB of flash capacity.

NGD is not claiming that it is shipping the world's only 16TB NVMe drives, but the only such drive in U.2 form factor. The drive consumes just 12W even when performing in situ computing simultaneously with heavy data writing, the company says. Other vendors are shipping 16TB NVMe flash drives, but only as add-in cards (AICs) that consume more space, and according to NGD, consume 100% more power, even without in situ processing. NGD also offers an AIC drive that stores 32TB. The third-generation, ASIC-powered drives that will ship in the fall will also be offered in M.2 and EDSFF form factors.

COMPETITION

In 2013, giant flash chip and drive maker Micron said it had developed a drive that completed MySQL searches using on-board processing power in what it called a scale-in architecture, with very significant impact on performance. However, it has not released any such products – and to 451 Research's knowledge, neither have any other major drive makers.

At the other end of the scale in terms of vendor size, ScaleFlux is the only other startups that 451 Research is aware of that claims to have implemented in situ computing in NVMe flash drives. Unlike NGD, ScaleFlux says it has offloaded FTL processing to the host server and says this delivers consistent performance. This suggest a very different method of preventing resource contention. ScaleFlux also appears to be targeting different workloads, as it cites analytics and database applications such as Hadoop, Spark and MySQL as suitable for its devices.

Multiple other vendors have developed in situ computing on disk drives, including drive giant Seagate and its Kinetic devices. However, as disk devices, these are not direct competitors to NGD's devices.

SWOT ANALYSIS

STRENGTHS
NGD has flash drive and system-on-a-chip expertise, and is very much a pioneer in its field, with very little direct competition.

WEAKNESSES
The company has not yet named any production customers, and the viability and appeal of its product is not yet proven.

OPPORTUNITIES
The widely expected growth in AI presents a major market for technologies that can boost infrastructure performance.

THREATS
Larger vendors may yet enter the sector.