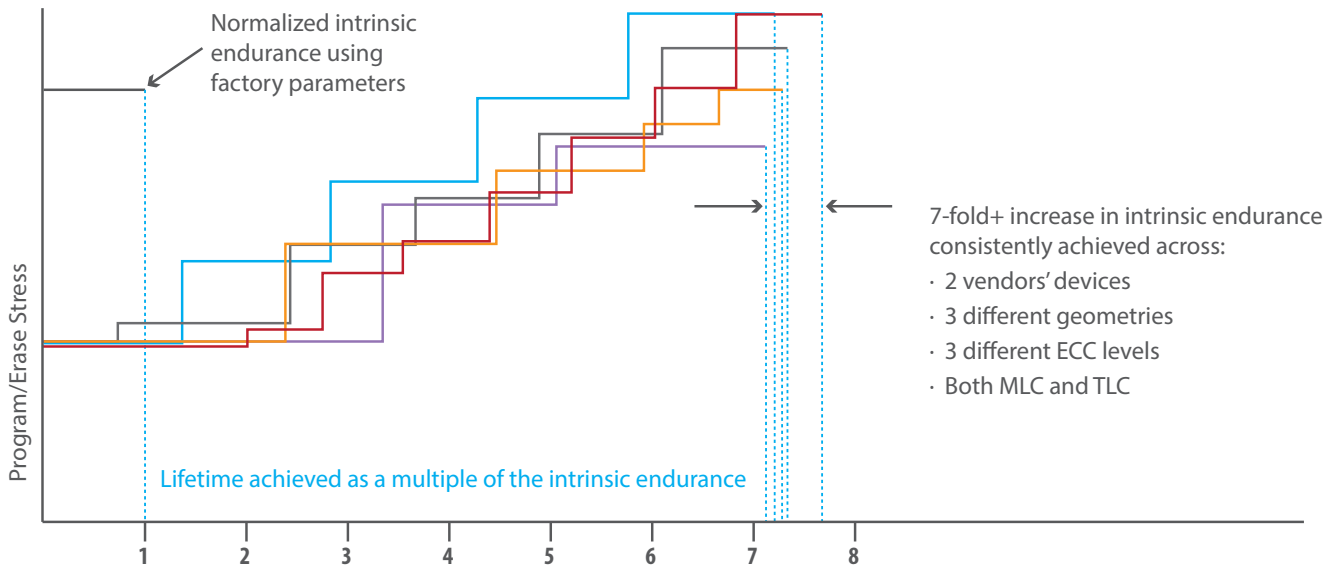




## NVMdurance – Extending flash endurance

Our software enables flash memory to last longer, by extending the intrinsic endurance of the NAND flash.

### NVMdurance Results



NVMdurance software implements a set of NAND flash optimization techniques that constantly monitors the health of the NAND flash and autonomously adjusts the operating parameters in real time. Our software optimizes NAND flash designed for the mass market to **your** application requirements.

NVMdurance also enables the use of lower cost, lower endurance flash in consumer product categories (e.g. phones, tablets, cameras), which would otherwise require a higher grade of flash or a more powerful controller to meet the minimum endurance requirements of their category.

We apply our technology in concert with our customers' existing technology to compound or multiply its effect, achieving an overall endurance extension of up to 20 times the rated endurance.

### How does it work?

Before the memory product (e.g. an SSD) goes into production, NVMdurance Pathfinder determines multiple sets of viable flash register values, using a custom-built suite of machine-learning techniques. Then on the controller of the end-product NVMdurance Navigator chooses which of these predetermined sets to use for each stage of life to ensure that the flash lasts as long as possible.

Major financial savings can be made in final product bill of materials cost because TLC can be used without the need for LDPC, a more powerful controller or high over-provisioning.

# Why NVMdurance

No factory determined operating parameters are ideally suited to your application, nor do standard SSDs track and manage the condition of the flash as it degrades through use.

The power behind NVMdurance is the use of off-line machine learning software that automatically learns the optimal parameter settings for the NAND device. It provides either:

- A static set of parameters, which are set at the start of life for the device, or for optimal endurance.
- A dynamic set of multiple parameter combinations, which are used over time by NVMdurance Navigator to autonomically optimize the endurance, as the device ages.

The parameters provided are all relative to the manufacturers' specified parameters so they work even though individual chips or batches have slight variations in their absolute performance.

The actual extension of endurance depends on the particular use-case and the information available to the NVMdurance Navigator autonomic system.

## NVMdurance benefits

Extended intrinsic endurance of flash devices

Makes TLC usable, without need for LDPC or a more powerful controller

Completely avoids runtime impact and bad tail latency of read-retry

Automated, accelerated flash characterization - ideal for 3D NAND

Compounds the endurance gain currently being achieved by other means (e.g. ECC or over-provisioning)

# NVMdurance customers



Altera Corporation recently released an FPGA-based storage reference design for data centers which implements proprietary software licensed from NVMdurance that increases the number of program-erase cycles by up to 7 times compared to existing NAND flash implementations.

The Altera reference design includes an Arria 10 SoC with an integrated dual-core ARM Cortex A9 processor using NAND flash optimization software from NVMdurance and an NVM Express (NVMe) solid-state disk (SSD) controller from Mobiveil.

## NVMdurance

NVMdurance is a privately held, venture backed software company, founded in Ireland in 2013. The technology is the result of 15 years' experimental work on flash memory endurance optimization by the founding team. After extensive successful trials with multiple flash manufacturers NVMdurance is now announcing customer wins, expanding its team and focusing on the success of the early deployments of its technology.

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