



Flash Memory Summit

3D Xpoint in 2022

Where are We and How We Get There

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What Will Change by 2022

- DRAM bus will become the interface of choice for high performance SSDs
- DRAM bus undergoing major changes
 - NVDIMM-P Protocol – **BIG DEAL**
 - Biggest DRAM bus architectural change since the 1970's
 - Enables non-DRAM media, caching, mixing of media, command queues, out-of-order execution, etc.
 - DDR4 to DDR5



What Will Change by 2022

- Other competitors will be offering other types of “New Media”
 - ReRAM, MRAM, PCM, Memristor, DRAM-NAND hybrid
 - Intel will no longer be the only one
- Increased usage of in-Memory Computing which will require very large main memories
- More software will be available that takes advantage of DAX (Direct Access) mode to significantly reduce I/O overheads
 - Requires byte rather than block access



What Won't Change by 2022

- End users will continue to be very cost driven
- “Good Enough Syndrome” – Customers accept a little lower performance for a reduction in price
 - Example: MLC versus SLC in SSDs
- But media articles will continue to focus on performance and mostly ignore costs



Bottom Line

- Many vendors entering the persistent memory market
- Winner will largely be determined by pricing
 - Like most technology businesses
- Relative Pricing Trends (approximate)

	2017	2022
MLC NAND	1X	1X
Persistent Memory	~5X	~2X
DRAM	~10X	~10X

} Price point will be closer to that of NAND than to DRAM



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Thank-You!

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