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
NAND	1X	1X
Persistent Memory	~5X	~2X
DRAM	~10X	~10X

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

Thank-You!

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