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Is NVMe Right for Mil/Industrial Applications?

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Outline

- NVMe Overview
- Mil/Industrial Storage Requirements
- Predictions

Introduction

- Early 2000s
  - Storage interfaces improved
    - Parallel ATA → Serial ATA (SATA)
    - Parallel SCSI → Serial Attached SCSI (SAS)
  - SSDs entered the mass market
    - Near zero seek time, and parallel data paths
    - Still limited by existing storage interfaces

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Introduction

- 2007 Intel and others wanted an improvement
  - Started Non-Volatile Memory Express (NVMe)
  - Now NVMe is one of the hottest topics in storage
- Is NVMe right for mil/industrial applications?
  - Designers want COTS for cost savings
  - Mil/industrial apps have special requirements

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NVMe Overview

- Designed specifically for non-volatile storage
- Shed support for legacy storage devices
- Takes advantage of parallel flash channels with parallel command queues and PCIe lanes
  - Up to 4 GB/s on NVMe versus 0.5 GB/s on SATA
- Performance costs 6W-12W+! *

* A. Malventano, "PCIe SSD Roundup - Samsung SM951 NVMe vs. AHCI, XP941, SSD 750 and More!"

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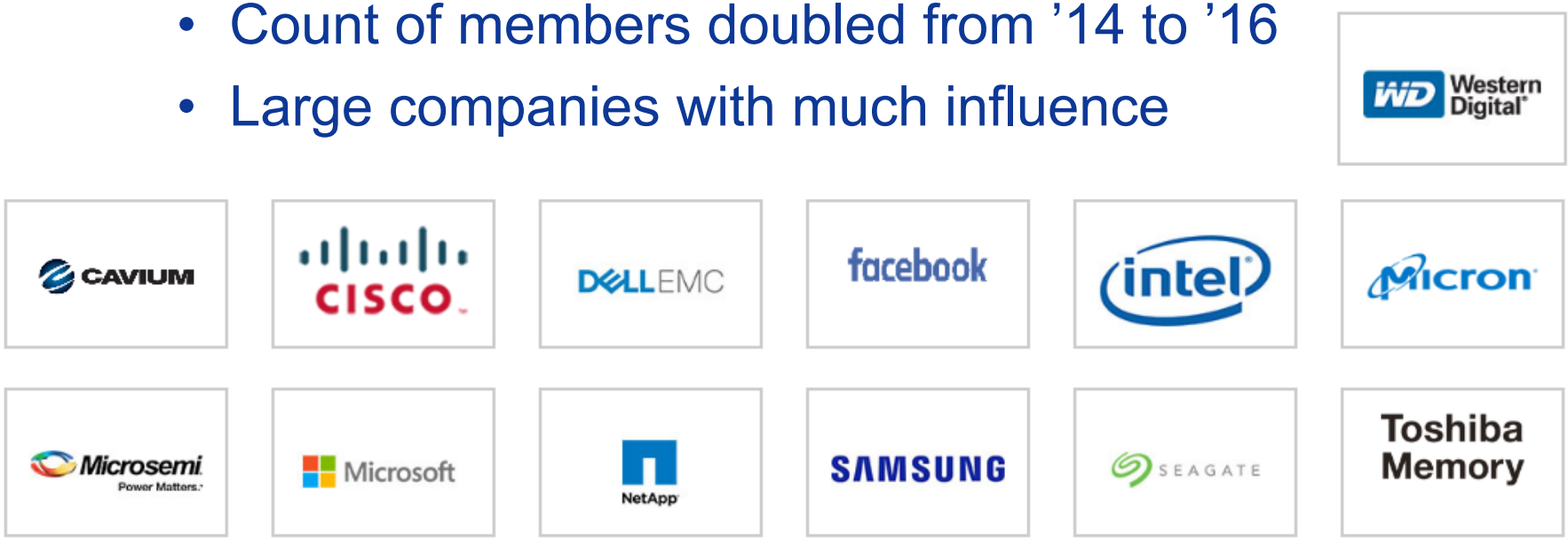
NVMe Overview

- NVMe gaining momentum
  - Count of members doubled from ’14 to ’16
  - Large companies with much influence



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Mil/Industrial Storage Requirements

- Seek long-term supply to avoid requalification
- Demand less performance
  - Many applications cannot saturate 6 Gbps SATA
  - If needed, stripe data across multiple SATA devices

Mil/Industrial Storage Requirements



- Many restricted by SWaP
  - Size, Weight, and Power
- No place for 120V AC



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Mil/Industrial Storage Requirements

- Special features not found on standard commercial drives
  - Write protection: boot drive or protect collected data
  - Data elimination: prevent adversary or prepare for reuse
  - Encryption: including isolated key fill
  - Security: Vbat and malicious unplug detection
  - Authentication: either host or SSD

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Predictions

- Storage industry is moving to NVMe
- 20% of ent. storage revenues will be NVMe by ’20
  - Higher % in overall storage market *
- Eventually will be difficult to find SATA and SAS
  - Similar to difficulty finding PATA and SCSI today
- Improvements will be on NVMe, not old interfaces

* T. Coughlin, "Digital Storage Projections for 2018, Part 2”

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Predictions

- Limit performance to lower power consumption
- Implement low-power sleep modes
  - Consume few milliwatts when idle
  - Consume few hundred milliwatts on average overall *

* R. Huang, "Making the Right Power/Performance Tradeoffs for PCIe/NVMe SSDs"

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Predictions

- Several vendors agreed on a pin-out on the 2.5” U.2 NVMe form factor for special features
- Using this pin-out both system designers and SSD designers can benefit from compatibility

Flash Memory Summit

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Pin Number	Defense pin name and function when used on U.2	Pin IO Direction (With respect to U.2 SSD)	Legacy SATA function
P1	SSD vendor defined. Suggested use: **Authentication** of Host and/or SSD using an Atmel ATSHA204.	Input/Output	3.3 V
P2	**Erase Trigger**, Low true or Erase Trigger Return: 0 = Trigger a Secure Erase operation, if enabled. Can also be the return pin for an isolated Erase Trigger using pin S7. 1 = No secure erase operation. Signal is ignored if low at power-on and a weak pullup is suggested. Operating details are SSD vendor defined.	Input	3.3 V
P7	**Vbat: Encryption key hold-up voltage** used when main 12V is off. Voltage is SSD vendor defined. 1.8 V to 3.3 V. 3V is suggested. Exact operating details are SSD vendor defined.	Input	5 V
P8	SSD vendor reserved	Input	5 V
P9	**CryptoErase** (SSD must have weak internal pullup): 0 = Trigger a crypto erase 1 = No crypto erase	Input	5V
P11	**Activity/Secure Erase Activity** (Weak Pullup, Minimum 5ma sink current) Can operate as the standard activity function or by a programmable option, the output can indicate the status of an Erase, Key Purge, or Sanitize operation. Exact operating details are SSD vendor defined.	Open Drain Output	Activity

Pin Number	Defense pin name and function when used on U.2	Pin IO Direction (With respect to U.2 SSD)	Legacy SATA function
S1	**Malicious Unplug Detect** (SSD has weak internal pullup): 0= U.2 connector is Engaged. 1= U.2 connector Dis-engaged.	Input (Ground host side)	GND
S2	**Write Protect** (SSD must have weak Internal pullup): 0 = SSD is hardware write protected. 1 = Not write protected.	Input	SATA RX+ (Input to SSD)
S3	**Write Protect LED** 0 = Illuminate Write Protect LED (Minimum 5ma sink current) 1 = Write Protect LED off.	Open Drain output Weak internal pullup	SATA RX- (Input to SSD)
S4	**Destruct**: 0 = No Destruct. 1 = Self-Destruct operation after a SSD vendor defined de-bounce. Signal is ignored if high at power on time and SSD should include an internal pulldown. Actual type of destruct operation is defined by the SSD vendor.	Input	GND
S5	**Isolated Key Fill Port:** 3.3V RS-232 TX, RS-485+, DS-101+ Protocol is SSD vendor defined.	Output, or BIDIR Differential+	SATA TX- (Output from SSD)
S6	**Isolated Key Fill Port:** 3.3V RS-232 RX, RS-485-, DS-101- Protocol is SSD vendor defined.	Input or BIDIR Differential-	SATA TX+ (Output from SSD)
S7	**Erase Trigger**, High True 0 = No secure erase operation. 1 = Trigger a Secure Erase operation, if enabled. If the signal is fully isolated, then pin P2 is the erase return. Signal is ignored if high at power-on and a weak pulldown is suggested. Operating details are SSD vendor defined.	Input	GND

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Conclusion

- NVMe is relatively new
  - NVMe positioned as interface of the future
- NVMe market share increasing
  - Lower cost
  - More vendors
  - More supply
  - More choices . . .

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Conclusion

- Focused on enterprise and consumer
  - Mil/industrial vendors working on products now
  - Controlling power consumption
  - Adding mil/industrial features

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Conclusion

- Is NVMe right for mil/industrial applications?

YES

To my surprise!

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Conclusion

- SMART High Reliability Solutions
  - Has over 20 years of experience in rugged, solid-state storage
  - Has solutions for rugged military and industrial applications
- Find us in booth #627, or at pizza tonight, and ask us about NVMe for industrial applications