2019 Is the Year of NVMe™

Narayan Venkat
Vice President, Data Center Systems
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Forward-Looking Statements
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Western Digital – A Leader in High-Performance Storage

A market leader with industry’s broadest product portfolio

Portfolio – storage systems, SSDs, HDDs, embedded and removable flash memory

Vertically integrated business model for operational efficiency

High performance storage solutions leader driving long-term profitable growth

With a portfolio of leading brands

Western Digital
SanDisk
G-Technology
WD
upthere
Leading Portfolio Breadth and Depth
Solutions to Capture, Preserve, Access and Transform Data

- JBOD & JBOF
- Storage Servers
- Object Storage Systems
- All-Flash & Hybrid Arrays
- NVMe-over-Fabric Storage

- Memory Extension Drive
- Enterprise SSD
- Enterprise HDD
- Client SSD
- Client HDD
- Network Attached Storage & Personal Cloud
- Direct-Attached Storage

- NAND Components
- Embedded Flash Devices
- Flash Cards
- Flash USB
- Portable Storage

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Data Interaction is Changing

**Past**
Data Held Captive by Single Application

**Current and Future**
Data Pooled and Shared by Multiple Applications

- create
- transform
- store
- access

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2019 Is the Year of NVMe! Or is it?

NVMe: Perception and Real World Usage

• NVMe Understanding and Awareness
• Is current storage infrastructure adequate?
• Where is NVMe deployed now?
• Where will NVMe be found in the future?
• What’s inhibiting greater NVMe deployment?
• Is the business case clear?
• What can vendors to help accelerate adoption?
2019 Is the Year of NVMe! Or is it?

NVMe: Perception and Real World Usage

Survey of Practitioners across Organizations & Geographies

- More than 5,000 employees: 27%
- 1,000 to 5,000 employees: 13%
- 250 to 1,000 employees: 13%
- 50 to 250 employees: 18%
- Fewer than 50 employees: 29%

NVMe: Perception and Real World Usage, July 2019 – Freeform Dynamics

- UK: 35%
- Rest of Europe: 20%
- USA: 30%
- Rest of World: 15%
NVMe Understanding and Awareness

I have good knowledge of NVMe storage
78% Strongly Agree / Agree
8% Strongly Disagree / Disagree

I understand which workloads benefit from using NVMe
82% Strongly Agree / Agree
8% Strongly Disagree / Disagree

I know how to make a good business case for NVMe investment
61% Strongly Agree / Agree
12% Strongly Disagree / Disagree

I have confidence that NVMe storage is mainstream-ready
64% Strongly Agree / Agree
12% Strongly Disagree / Disagree

NVMe: Perception and Real World Usage, July 2019 – Freeform Dynamics
State of Current Storage Infrastructure

Existing storage might work today, but maybe not in the future

Q: How would you regard your current storage environment in terms of?

- **Efficiency**: 64% Very Good/Good, 27% Adequate, 9% Lacking/Not Very Good
- **Ease of management**: 62% Very Good/Good, 26% Adequate, 12% Lacking/Not Very Good
- **Reliability**: 82% Very Good/Good, 14% Adequate, 4% Lacking/Not Very Good
- **Longevity of service**: 84% Very Good/Good, 27% Adequate, 4% Lacking/Not Very Good

**Does is work today?**
Ability to support current application requirements
- 74% Very Good/Good, 19% Adequate, 7% Lacking/Not Very Good

**Will it work tomorrow?**
Ability to scale as current demands grow
- 62% Very Good/Good, 24% Adequate, 14% Lacking/Not Very Good

Suitability to meet future application needs
- 54% Very Good/Good, 28% Adequate, 18% Lacking/Not Very Good

*NVMe: Perception and Real World Usage, July 2019 – Freeform Dynamics*
Where Is NVMe Deployed Today?
Some of the usual suspects; but how ubiquitous is it given its age?

Q: How far have you deployed NVMe to support workloads in the following areas?

- **Very low latency sensitive transaction systems**
  - 22% WIDE USE
  - 16% LIMITED BUT EXPANDING
  - 3% LIMITED AND WILL REMAIN SO

- **Business critical real-time analytics in particular**
  - 17% WIDE USE
  - 15% LIMITED BUT EXPANDING
  - 7% LIMITED AND WILL REMAIN SO

- **Demanding analytics workloads**
  - 16% WIDE USE
  - 17% LIMITED BUT EXPANDING
  - 7% LIMITED AND WILL REMAIN SO

NVMe: Perception and Real World Usage, July 2019 – Freeform Dynamics
Where Is NVMe Deployed Today?
Less in where you’d think

Q: How far have you deployed NVMe to support workloads in the following areas?

<table>
<thead>
<tr>
<th>Area</th>
<th>WIDE USE</th>
<th>LIMITED BUT EXPANDING</th>
<th>LIMITED AND WILL REMAIN SO</th>
</tr>
</thead>
<tbody>
<tr>
<td>AI and/or ML systems</td>
<td>8%</td>
<td>13%</td>
<td>4%</td>
</tr>
<tr>
<td>The widespread deployment of containers</td>
<td>8%</td>
<td>10%</td>
<td>5%</td>
</tr>
<tr>
<td>Data intensive modelling</td>
<td>engineering systems</td>
<td>17%</td>
<td>15%</td>
</tr>
</tbody>
</table>
Where Is NVMe Deployed Today?
Maybe not where you’d think

Q: How far have you deployed NVMe to support workloads in the following areas?

General business applications

- 12% WIDE USE
- 21% LIMITED BUT EXPANDING
- 11% LIMITED AND WILL REMAIN SO

Across the board/life, the universe and everything

- 7% WIDE USE
- 18% LIMITED BUT EXPANDING
- 5% LIMITED AND WILL REMAIN SO

Other

- 18% WIDE USE
- 7% LIMITED BUT EXPANDING
- 5% LIMITED AND WILL REMAIN SO

NVMe: Perception and Real World Usage, July 2019 – Freeform Dynamics
Where Will NVMe Be Found in the Future?
“Past performance is no guarantee of future results…”

Q: How far have you deployed NVMe to support workloads in the following areas?

NVMe established workloads

- Demanding analytics workloads: 10% on the agenda, 17% potential future use
- Business critical real-time analytics in particular: 10% on the agenda, 15% potential future use
- Very low latency sensitive transaction systems: 10% on the agenda, 15% potential future use
- Large virtual machine environments: 15% on the agenda, 14% potential future use
- Large desktop visualisation solutions: 12% on the agenda, 17% potential future use
- Data intensive modelling/engineering systems: 8% on the agenda, 15% potential future use

NVMe as standard

- General business applications: 15% on the agenda, 11% potential future use
- Across the board/life, the universe and everything: 15% on the agenda, 19% potential future use

NVMe for cutting edge workloads

- The widespread deployment of containers: 13% on the agenda, 17% potential future use
- AI and/or ML systems: 9% on the agenda, 17% potential future use

*NVMe: Perception and Real World Usage, July 2019 – Freeform Dynamics*
What’s Inhibiting Greater NVMe Deployment?
Infrastructure is team sport, technically and financially

Q: How much do the following stand in the way of NVMe?

- The current state of the server systems already deployed
  - 26% significant inhibitor
  - 36% causes friction

- Current network unable to handle NVMe and NVMe-oF
  - 17% significant inhibitor
  - 23% causes friction

- Pushback from finance/procurement
  - 16% significant inhibitor
  - 21% causes friction

- The technical maturity of NVMe solutions
  - 13% significant inhibitor
  - 28% causes friction

- Recent storage platform investments elsewhere (AFA etc)
  - 10% significant inhibitor
  - 27% causes friction

- Inability to make a convincing business case for investment
  - 7% significant inhibitor
  - 25% causes friction

NVMe: Perception and Real World Usage, July 2019 – Freeform Dynamics
What’s Inhibiting Greater NVMe Deployment?
Financial timelines and/or business needs are clear considerations

Q: How likely are the following Business or IT events to trigger the acquisition of NVMe Solutions?

<table>
<thead>
<tr>
<th>Event</th>
<th>Very Likely</th>
<th>Possible</th>
<th>Unlikely</th>
<th>No Chance</th>
</tr>
</thead>
<tbody>
<tr>
<td>IT infrastructure refresh</td>
<td>52%</td>
<td>32%</td>
<td>11%</td>
<td>2%</td>
</tr>
<tr>
<td>Storage refresh / End of life</td>
<td>49%</td>
<td>36%</td>
<td>9%</td>
<td>3%</td>
</tr>
<tr>
<td>New business applications</td>
<td>29%</td>
<td>38%</td>
<td>26%</td>
<td>5%</td>
</tr>
<tr>
<td>Business application upgrade / migration</td>
<td>19%</td>
<td>38%</td>
<td>34%</td>
<td>6%</td>
</tr>
<tr>
<td>Vendor offers</td>
<td>11%</td>
<td>33%</td>
<td>38%</td>
<td>16%</td>
</tr>
<tr>
<td>Business threats from competitors’ investment</td>
<td>9%</td>
<td>20%</td>
<td>42%</td>
<td>24%</td>
</tr>
</tbody>
</table>

*NVMe: Perception and Real World Usage, July 2019 – Freeform Dynamics*
Too Many People Are Unsure of Too Many Things

The need for education and thought leadership remains

Q: How much do you agree with the following statements?

- We are committed to deploying NVMe storage
  - **37%** STRONGLY AGREE
  - **18%** AGREE
  - **21%** NEUTRAL/UNSURE
  - **14%** DISAGREE
  - **9%** STRONGLY DISAGREE

- We see a clear role for NVMe-of-F (over Fabric)
  - **34%** Strongly Agree / Agree
  - **20%** Strongly Disagree / Agree

- Our suppliers are offering viable NVMe-of-S solutions
  - **22%** Strongly Agree / Agree
  - **24%** Strongly Disagree / Agree

*NVMe: Perception and Real World Usage, July 2019 – Freeform Dynamics*
Too Many People Are Unsure of Too Many Things
Vendors need to do a better job in educating the marketplace

Q: How much do the following stand in the way of NVMe?

- The availability of suitable solutions
  - 16% Significant Inhibiter
  - 31% Causes Friction

Q: How much do you agree or disagree with the following statement?

- Our suppliers are offering viable NVMe solutions
  - Strongly Disagree
  - Strongly Agree
  - Disagree
  - Agree
  - Neutral

55%
20%

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The Business Case Must Be Clear

NVMe is **not** about technology, it’s about driving business success

Companies across any industry that aggressively leverage data can transform their businesses.

By placing Data @ the Center of your business, you can unlock the latent value of your data and drive business opportunity.

NVMe and NVMe-oF™ are the technologies that will make data sharing practical and ubiquitous.

Ultimately, everyone must be able to articulate the business value of NVMe in order for it to achieve market success.