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# NVMe™: Change Agent for Next-Gen Data Centers

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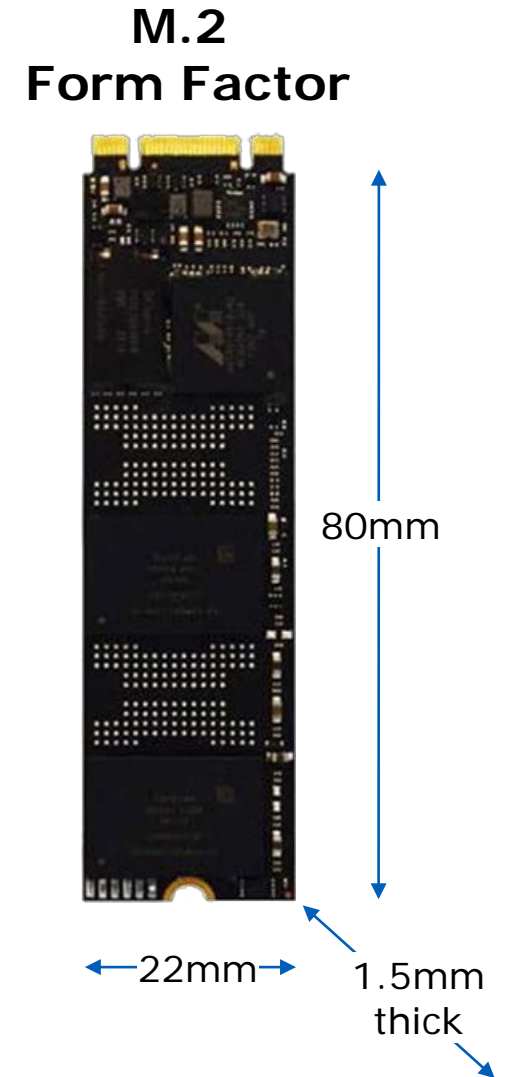
# Expanding Universe of Opportunity

- NVMe was designed for fast-and-lean storage
  - Fast: CPU-attached, ultra-low latency, ultra-high bandwidth
  - Lean: Single, standardized driver replaces proprietary ones
- NVMe enabled a wide ecosystem of storage solutions
  - NAND flash SSD
  - Persistent memories
- Today NVMe has grown to fill ALL enterprise and consumer segments
  - Performance
  - Capacity and Dynamic Allocation
  - Cost



# The Move Beyond M.2

- M.2 is great, but has fundamental challenges
  - Density
  - Cooling
  - Cost
- “Beyond M.2” Storage Goals
  - Smaller aggregate space needs for same TB of flash
  - Easier thermal management, enabling higher performance
  - Lower costs (of course!)
- Two Key Drivers
  - Enterprise
  - Hyperscale Clouds



# NVMe Impact on the Ecosystem

## • Server Design

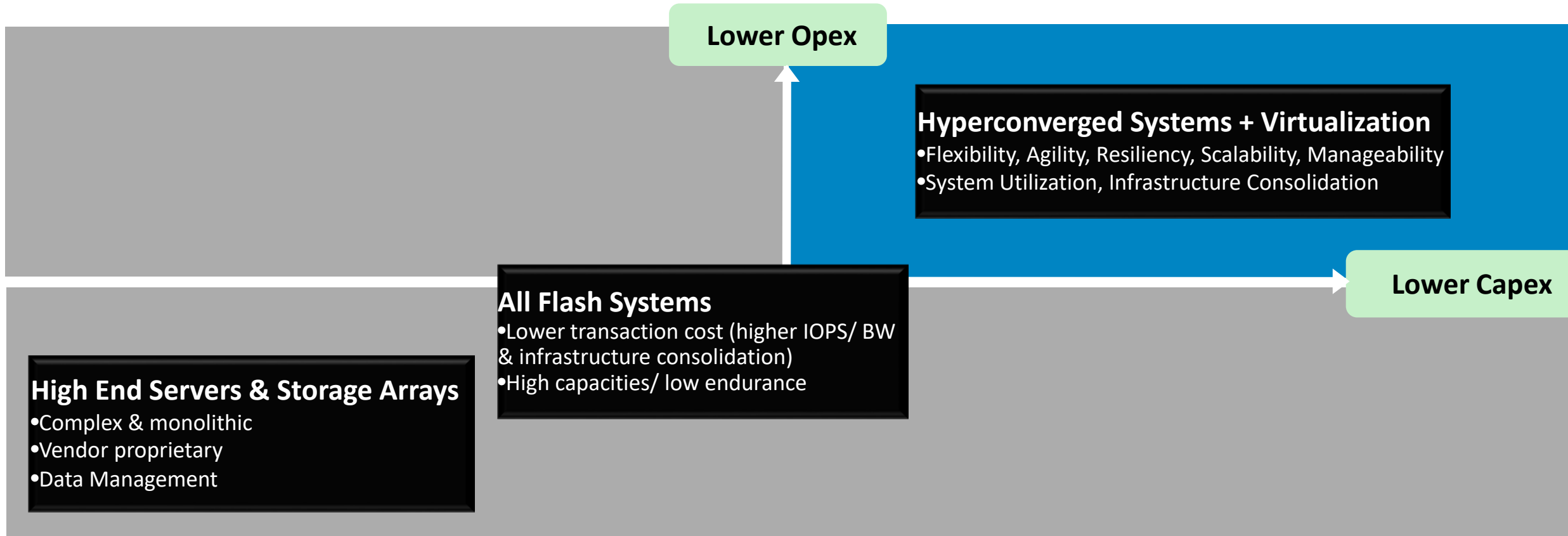
- Today, Server-Centric
  - Components designed for server
- Tomorrow, Storage-Focused
  - Server designed around storage

## • Connectivity

- Today, Server-Centric
  - Limited PCIe lanes
  - Power and thermal challenges limit M.2
- Tomorrow, Storage-Focused
  - More Lanes  
(AMD® EPYC™ = 128 lanes, Intel® Xeon® Scalable 48 lanes/chip)
  - Better airflow



# Enterprise Storage Space



- Enterprises lowering infrastructure Capex/ Opex via Hyperconverged Syst. & Virtualization
- All Flash Arrays helping smaller physical hardware footprints, lower \$/IOPS
- Multi-cloud interoperability because of better agility, flexibility, scalability, and security

# NVMe in Software Defined Storage & All Flash Arrays

- Number of PCIe lanes are increasing with every generation of processors
- High Performance, Lower I/O Overheads, Massive Parallelization, Namespaces sharing
  - Increasing number of VMs, Performance density scaling, Less hardware footprint
  - Higher flexibility, agility, resiliency, scalability, manageability, & system utilization
- Multi-path IO, Namespaces sharing, Scalability
  - Snapshot, replication, dedup, encryption & HA



# Beyond the Server

- NVMe over Fabric (NVMeoF)
  - Disaggregation of compute and storage
  - Enabled by cost-effective 25G and 40G networking
  - Dynamic provisioning, data lifecycle management
  - Allow clouds to provision storage as-needed
- In-Storage Compute
  - HPC's already there – Comms are the bottleneck, not CPU or memory speed!
  - Embed limited, programmable intelligence embedded in SSD





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