SNIA GSI | GREEN STORAGE

Draft Taxonomy
Update for Emerald Specification version 4.x.y

Rev 19-Dec‘18

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  - Disk Set - existing
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Introduction

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- Build on current taxonomy
- Separation by “storage sets”
  - Does not affect current taxonomy
  - Allows for a simple initial approach
- Does not include the gray areas below:
  1. Combined Storage and Compute
  2. Combined Storage and Network
  3. Software Defined
     - Hyper Converged

Ref. Emerald 3.0.3 – Existing Taxonomy

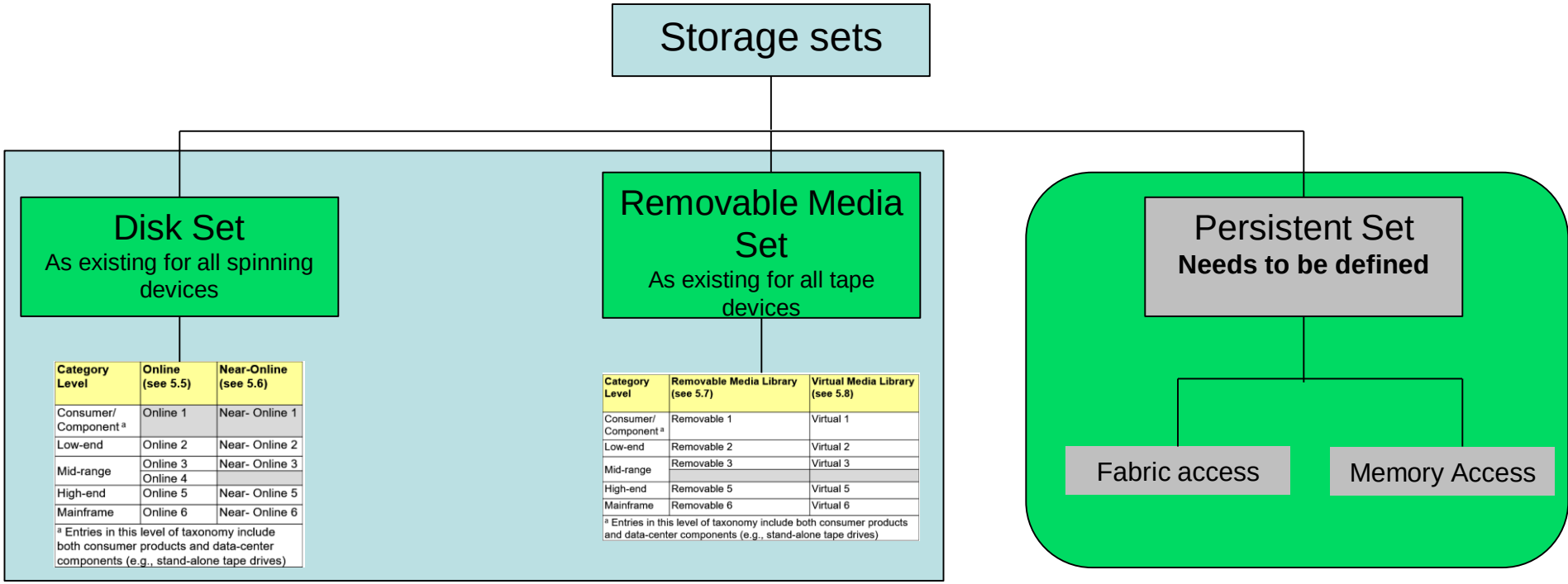
Disk Set

Removeable Media Set

Level	Category			
	Online (Sect 5.5)	**Near-Online (Sect 5.5)**	**Removable Media Library (Sect 5.7)**	**Virtual Media Library (Sect 5.8)**
Consumer/ Component[a]	Online 1	Near-Online 1	Removable 1	Virtual 1
Low-end	Online 2	Near-Online 2	Removable 2	Virtual 2
Mid-range	Online 3	Near-Online 3	Removable 3	Virtual 3
	Online 4			
High-end	Online 5	Near-Online 5	Removable 5	Virtual 5
Mainframe	Online 6	Near-Online 6	Removable 6	Virtual 6

[a] Entries in this level of taxonomy include both consumer products and data-center components (e.g., stand-alone tape drives)

Storage Hierarchy divided by Sets



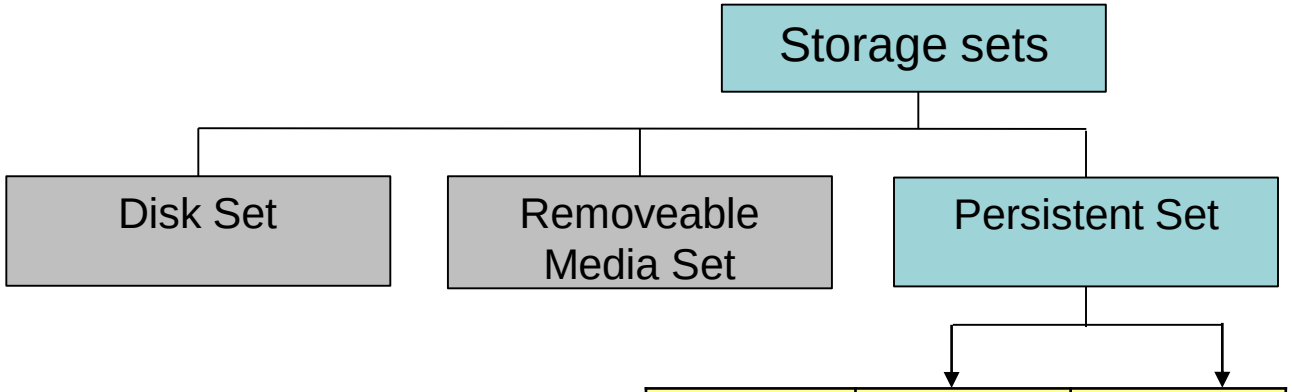
Category Level	Online (see 5.5)	Near-Online (see 5.6)
Consumer/ Component [a]	Online 1	Near- Online 1
Low-end	Online 2	Near- Online 2
Mid-range	Online 3	Near- Online 3
	Online 4	
High-end	Online 5	Near- Online 5
Mainframe	Online 6	Near- Online 6

[a] Entries in this level of taxonomy include both consumer products and data-center components (e.g., stand-alone tape drives)

Category Level	Removable Media Library (see 5.7)	Virtual Media Library (see 5.8)
Consumer/ Component [a]	Removable 1	Virtual 1
Low-end	Removable 2	Virtual 2
Mid-range	Removable 3	Virtual 3
High-end	Removable 5	Virtual 5
Mainframe	Removable 6	Virtual 6

[a] Entries in this level of taxonomy include both consumer products and data-center components (e.g., stand-alone tape drives)

Focus on Persistent Memory Set



Category Level	Fabric Access	Memory Access
Consumer/ Component[a]	Online 1	Online1
Low-end	Online 2	Online 2
Mid-range	Online 3, 4	Online3, 4
High-end	Online 5	Online 5
Mainframe	Online 6	NA

Persistent Set

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- Persistent Memory subsets:
  - Memory access: data is accessed via memory IO primitives
  - Fabric access (Traditional I/O): data is accessed via network IO primitives
- Workload for persistent memory
  - Use existing workloads for fabric access
  - For memory access workloads….
    - Point file access to memory mapped files
    - Minimal modification to file access environment to take advantaged of memory mapped files
    - Don’t have block based memory based target (need more data….talk to NVMe experts)

Existing table for Online Category

Attribute	Classification					
	Online 1	**Online 2**	**Online 3**	**Online 4**	**Online 5**	**Online 6**
Access Pattern	Random/ Sequential	Random/ Sequential	Random/ Sequential	Random/ Sequential	Random/ Sequential	Random/ Sequential
MaxTTFD (t)	t < 80 ms	t < 80 ms	t < 80 ms	t < 80 ms	t < 80 ms	t < 80 ms
Connectivity	Not Specified	Direct-connected to single or multiple hosts	Network-connected	Network-connected	Network-connected	Network-connected
Consumer/ Component	Yes	No	No	No	No	No
Integrated Storage Controller	Optional	Optional	Required	Required	Required	Required
Storage Protection	Optional	Optional	Required	Required	Required	Required
No SPOF	Optional	Optional	Optional	Required	Required	Required
Stable storage support	Optional, unless Required by protocol	Optional, unless Required by protocol	Required	Required	Required	Required
Non-Disruptive Serviceability	Optional	Optional	Optional	Optional	Required	Required
FBA/CKD Support	Optional	Optional	Optional	Optional	Optional	Required
Maximum Supported Configuration[a]	≥ 1	≥ 4	≥ 12	> 100	> 400	> 400

a. Maximum Supported Configuration does not apply to an all solid-state system that is not based on replaceable storage devices.

Modified table for Online Category

Attribute	Classification (Hard Disk Drives)						
	Online 1	Online 1.5	Online 2	Online 3	Online 4	Online 5	Online 6
Access Pattern	Random/ Sequential	Random/ Sequential	Random/ Sequential	Random/ Sequential	Random/ Sequential	Random/ Sequential	Random/ Sequential
MaxTTFD (t)	t < 80 ms	t < 80 ms	t < 80 ms	t < 80 ms	t < 80 ms	t < 80 ms	t < 80 ms
Connectivity	Not Specified	Direct-connected to single or multiple hosts	Direct-connected to single or multiple hosts or network connected	Network-connected	Network-connected	Network-connected	Network-connected
Consumer/ Component	Yes	No	No	No	No	No	No
Integrated Storage Controller	Optional	Optional	Optional	Required	Required	Required	Required
Storage Protection	Optional	Optional	Required	Required	Required	Required	Required
No SPOF	Optional	Optional	Optional	Optional	Required	Required	Required
Stable storage support	Optional, unless Required by protocol	Optional, unless Required by protocol	Optional, unless Required by protocol	Required	Required	Required	Required
Non-Disruptive Serviceability	Optional	Optional	Optional	Optional	Optional	Required	Required
FBA/CKD Support	Optional	Optional	Optional	Optional	Optional	Optional	Required
System Capacity	≥ 1	≥ 4	≥ 4	≥ 12	> 100	> 400	> 400

Draft table for Persistent – Fabric Access

Attribute	Classification (Persistent – Fabric Access)						
	Online 1	Online 1.5	Online 2	Online 3	Online 4	Online 5	Online 6
Access Pattern	Random/ Sequential	Random/ Sequential	Random/ Sequential	Random/ Sequential	Random/ Sequential	Random/ Sequential	Random/ Sequential
MaxTTFD (t)	t < 80 ms	t < 80 ms	t < 80 ms	t < 80 ms	t < 80 ms	t < 80 ms	t < 80 ms
Connectivity	Not Specified	Direct-connected to single or multiple hosts	Direct-connected to single or multiple hosts or Network-Connected	Network-connected	Network-connected	Network-connected	Network-connected
Consumer/ Component	Yes	No	No	No	No	No	No
Integrated Storage Controller	Optional	Optional	Optional	Required	Required	Required	Required
Storage Protection	Optional	Optional	Required	Required	Required	Required	Required
No SPOF	Optional	Optional	Optional	Optional	Required	Required	Required
Stable storage support	Optional, unless Required by protocol	Optional, unless Required by protocol	Optional, unless Required by protocol	Required	Required	Required	Required
Non-Disruptive Serviceability	Optional	Optional	Optional	Optional	Optional	Required	Required
FBA/CKD Support	Optional	Optional	Optional	Optional	Optional	Optional	Required
System Capacity	“home”	“small, JBOD”	“small”	“small”	“medium”	“large”	“mainframe”

Draft table for Persistent – Memory Access

Attribute	Classification (Persistent – Memory Access)					
	Online 1	**Online 2**	**Online 3**	**Online 4**	**Online 5**	**Online 6**
Access Pattern	Random/ Sequential	Random/ Sequential	Random/ Sequential	Random/ Sequential	Random/ Sequential	Random/ Sequential
MaxTTFD (t)	t < 80 ms	t < 80 ms	t < 80 ms	t < 80 ms	t < 80 ms	t < 80 ms
Connectivity	Not Specified	Direct-connected to single or multiple hosts or network connected	Network-connected	Network-connected	Network-connected	Network-connected
Consumer/ Component	Yes	No	No	No	No	No
Storage Protection	Optional	Optional	Required	Required	Required	Required
No SPOF	Optional	Optional	Optional	Required	Required	Required
Stable storage support	Optional, unless Required by protocol	Optional, unless Required by protocol	Required	Required	Required	Required
Non-Disruptive Serviceability	Optional	Optional	Optional	Optional	Required	Required
FBA/CKD Support	Optional	Optional	Optional	Optional	Optional	Required
System Capacity	"home"	"small"	"small"	"medium"	"large"	"mainframe

Add Attribute Definitions

- Storage Controller
  - Ref. SNIA dictionary…..
- Integrated Storage Controller
  - Storage controller and storage media are in integrated into the same physical enclosure(s). May allow for expansion to additional enclosures via network access
- Storage Protection
  - Ref. Emerald Spec…..
- System Capacity (topic for discussion)
  - Hard Disk
  - SSD (fabric attached)
  - Memory access

Additional Topics

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- Mixed systems (HDDs w/ either or both types of persistent storage)
  - How to handle this? A topic for discussion

Appendix

Persistent class current technologies

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- SSD
  - Mainly differentiated by the interface
    - SATA, M.2/U.2, PCIE … others
- NVME
  - One of the underlying technology for enterprise SSD
  - Often confused with flash
  - NVME over fabrics (Mainly frees storage from the latency of the interface)
  - There are many ways of categorizing this one since it covers a broad spectrum of non volatile memory.
  - It is in many cases the technology under the hood of the NVDIMM

Persistent class current technologies

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- Flash
- NVDIMM
  - Direct attached to the memory modules of a computer board
  - There are several types:
    - **-F:** built using flash only
    - **-N:** built combining DRAM and Flash originally using a DDR3 interface
    - **-P:** built using DRAM and ReRAM technology from JEDEC (to be released on 2018) it will use a DDR5 interface
    - **-X:** Same as N but uses DDR4 interface

There is currently more R & D on this type of persistent memory that will generate more types. The party continues…