# Containerizing Byte-Addressable NVM

PDSW-DISCS 2016: 1ST JOINT INTERNATIONAL WORKSHOP ON PARALLEL
DATA STORAGE & DATA INTENSIVE SCALABLE COMPUTING SYSTEMS

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Byte-Addressable Dynamic Memory vs. Block Based Persistent Storage

Byte Addressable

| L1 | L2-L3 | DRAM |

Dynamic Memory

Block Based

| Flash | SSD | HDD |

Persistent Storage

Latency →
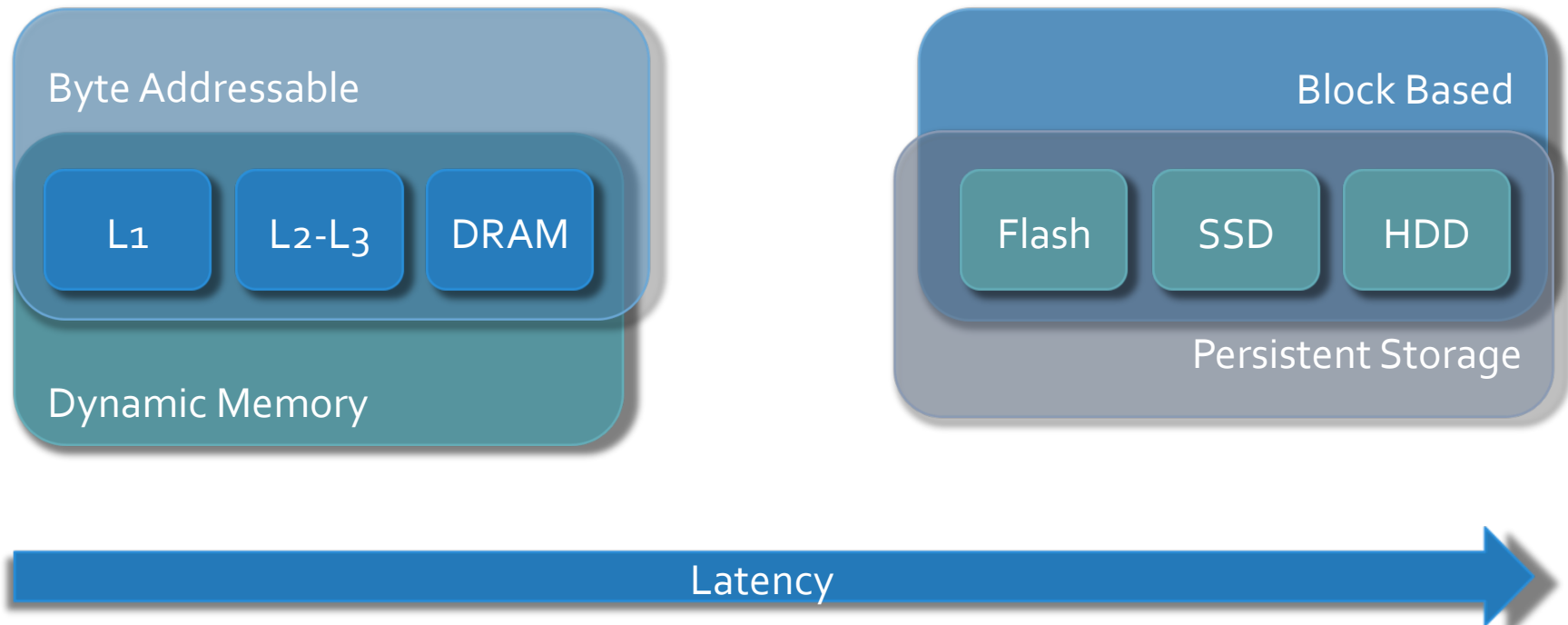
Applications typically live in the middle, operating on data in byte-addressable cache attached to main memory and serializing data for persistence storage operations.

Byte-Addressable, Non-Volatile Memory

Byte Addressable			SCM	Block Based		
L1	L2-L3	DRAM		Flash	SSD	HDD

Dynamic Memory

Persistent Storage

Latency →
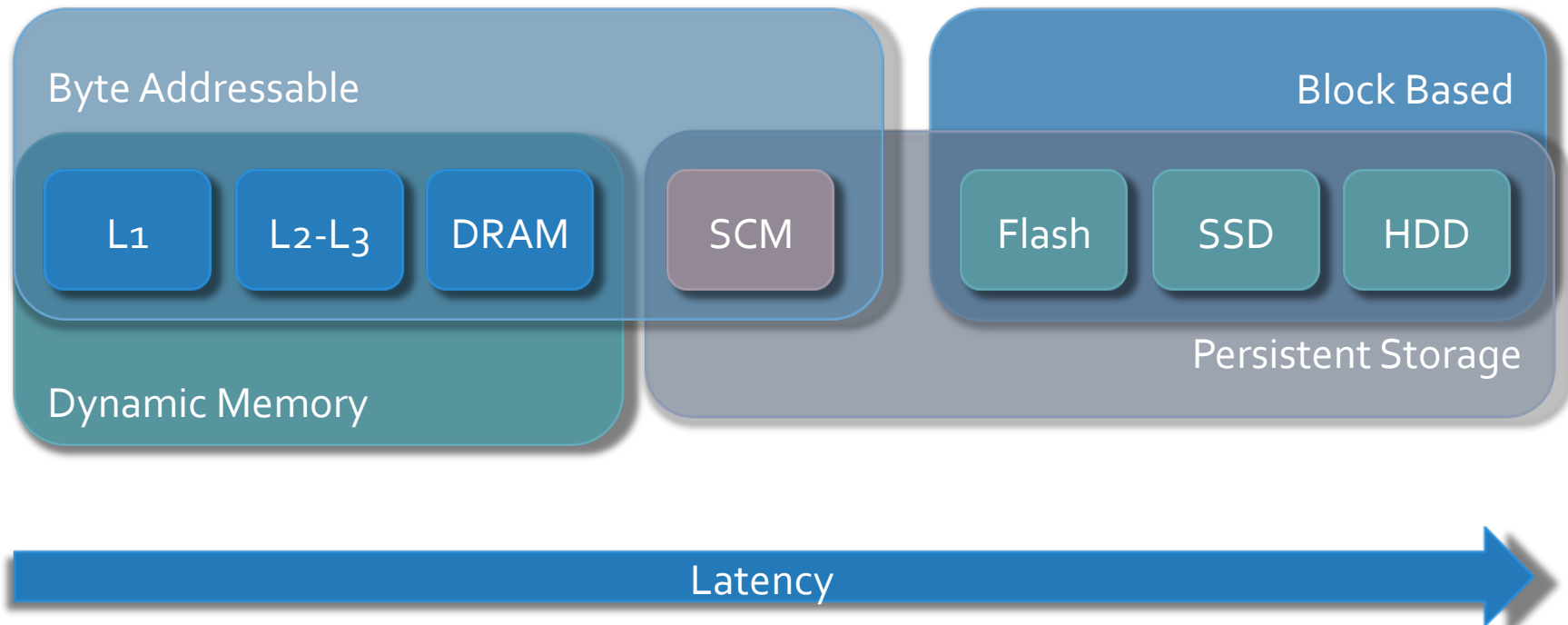
Storage Class Memory (SCM) – byte-addressable non-volatile memory on the main memory bus. SCM technologies such as PCM can have very large capacities.

Container Based Virtualization

Container

Byte Addressable

Block Based

| L1 | L2-L3 | DRAM | | SCM | | Flash | SSD | HDD |

Dynamic Memory

Persistent Storage

Latency
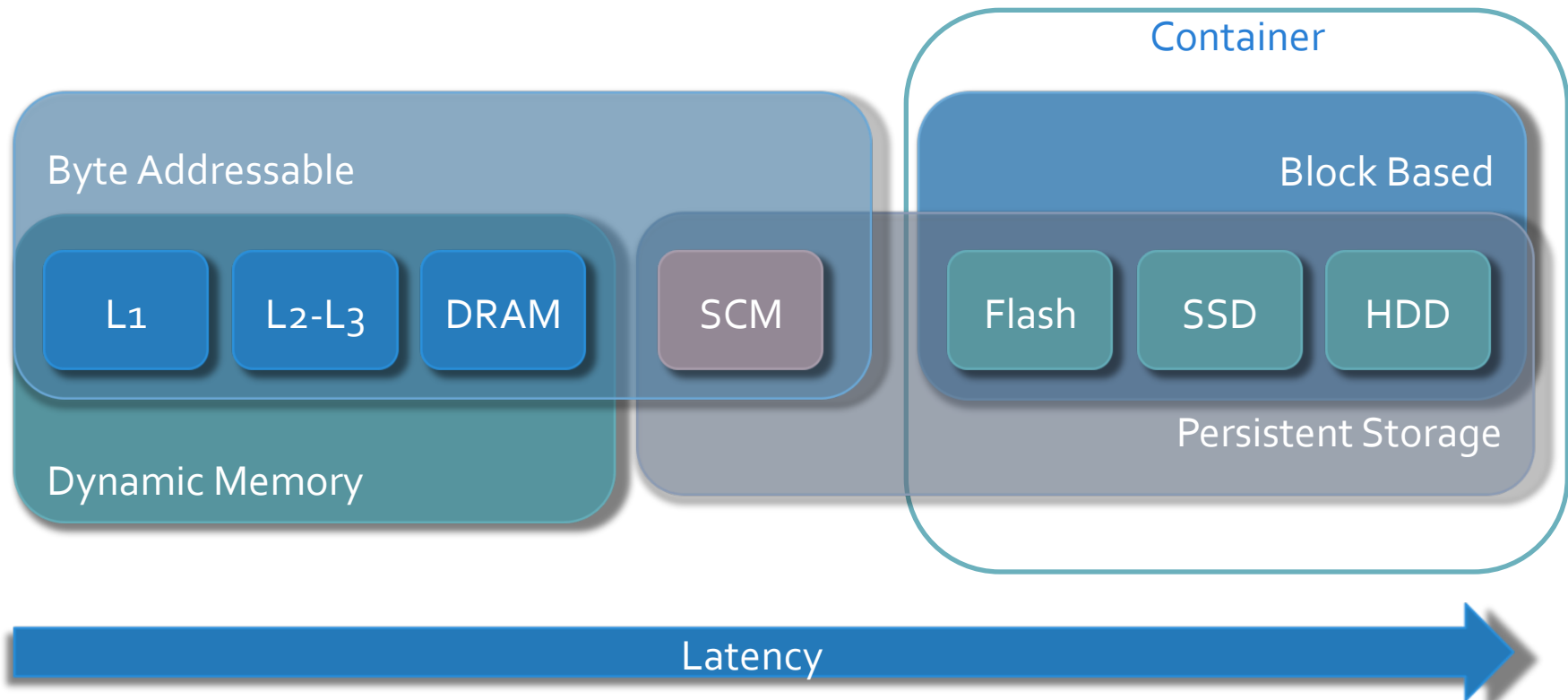
Containers provide persistence isolation through a chroot file system.
Linux Containers can restrict virtual memory and CPU usage with Linux CGroups.
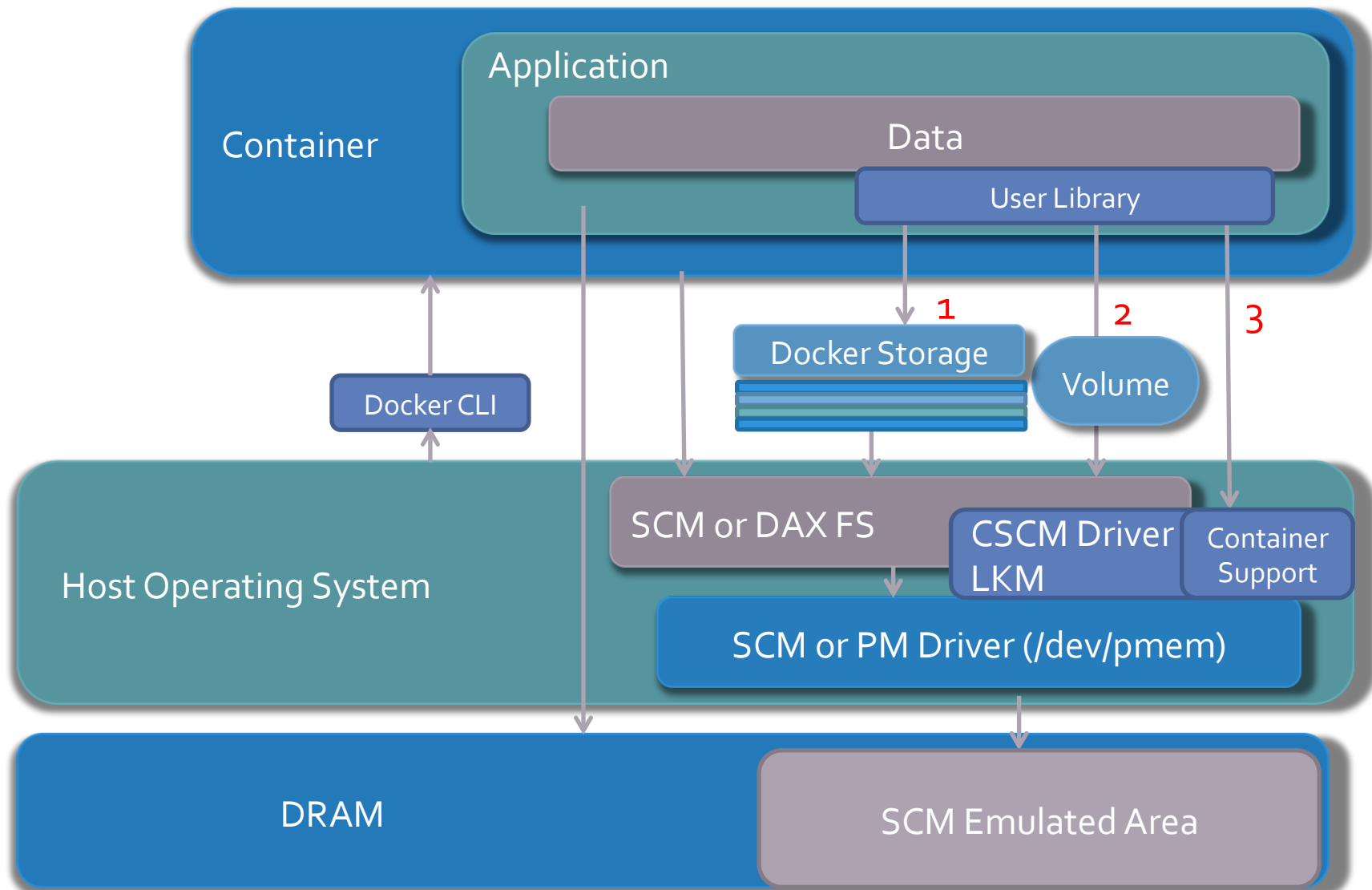
Containerizing SCM
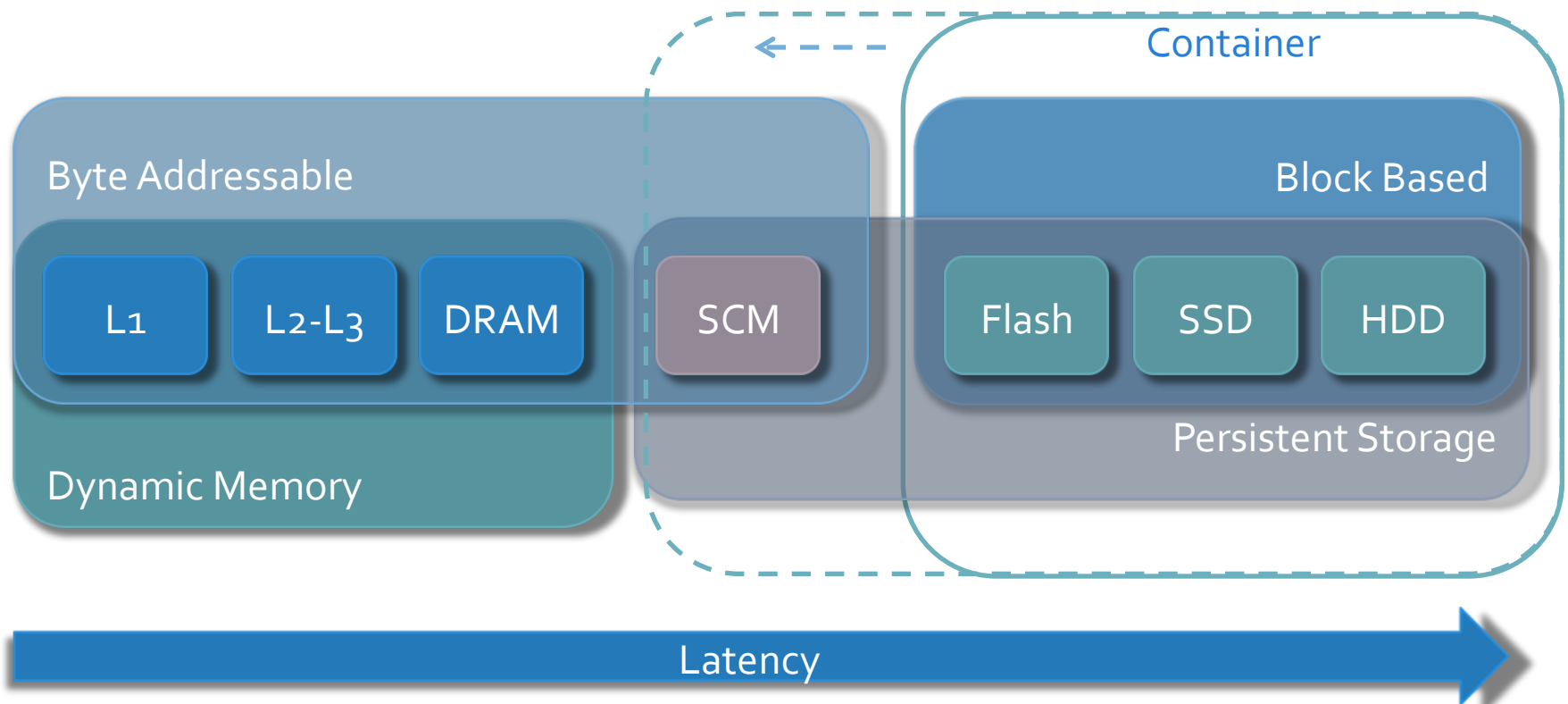
Can we extended containers to support a persistent virtual memory address space without suffering from low performance or violating isolation guarantees?
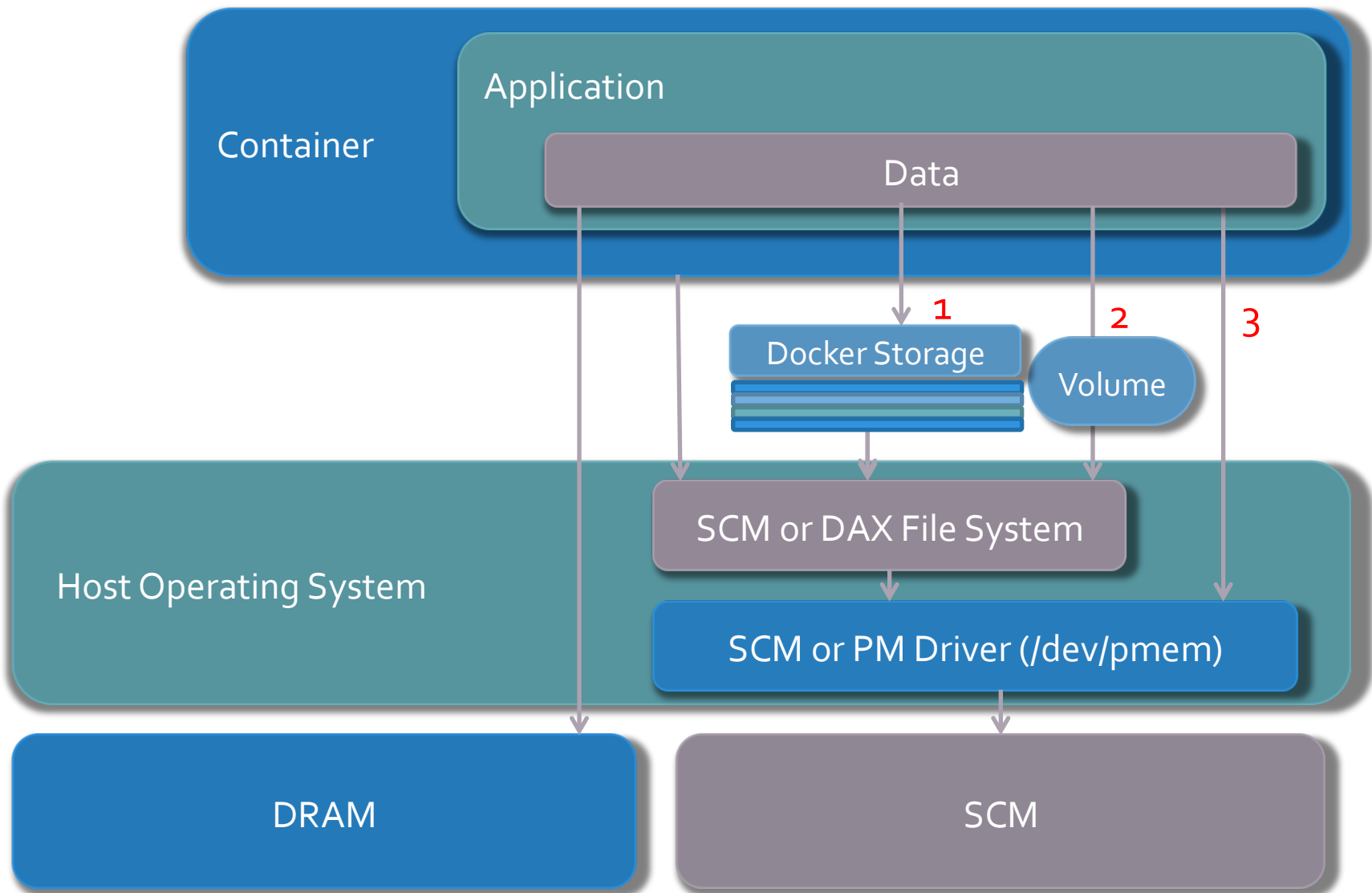
Docker Containers can access persistent data in three ways, layered Storage, Volume or privileged device driver. For SCM this creates performance and isolation challenges.

Containerized Storage Class Memory Driver (CSCM) - preserves the isolation guarantees for container based SCM storage while providing high performance.
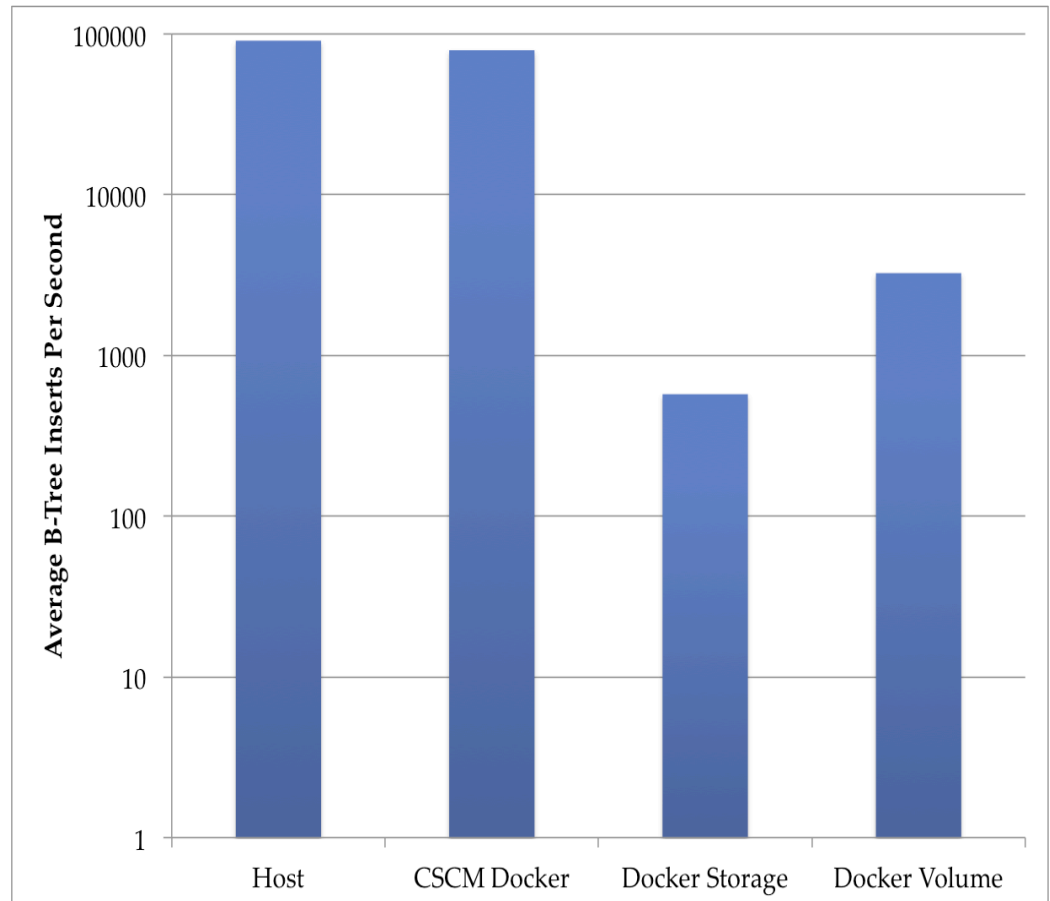
STREAMS Benchmark

- STREAMS Benchmark

- 3, 8-byte double 5 Million element arrays

- Element by Element test

- COPY/SCALE/ADD/TRIADD
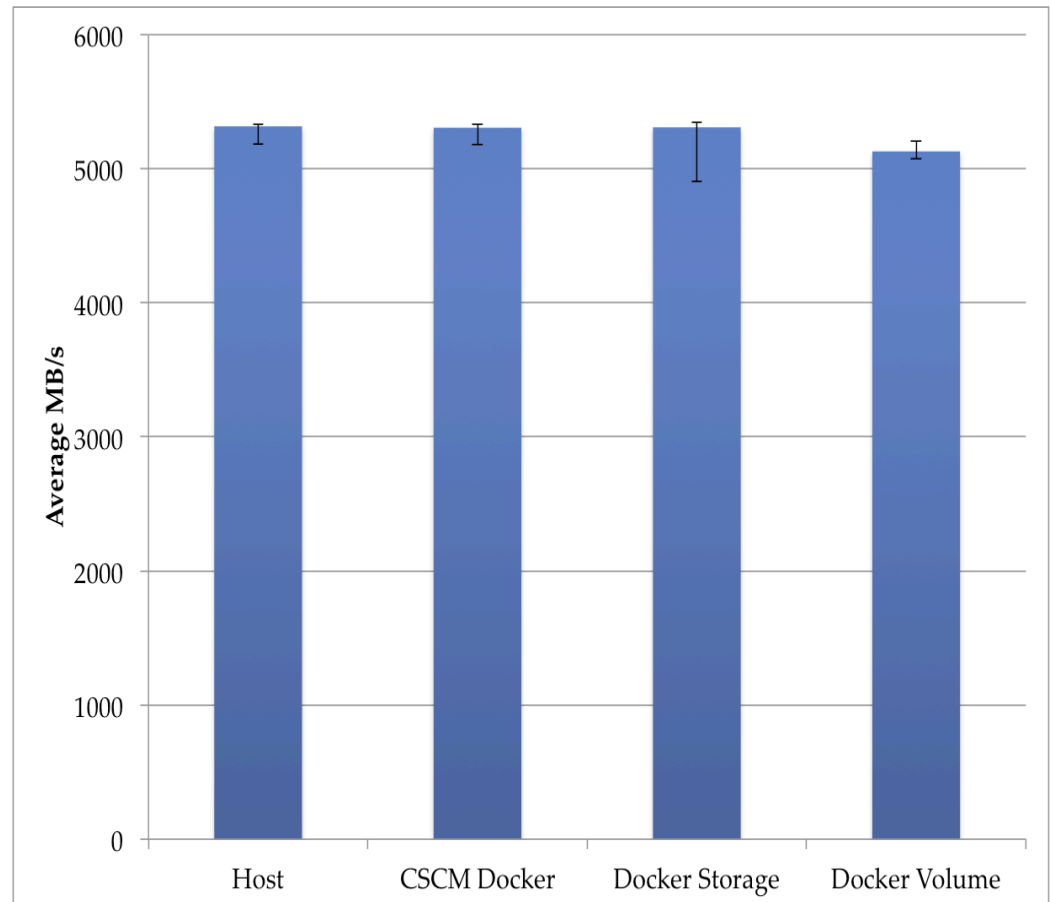
Transactional B-Tree Element Inserts

- Modified a B-Tree data structure for transaction safe element inserts

- New nodes allocated using the scmalloc user library

- Writes to variables, pointers, etc. go into a log area first

- 1 Insert can update multiple values and pointers

Thank You!