

The Skinny



On Memory Machine™

Enterprise-Class Big Memory Software



Introduction

Since DRAM was invented in 1969, the user experience for server memory infrastructure changed very little. Now there's a need for change driven by the emergence of big and fast data. Memory is good for fast data and storage is good for big data, but neither is good for both.

This document is designed to provide IT pros working with memory-centric apps with essential facts about Big Memory Computing designed for both big data sets and real-time performance.

Big Memory Computing

The next generation of in-memory computing, Big Memory transforms low-density, expensive, and volatile DRAM-only environments, into high-density, lower-cost, and highly available environments based on DRAM + persistent memory (PMEM).

Big Memory Hardware

Any type of server memory. Today that is DRAM plus higher density and lower cost Intel® Optane™ Persistent Memory (PMEM).

DRAM scales to 256GB per DIMM while PMEM scales to 512GB per DIMM at half the cost per GB of DRAM.

Big Memory Software

Big Memory software virtualizes DRAM and PMEM, creating a pool of software-defined memory and delivering software-defined memory services for higher performance, availability, and agility (next page).

Big Memory software also serves as an abstraction layer that allows all applications in a data center to benefit from new types of memory, memory interconnects, processors, memory allocators, etc., all without changes to the apps.

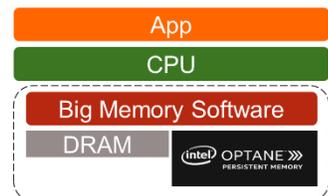


[IDC definition and forecast for of Big Memory](#)

Capacity	PMEM	DRAM
1 x 512GB	\$13.86/GB	-
1 x 256GB	\$7.02/GB	\$18.94/GB
1 x 128GB	\$4.00/GB	\$13.67/GB
1 x 64GB	-	\$7.65/GB
1 x 32GB	-	\$8.43/GB
1 x 16GB	-	\$9.37/GB

PMEM scales to 2x the capacity per DIMM of DRAM and is as low as 1/3 the cost of DRAM DIMMs.

Source: online retailers

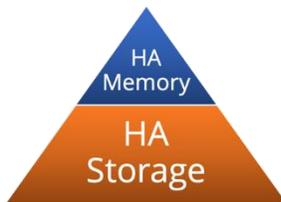


Big Memory software virtualizes DRAM and PMEM to create a pool of software-defined memory

Memory Machine™ Software



Standard Edition - The easiest way to implement Intel® Optane™ Persistent Memory as volatile memory and go DRAM fast.



Advanced Edition - Enterprise-class memory data services create the world's first high availability memory tier.

The industry's first Big Memory software virtualizes byte-addressable DRAM and PMEM memory.

Standard Edition

- Powers your apps to run faster with installed DRAM, or lower-cost persistent memory to perform like DRAM.
- Provides applications with transparent access to PMEM, but persistence is not enabled.

Advanced Edition

- Includes all the capabilities of Memory Machine Standard Edition, plus transparent access to persistence
- Enterprise-class memory services based on ZeroIO memory-to-memory snapshots

System Requirements

Once virtualized, Memory Machine software delivers a slew of innovative new software-defined memory services for higher performance, availability, and agility:

- Minimum of 128GB of DRAM
- Servers with DRAM-only and pre-Cascade Lake processors
- Servers with DRAM + PMEM and Intel Cascade Lake processors and beyond
- Linux CentOS or REHL 7.6 or higher
- Bare metal server and virtual server
 - vCenter 6.7+
 - KVM
 - RedHat OpenShift
- Public Cloud
 - AWS
 - Azure

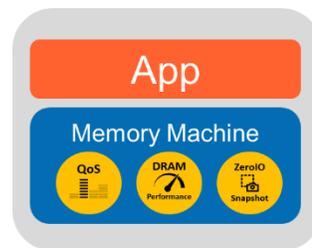
Key Features & Business Benefits

Once Memory Machine is installed and the DRAM and PMEM is virtualized, the software delivers 5 key features and business benefits.

Memory Virtualization

Allows access to new technology without changes to apps

The Memory Machine virtualization layer abstracts applications from changes that would otherwise be needed to support persistent memory and other new memory-related technologies. One virtualization layer supports all apps in the datacenter.



The 3 key capabilities of Memory Machine are QoS, DRAM Performance and ZeroIO™ memory-to-memory Snapshots

Higher DRAM Performance

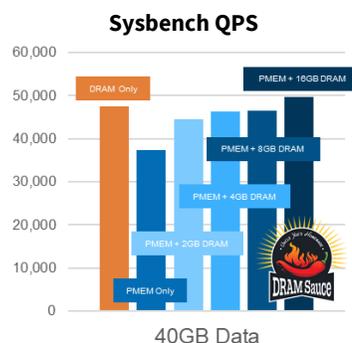
Extends the life or increases capacity of servers

If a server upgrade is under consideration because memory is the bottleneck, Memory Machine can squeeze more performance and workload capacity out of installed DRAM.

Higher PMEM Performance

Opens the door to lower cost persistent memory

Without Memory Machine, Intel Optane Persistent Memory runs slower than DRAM. Memory Machine enables mass deployment of lower cost and higher density PMEM without sacrificing performance.



The Memory Machine Huge Page Allocator provides apps with faster access to installed DRAM and can also make a mix of DRAM and PMEM run as fast or faster than DRAM (above).

Higher Availability

For the 1st time brings memory into an HA environment

Most memory are not protected with snapshots and replication. The large memory footprints that are protected take minutes to snapshot and hours to recover. Memory Machine enables instant snapshot and recovery, decreasing business disruption by 1,500x.

Done every few hours because it's disruptive



Automatically done every few minutes

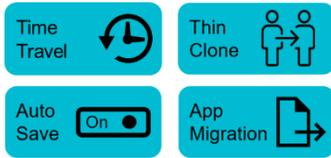


On-Prem & Public Cloud

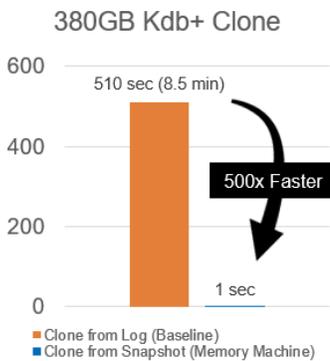
Opens the Door to Lower Cost Persistent Memory

The industry's fastest memory allocator uses Huge Pages to enable apps to run faster on installed DRAM and allows a pool of DRAM and PMEM to run DRAM-fast.

Without Memory Machine, snapshots are manual, sent to storage in minutes and recovered in hours. With Memory Machine, it takes a second or two to snapshot and restore 1TB.



Organizations can deploy a high availability memory tier while increasing their agility with memory snapshot-based time travel, auto save, thin clones and app migration.



Memory Machine can clone of a 380GB kdb+ database in 1 second, with no additional memory needed.



In this [video](#), Charlie Yu explains and demonstrates software-defined memory services.

Software-Defined Memory Services

Once Memory Machine software is installed and the memory is virtualized, a suite of services is available based on ZeroIO™ memory-to-memory snapshots.

ZeroIO™ Snapshots

Memory Machine features the world’s first memory-to-memory snapshot technology. The ability to snapshot data from DRAM to DRAM or persistent memory transforms the volatile low-availability memory tier into a higher availability tier. Memory Machine ZeroIO Snapshots are also the foundation of the 4 data services below.

Time Travel

Allows an application to roll back to any of the snapshots previously taken, therefore creating “time travel” for that application.

AutoSave

Configured automatic snapshots at predetermined intervals to protect an app from the effects of a crash. After a crash, the app will automatically recover to the last snapshot taken.

Thin Clone

Clones of in-memory databases are frequently made so DevOps or other applications can have access to the database. The process can be complex, lengthy and requires additional memory. The Memory Machine Thin Clone service uses ZeroIO snapshot technology to create another instance of the last snapshot of the in-memory app in a couple of seconds, and without additional physical memory.

App Migration

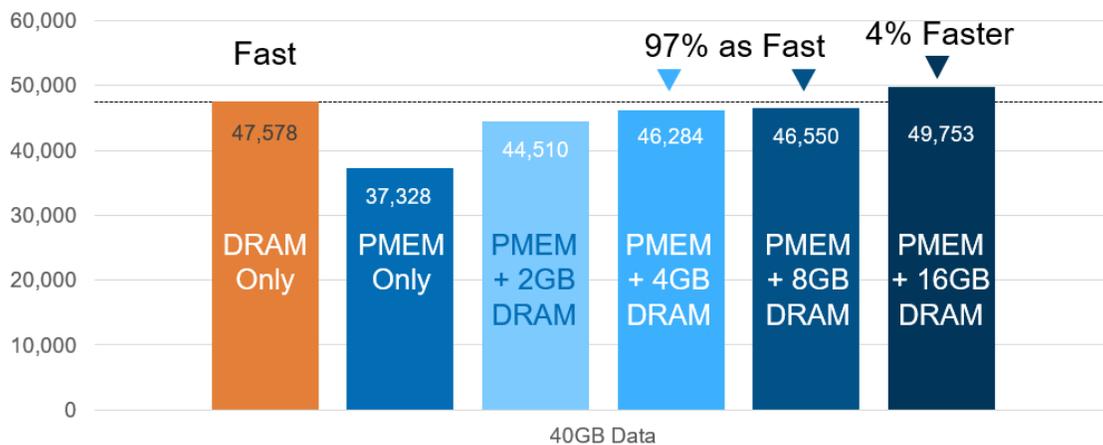
After an in-memory snapshot is taken, this snapshot can be moved to another server, and a new application instance can be created from this snapshot.

Memory Machine Performance

Customers tell MemVerge the 3 most important features of their server memory are 1. Performance, 2. Performance, and 3. Performance. It's only after these 3 requirements are met that most IT organizations will consider addressing lower cost and higher availability.

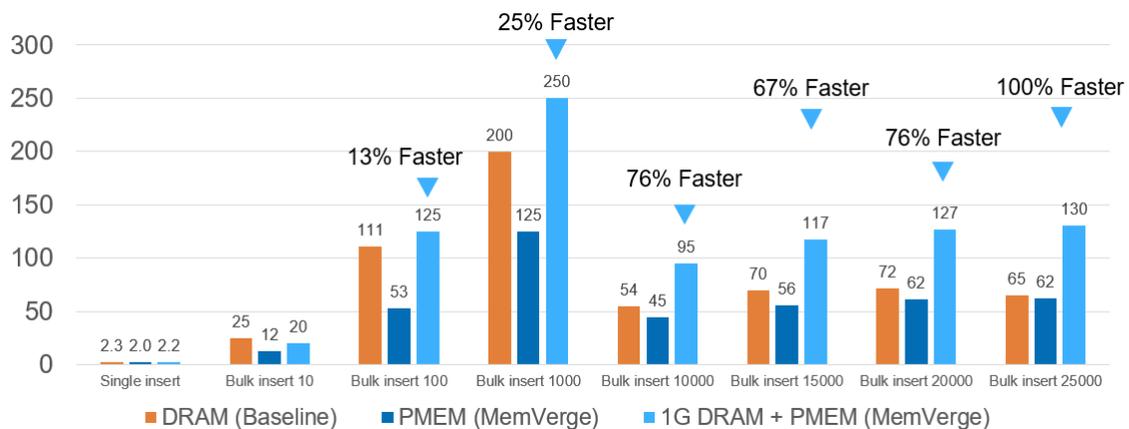
Memory Machine software makes it possible to have it all. Memory Machine can deliver higher application performance with your existing DRAM or provide the same or better performance from a pool of DRAM + PMEM. Below are a few of many examples of superior application performance with Memory Machine and lower cost PMEM.

MySQL Performance - Sysbench QPS



MySQL with Memory Machine and DRAM-only out-performs PMEM-only. However, as more DRAM is added, application performance is as good or better than DRAM-only

kdb+ Performance Stress Test - Million Inserts per Second

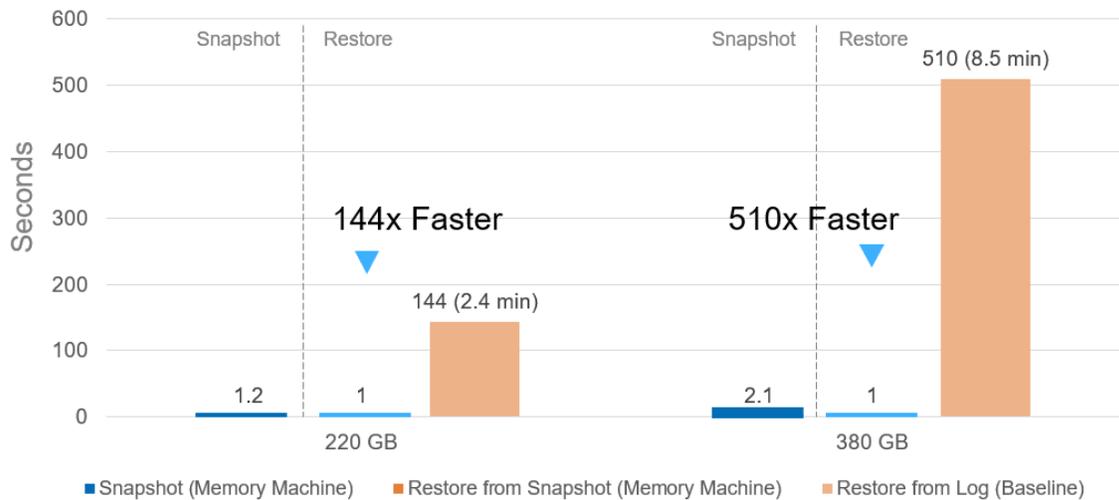


Kdb+ with Memory Machine and DRAM-only out-performs PMEM-only at single and 10 inserts. However, as the number of inserts increases, application performance is increasingly better than DRAM-only

Memory Machine Performance (cont.)

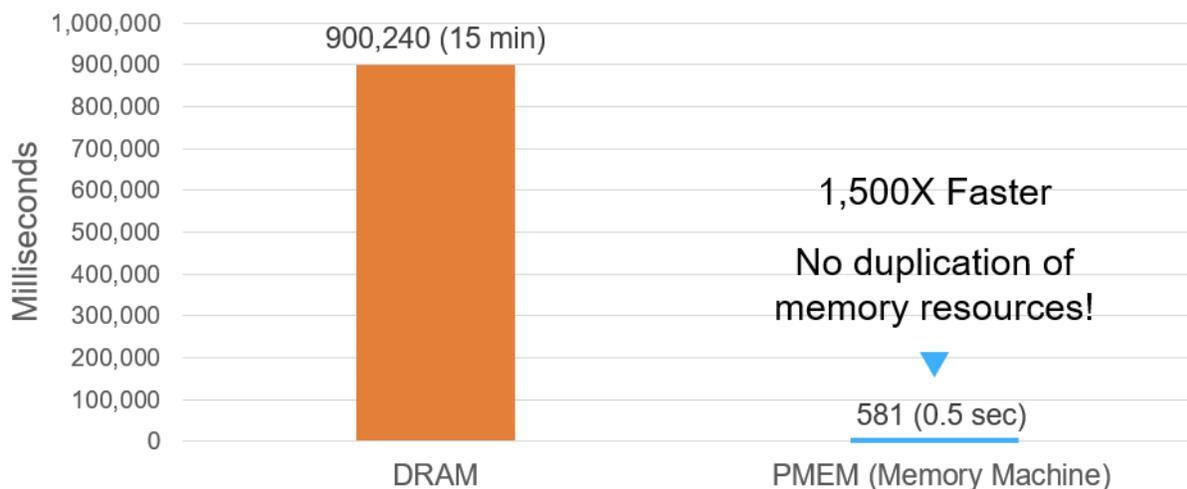
Having met or exceeded performance requirements, IT organizations can now think about using persistent memory and new memory services to modernize their server memory infrastructure. Below is an example of how Memory Machine can increase application availability with instant snapshot and recover, and an example of increasing IT agility with thin clones.

kdb+ Snapshot and Restore Performance



Without Memory Machine, snapshots to storage can take minutes, and recovery can take hours. With Memory Machine frequent snapshots are encouraged because they are non-disruptive, and recovery to memory can happen in only one second.

Cloning a Redis Database with 300M Keys



Providing clones of in-memory databases for developers or other applications is time-consuming and requires more expensive memory. With Memory Machine, new database instances can be created in less than a second and without additional memory.

Memory Machine Migration Strategy

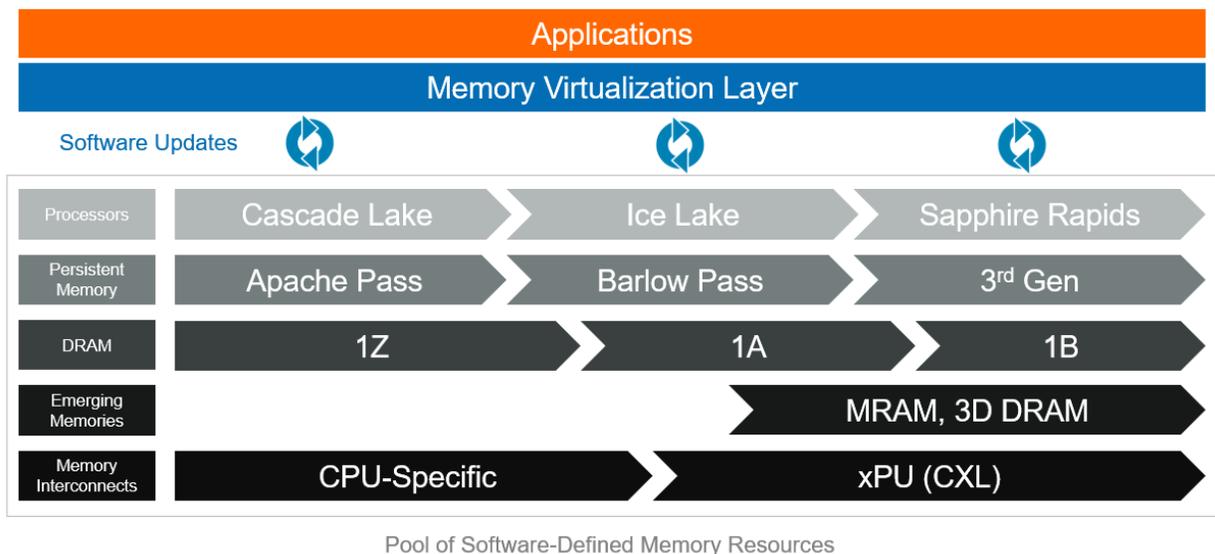
There is 1 important reason for developing a strategy for migrating to Big Memory, and there are 2 primary paths to get there.

A Strategy is Important Because Software-Defined Memory is Foundational

After 50 years with very little change to DRAM-based memory infrastructure, there is a revolution underway in memory-related technology. The memory virtualization layer plays a key role in the revolution by abstracting applications from the changes that would otherwise be needed to support new processors, persistent memory, DRAM, emerging memories, and CPU-memory interconnects.

With memory virtualization transforming your memory infrastructure into software-defined memory, IT organizations will benefit from a Tesla-like model where over the air software updates bring support for new features. This makes Memory Machine software a foundational piece of a long-term memory strategy.

The Tesla Model for Memory Infrastructure



Big Memory software like Memory Machine will be essential for harnessing the capabilities of new technology. It also will be needed to efficiently support the new technology with software updates and without modifying applications.

Memory Machine Migration Strategy (cont.)

Migration Path #1: Start with Installed DRAM

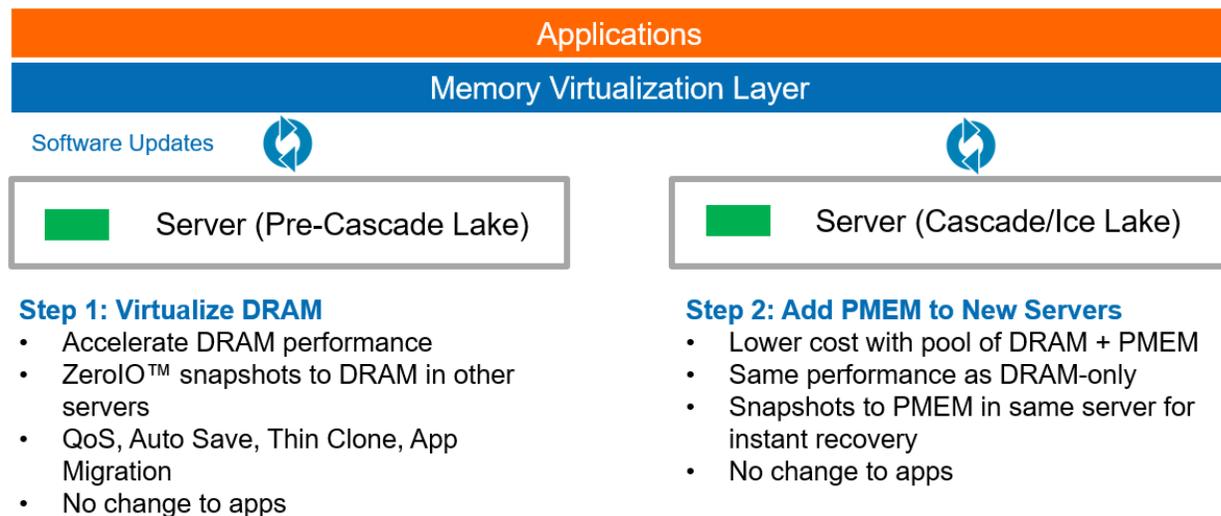
Deploying Memory Machine in your existing servers lays a foundation for supporting future memory technology and can make:

- 1) Memory-intensive applications run faster
- 2) Large in-memory apps recover from crashes instantly
- 3) IT agile with Time Travel, Auto Save, Thin Clone and App Migration memory services

Migration Path #2: Next Server Refresh

It's simple. Big Memory (Intel® Optane™ persistent memory + Memory Machine software) delivers more memory capacity, performance, and availability for less money, and with no changes to the apps. That's why we believe it should be considered for every in-memory app server refresh.

2-Step Strategy for Migration to Big Memory



Your applications and memory services for higher performance, availability, and agility can move together from old servers to new. Along the way, new features are delivered with software updates.

Applications Tested with Memory Machine and Supported by MemVerge

MemVerge is continuously testing and qualifying compatibility with memory-centric applications. Below is a list of apps tested with Memory Machine software and supported by MemVerge. If you have questions about our testing and support, or you would like us to test a new application, contact us at support@memverge.com.

App Name	Type	Description
kdb+	ts	time series in-memory db
maya	gfx	3D graphics
spark	pf	scalable processing framework
redis OSS	kv	in-memory KV store
redis enterprise	kv	in-memory KV store
tensorflow	ml	machine learning framework
pytorch	ml	machine learning framework
flink	str	stream processing
xgboost	ml	machine learning framework
memcached	kv	in-memory KV store
hazelcast	dg	in-memory data grid
aerospike	kv	noSQL database
rocksdb	kv	noSQL database
ms sql server linux	sql	SQL relational database
mysql/innodb	sql	SQL relational database
mongodb	doc	document-oriented database
Jupyter	comp	analysis / presentation tool
R	comp	statistical analysis tool
KVM	vm	Linux hypervisor
couchbase	doc	document-oriented database

Learn More about Big Memory & Memory Machine Software

1-Page Content

1-page MemVerge Company Profile: https://www.memverge.com/wp-content/uploads/2020/09/Corporate-Profile_2020.pdf

1-Slide MemVerge Overview: <https://www.slideshare.net/MemVerge/overview-of-memverge-in-one-slide>

1-Page Memory Machine Data Sheet: https://www.memverge.com/wp-content/uploads/2020/10/Data-Sheet_Memory-Machine.pdf

Multi-Page Content

MemVerge Company Overview Presentation: <https://www.slideshare.net/MemVerge/memverge-company-overview>

MemVerge Corporate Brochure: https://www.memverge.com/wp-content/uploads/2020/09/Corporate-Brochure_2020.pdf

Big Memory Crash Recovery Technology Brief: https://www.memverge.com/wp-content/uploads/2020/09/Technology-Brief_Crash-Recovery.pdf

Zero-Impact Crash Recovery for Kx Kdb+ Technology Brief: <https://www.memverge.com/wp-content/uploads/2020/09/Technical-Brief-Zero-Impact-Crash-Recovery-for-kdb-v6.pdf>

Big Memory Pub/Sub Solution Brief: https://www.memverge.com/wp-content/uploads/2020/09/Solution-Brief_Pub-Sub.pdf

Big Memory AI/ML Solution Brief: https://www.memverge.com/wp-content/uploads/2020/09/Solution-Brief_Machine-Learning.pdf

Industry Analyst Content

IDC Big Memory Technology Spotlight: <https://www.slideshare.net/MemVerge/idc-technology-spotlight-big-memory-computing-emerges-to-better-enable-dataintensive-it>

IDC Big Memory Definition and PMEM Forecast Presentation: <https://www.slideshare.net/MemVerge/digital-transformation-driving-new-big-memory-requirements>

IDC Big Memory Definition and PMEM Forecast Video: <https://youtu.be/hdjZlkZ362k>

451 Research MemVerge Picks Up Big Backers Report: https://www.memverge.com/wp-content/uploads/2020/09/451_Reprint_MemVerge_03AUG2020.pdf

Podcasts

Intel: [Big Memory Software Defined Controller](#)

Storage Unpacked: [Exploiting Persistent Memory with MemVerge](#)

Greybeards on Storage: <https://silvertonconsulting.com/gbos2/2020/05/27/0102-greybeards-talk-big-memory-data-with-charles-fan-ceo-co-founder-memverge/>

Actual Tech Media: <https://www.actualtech.io/podcast/090-blurring-the-memory-storage-lines/>

Videos

NASDAQ Spotlight: <https://youtu.be/HIPqyJtd7sQ>

Demo: [Creating Clones of Redis VMs in Microsoft Azure](#)

Demo: [Memory Machine Software Capabilities: Memory Snapshots and Managing from GUI and Command Line](#)

Demo: [Cloning an 800GB kdb+ Database in Seconds](#)

Webinar Sep 20: [Breakthroughs in Big Memory](#)

Webinar Jul 20: [MLB Opening Day Tech Talk About Big Memory](#)

Webinar May 20: [Opening the Door to Big Memory Webinar](#)

Webinar Apr 20: [Tech Talk: Big Memory for Financial Services](#)

Memory
Virtualization

Software-
Defined Memory

DRAM + PMEM with
DRAM Performance

ZeroIO™ Memory-to-
Memory Snapshots

Memory Quality-
of-Service (QoS)

Memory
AutoSave

Memory
Replication

Instant In-
Memory Database

Lower Cost
Memory

DRAM
Performance

Memory is a High
Availability Tier

The Cascading Effect of Big Memory Software Innovation

Big Memory Computing is Intel® Optane™ Persistent Memory hardware and MemVerge Memory Machine software working together to form a new memory tier. Our software represents a long list of innovations cascading down into a new era of lower cost, higher availability, and DRAM performance.

