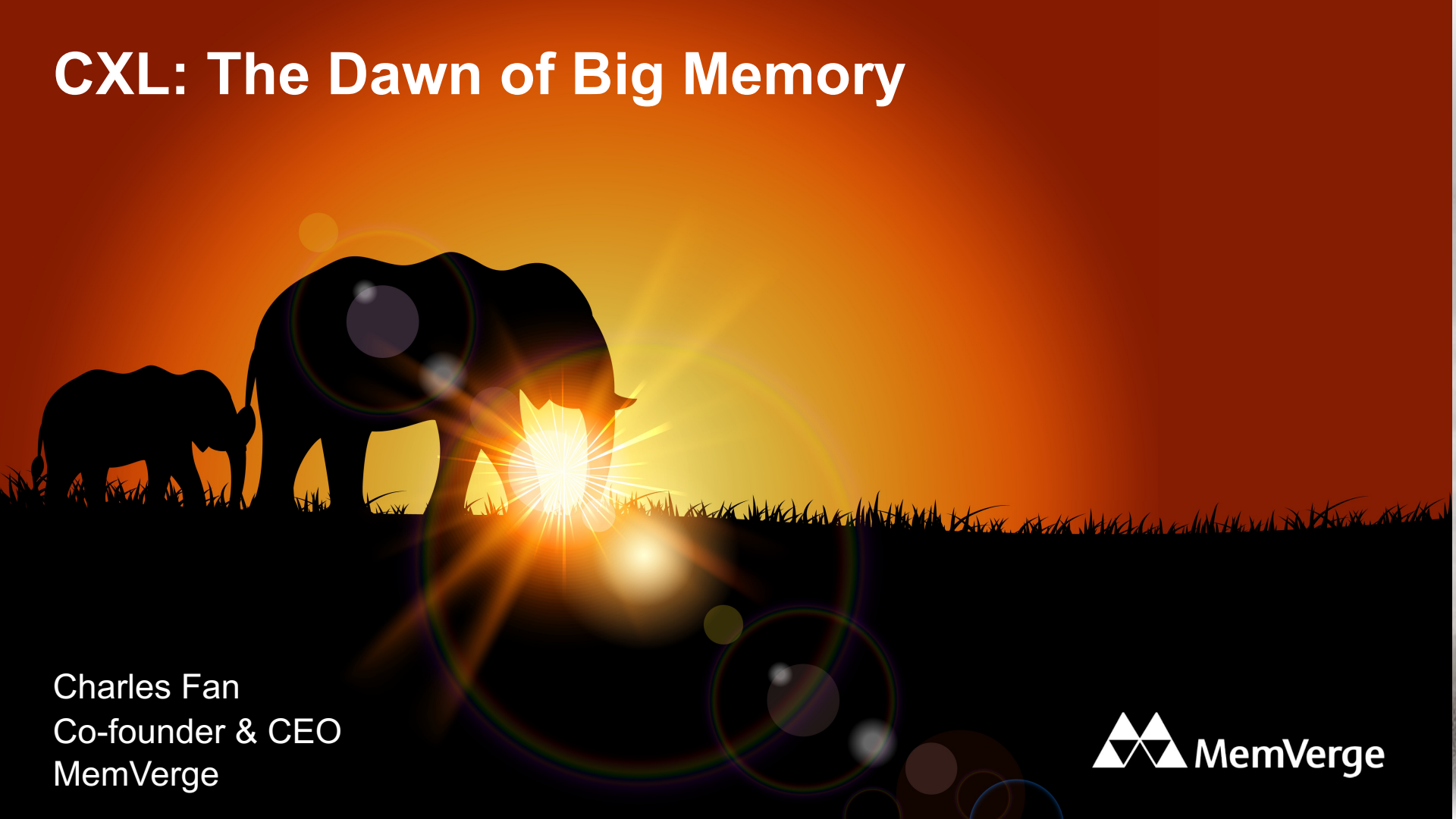
CXL: The Dawn of Big Memory



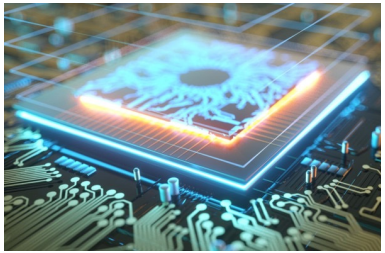
Charles Fan
Co-founder & CEO
MemVerge

MemVerge

The Rise of Modern Data-Centric Applications

AI/ML

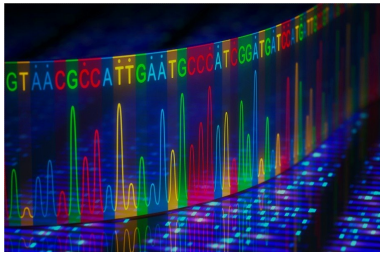
EDA Simulation



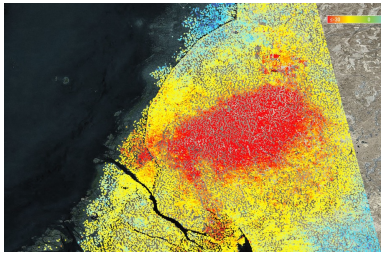
Video Rendering

Financial Analytics

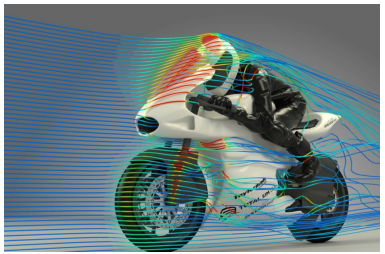
Genomics



Geophysical



CFD

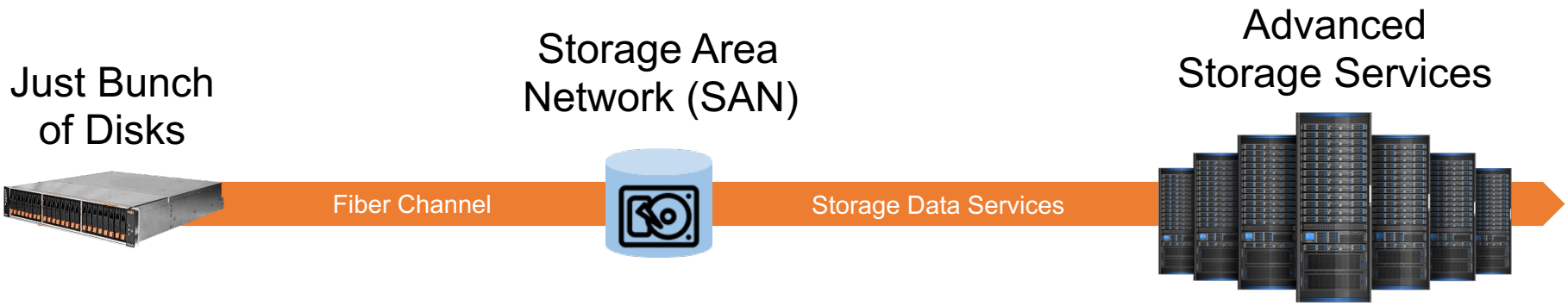


Risk Analysis

Opening the Door to the Era of Big Memory

Abundant
Composable
Available

What happened 30+ years ago



Where We Are Going…

Just Bunch of Disks

Fiber Channel

Storage Area Network (SAN)

Storage Data Services

Advanced Storage Services

CXL

Pooled Memory

Memory Data Services

New Memory

Memory-as-a-Service

Disaggregated & Pooled Memory

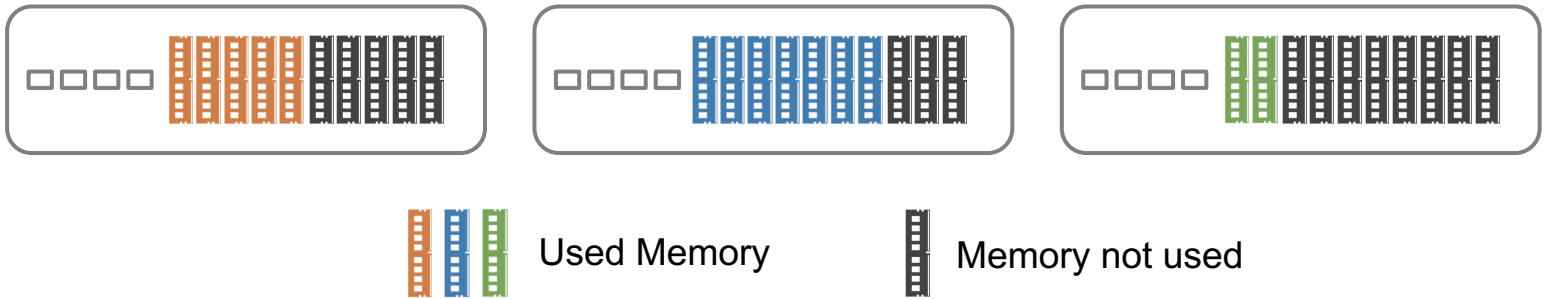
CXL Compute Express Link

Use Case #1

Dynamic Memory Expansion

Reduces Stranded Memory

Before CXL



Azure Paper*:

- **Up to 50% of server costs is from DRAM alone**
- **Up to 25% of memory is stranded**
- **50% of all VMs never touch 50% of their rented memory**

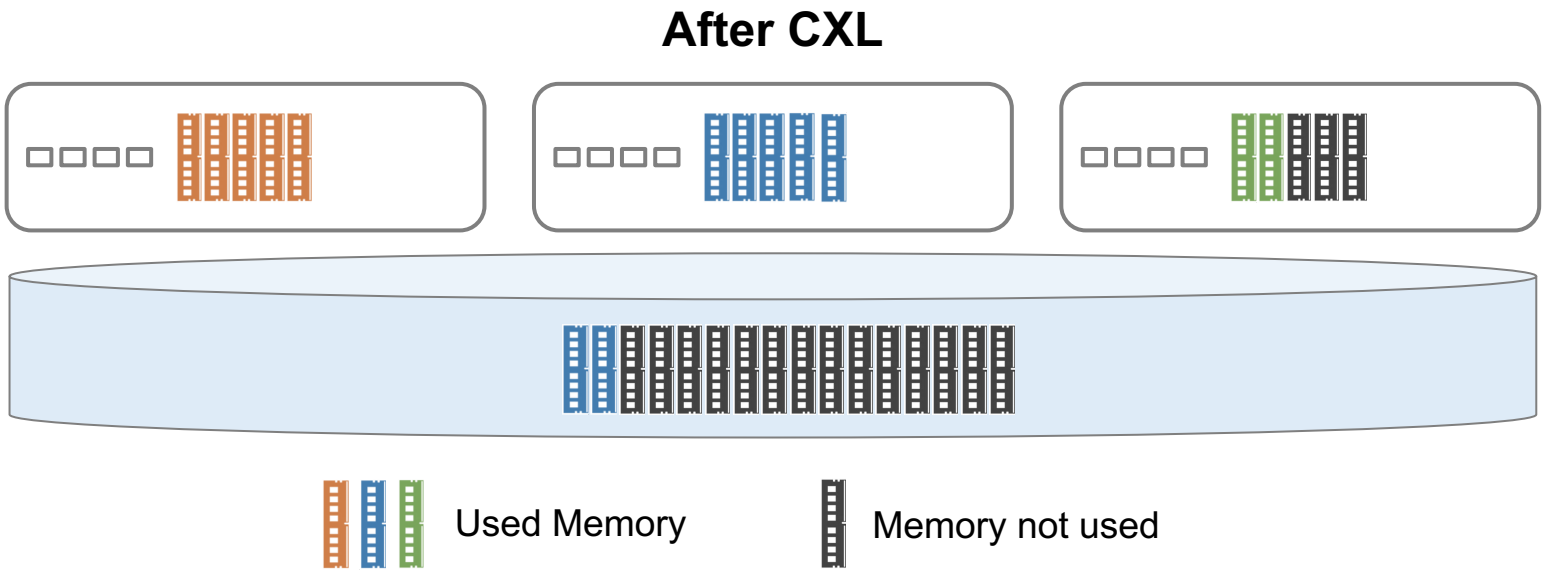
* H. Li et. Al. First-generation Memory Disaggregation for Cloud Platforms. arXiv:2203.00241v2 [cs.OS], March 5, 2022

CXL Compute Express Link

Use Case #1

Dynamic Memory Expansion

Reduces Stranded Memory



Memory disaggregation can save billions of dollars per year.

CXL Compute Express Link

Use Case #2

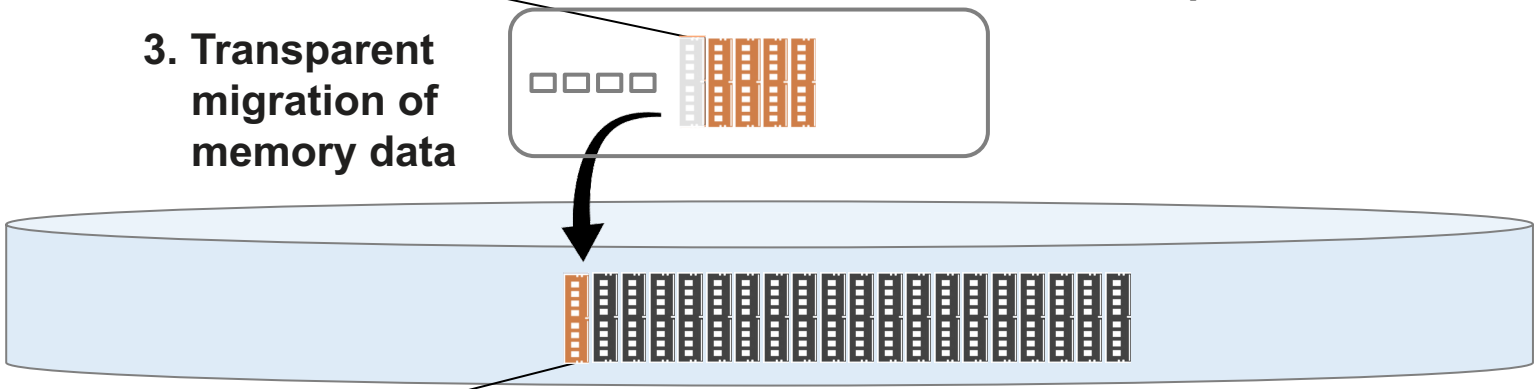
Memory Auto-healing

With Transparent Migration

1. A memory module is becoming bad: error rate going up.

4. Memory Auto-healing complete

3. Transparent migration of memory data



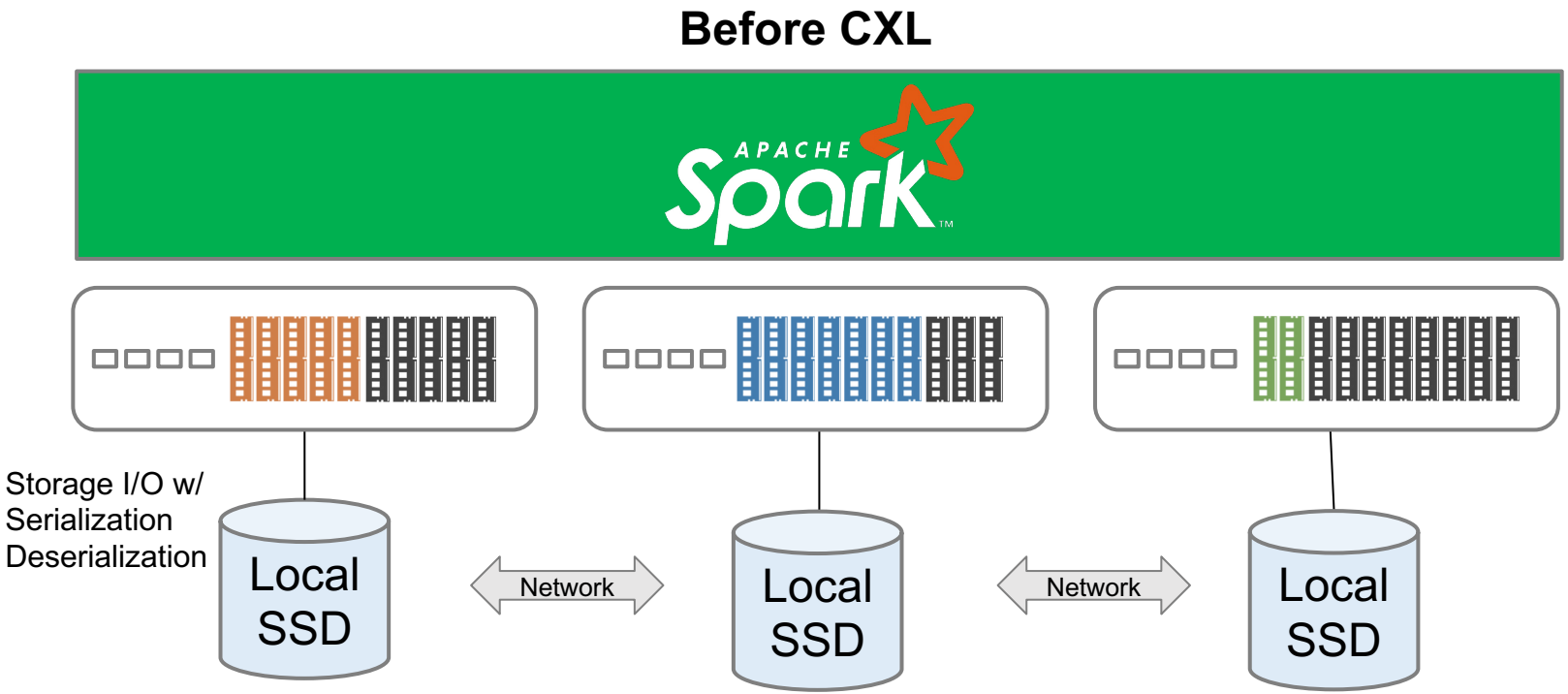
2. Provision a new memory region from the pool

MemVerge

CXL Compute Express Link

Use Case #3

Distributed Data Shuffling

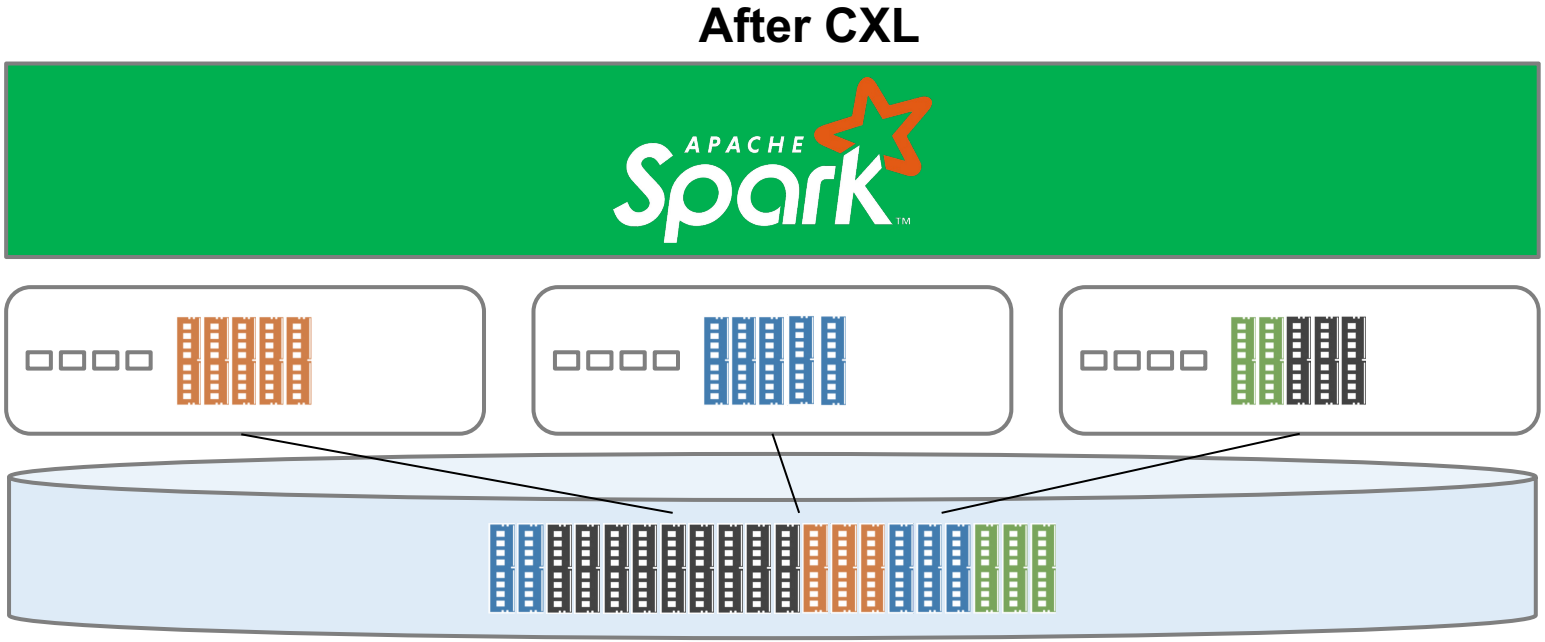


MemVerge

CXL Compute Express Link

Use Case #3

Using Shared Memory Read

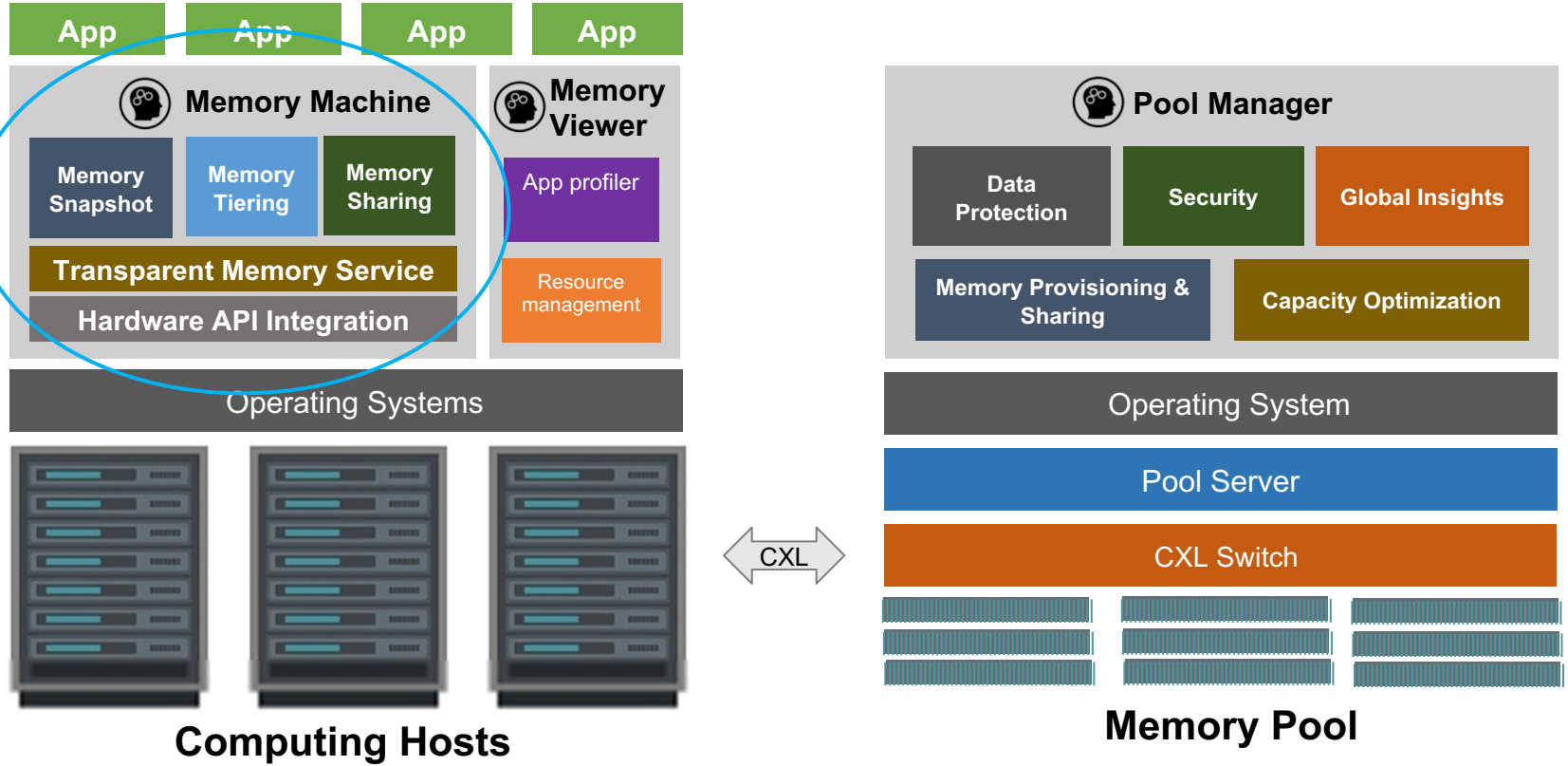


Project Splash is open source: https://github.com/MemVerge/splash

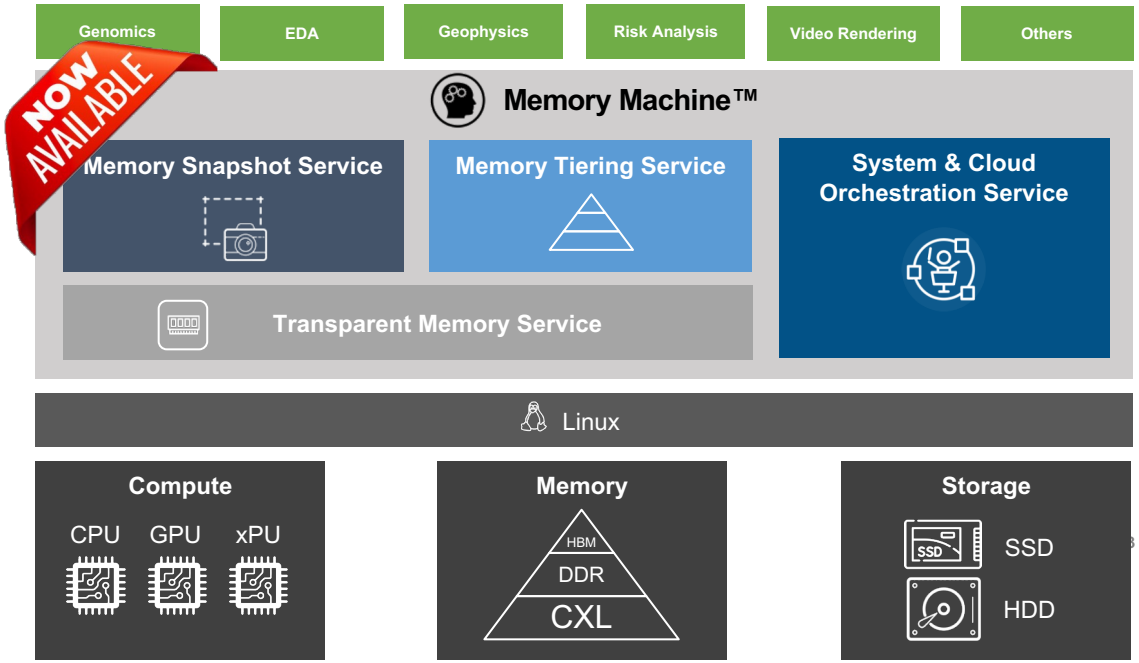
S. Chen, et. Al. Optimizing Performance and Computing Resource Management of in-memory Big Data Analytics with Disaggregated Persistent Memory. CCGRID'19

MemVerge

Key Software Components



Announcing Memory Machine Cloud Edition



Memory Capacity Expansion

- Software-defined Memory Pool with intelligent Auto-tiering
- No application change required

Accelerate Time-to-discovery

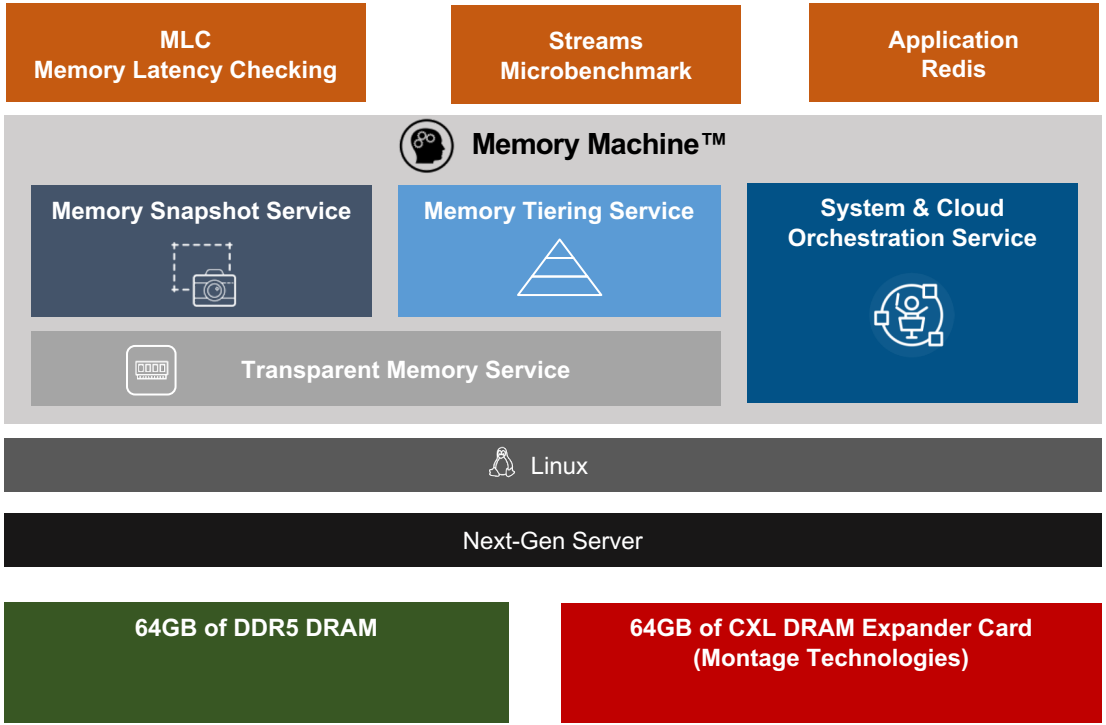
- Transparent checkpointing
- Roll-back, restore and clone anywhere any time

Reduce Cloud Cost by up to 70%

- Enable long-running applications to use low-cost Spot instances
- Integration with cloud automation and scheduler to auto-recover from CSP preemptions

MemVerge

Early Results Running Memory Machine on CXL



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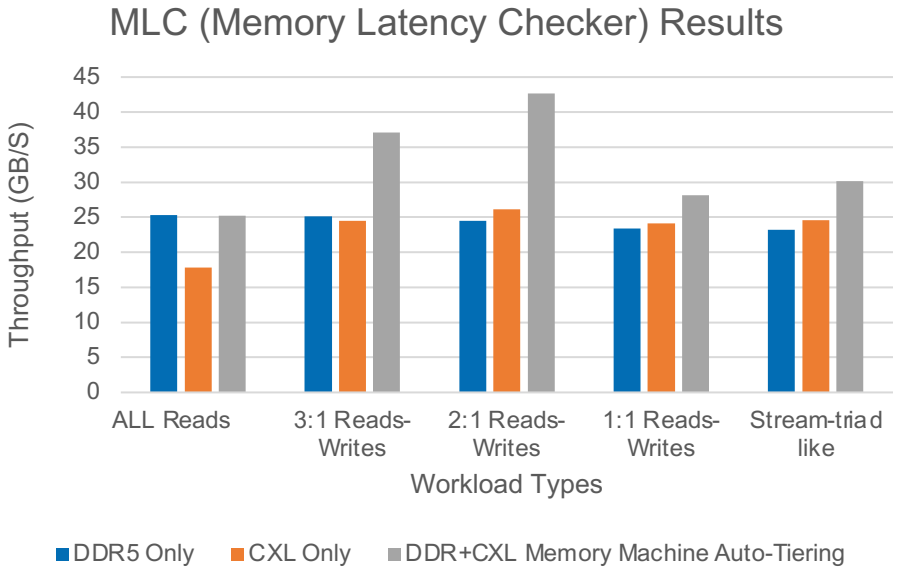
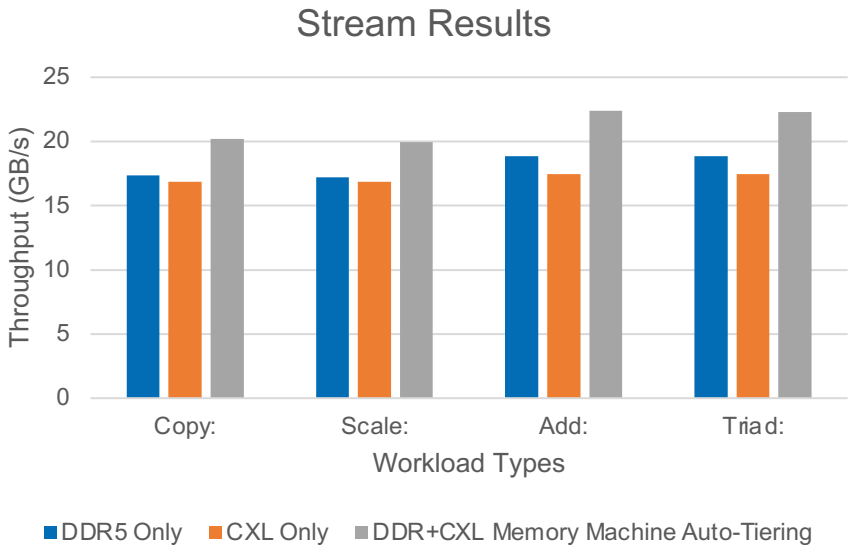
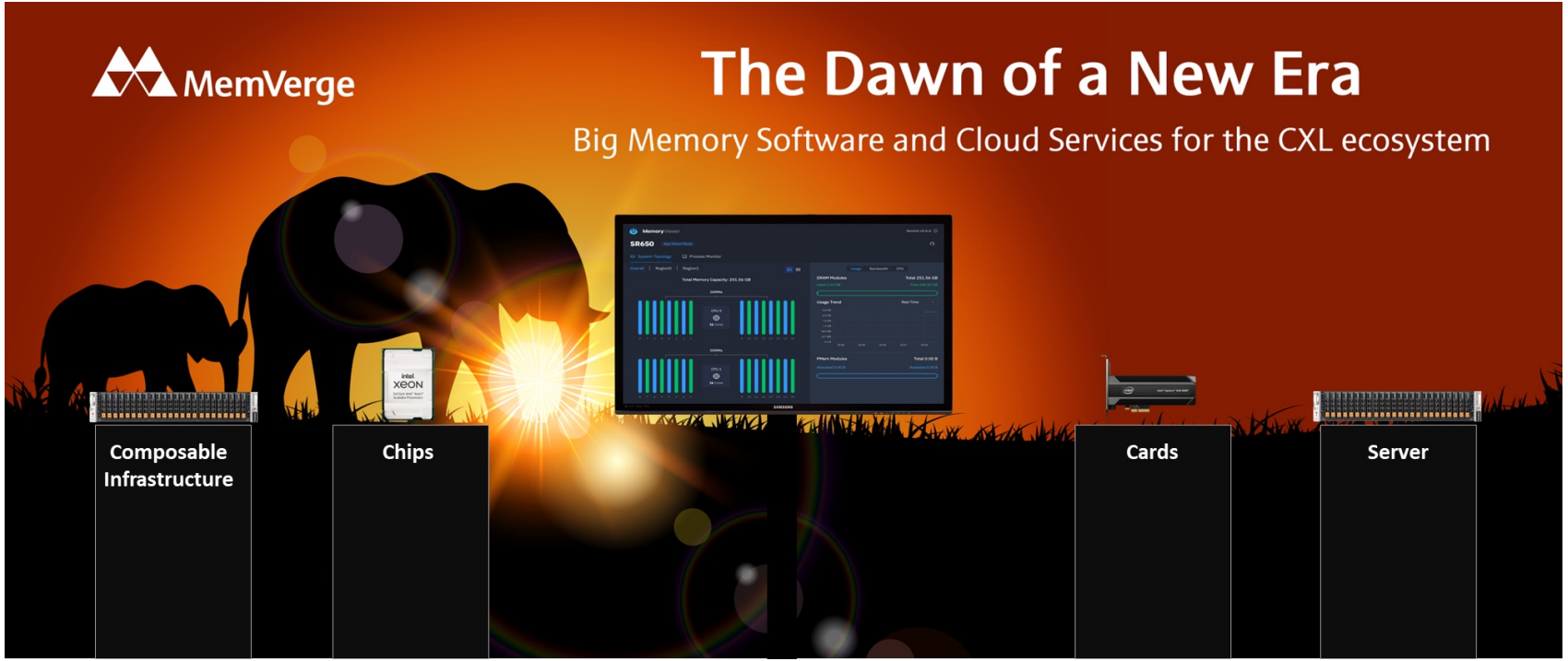
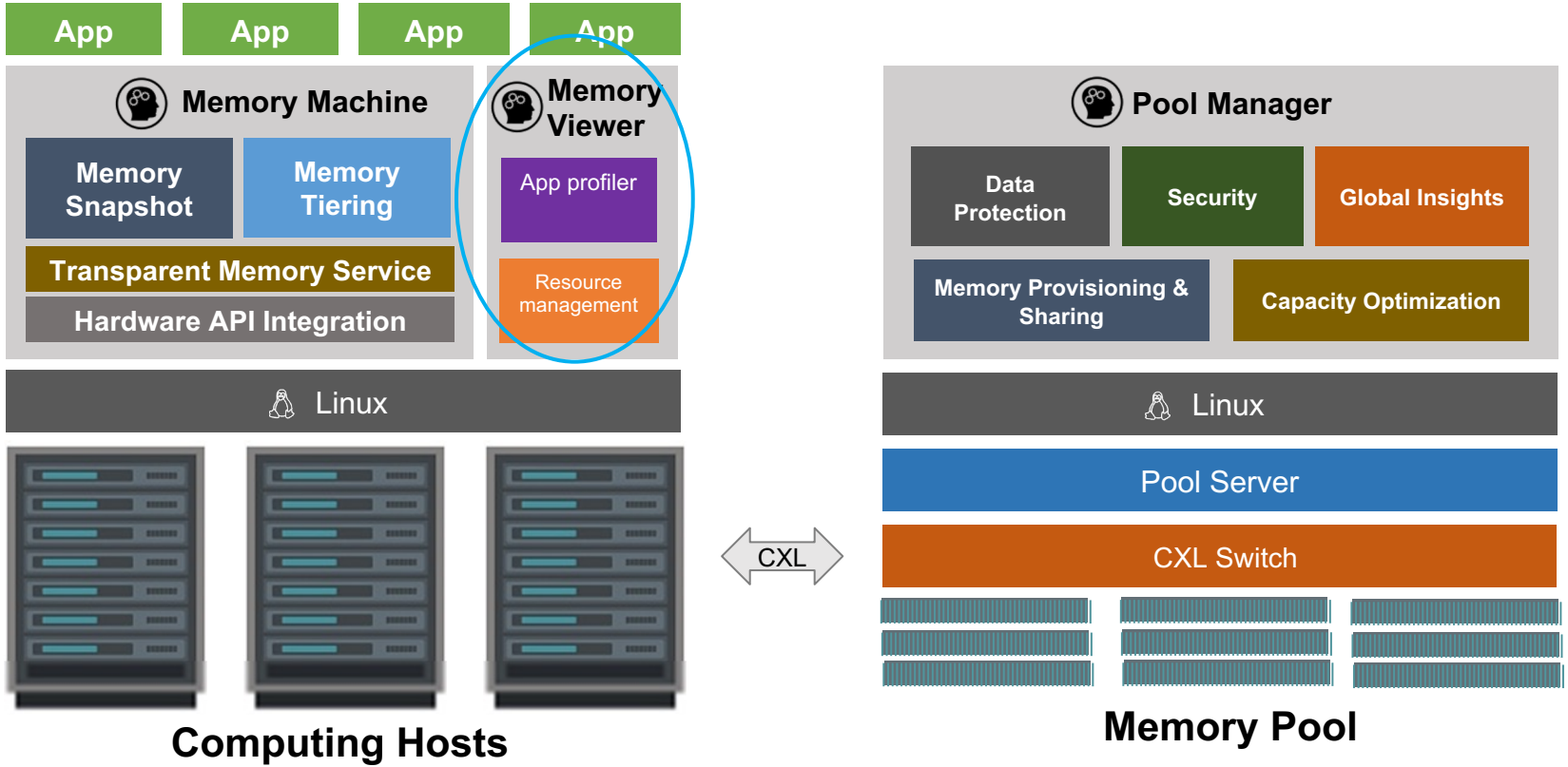




Live Demos at MemVerge Booth



Key Software Components



MemoryViewer

Version v0.7.1

SE02.ENG.MEMVERGE.LOCAL

App Direct Mod

AVAILABLE NOW

Announcing MemoryViewer

System Topology | Process Monitor

Overall | Region0 | Region1

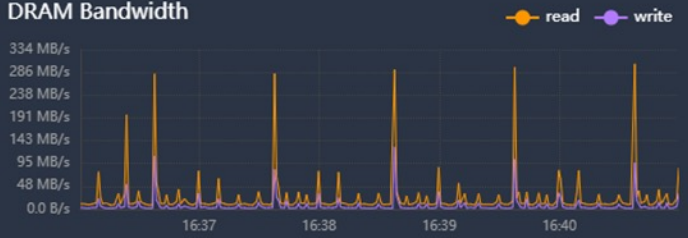
Total Memory Capacity: 1.66 TB

CPU - Socket 0

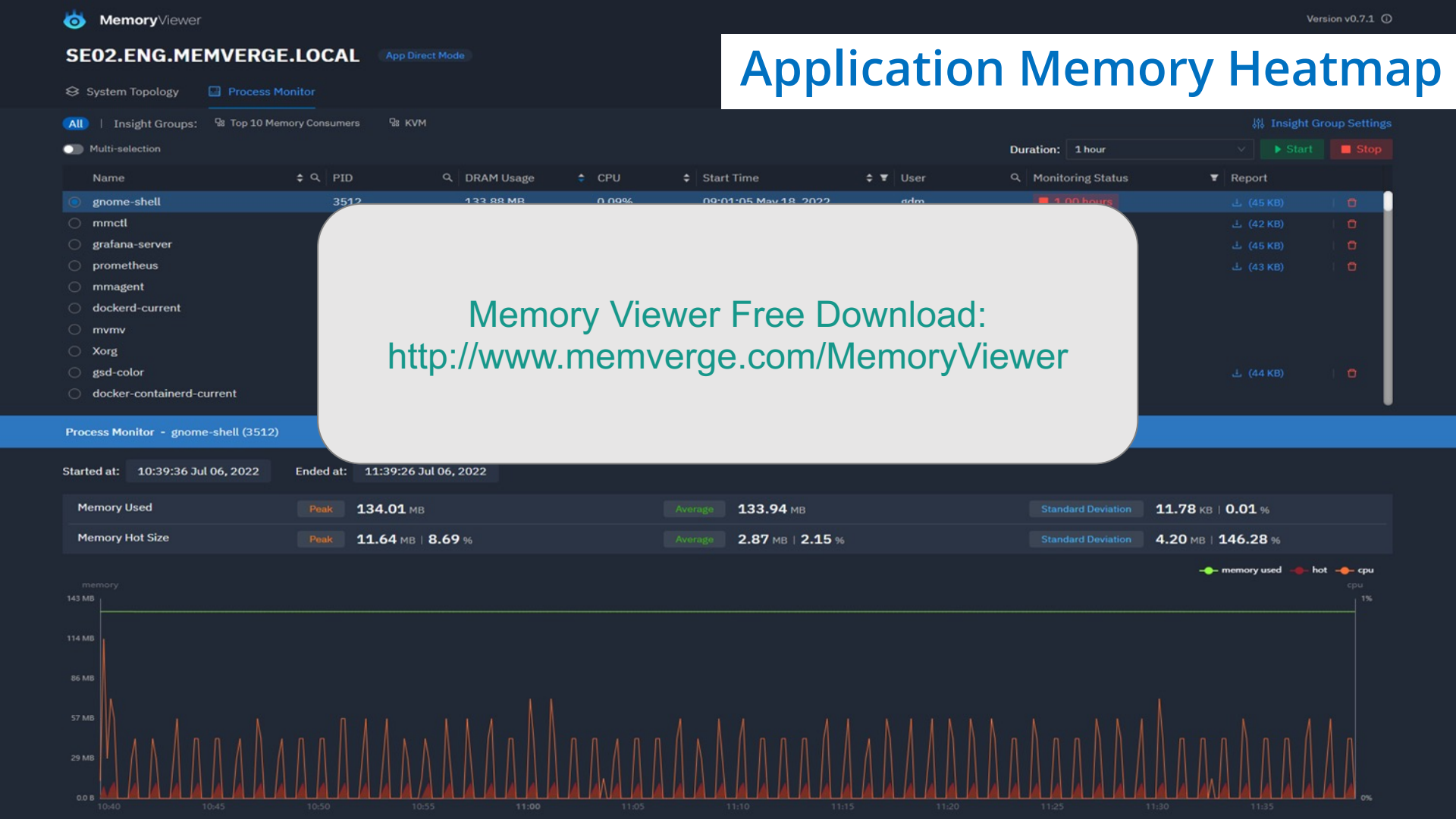
Model Intel(R) Xeon(R) Gold 6240 CPU @ 2.60GHz

Cores	Threads	Current Speed	Max Speed
18	36	2600 MHz	4000 MHz

DRAM Bandwidth



PMem Bandwidth


MemoryViewer
Version v0.7.1
SE02.ENG.MEMVERGE.LOCAL
App Direct Mode
Application Memory Heatmap
System Topology
Process Monitor
All | Insight Groups: Top 10 Memory Consumers KVM
Insight Group Settings
Multi-selection
Duration: 1 hour
Start
Stop
Name PID DRAM Usage CPU Start Time User Monitoring Status Report
gnome-shell 3512 133.88 MB 0.09% 09:01:05 May 18, 2022 gdm 1.00 hours (45 KB)
mmctl (42 KB)
grafana-server (45 KB)
prometheus (43 KB)
mmagent
dockerd-current
mvmv
Xorg
gsd-color (44 KB)
docker-containerd-current
Memory Viewer Free Download:
http://www.memverge.com/MemoryViewer
Process Monitor - gnome-shell (3512)
Started at: 10:39:36 Jul 06, 2022
Ended at: 11:39:26 Jul 06, 2022
Memory Used Peak 134.01 MB Average 133.94 MB Standard Deviation 11.78 KB | 0.01 %
Memory Hot Size Peak 11.64 MB | 8.69 % Average 2.87 MB | 2.15 % Standard Deviation 4.20 MB | 146.28 %
memory used
hot
cpu
memory
cpu
143 MB
114 MB
86 MB
57 MB
29 MB
0.0 B
1%
0%
10:40
10:45
10:50
10:55
11:00
11:05
11:10
11:15
11:20
11:25
11:30
11:35

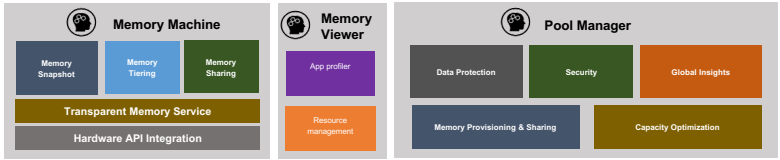
Software Partner to the CXL Ecosystem

Founded in 2017 to develop Big Memory software

Switches: MARVELL, XCONN TECH, Elastics.cloud, LIQID GIGAIO

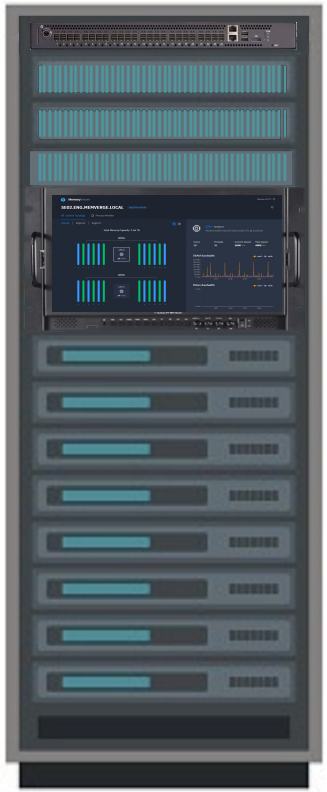
Memory Systems: SAMSUNG, SK hynix, Micron, KIOXIA, Rambus, MONTAGE Technology, AsteraLabs, SMART Modular Technologies, Western Digital, SEAGATE

Big Memory Software



Processors: intel, AMD, NVIDIA, arm

Servers: DELL, Hewlett Packard Enterprise, CISCO, Lenovo, SUPERMICRO, PENGUIN COMPUTING



Standards Bodies

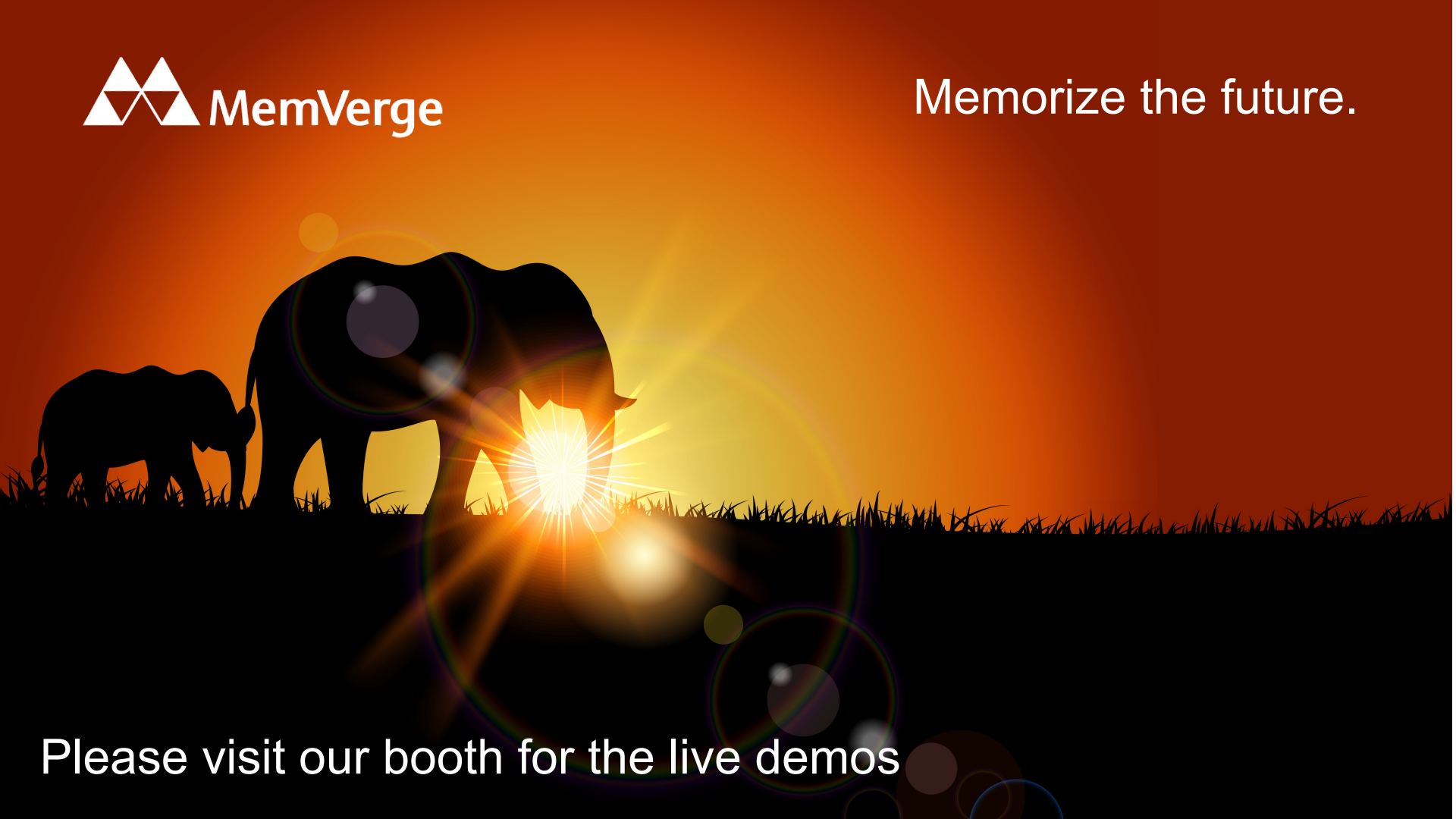
CXL Compute Express Link, OPEN Compute Project, SNIA

Big Memory Apps

SYNOPSYS, cadence, HAZELCAST

Clouds

aws, Alibaba Cloud, Azure, Tencent Cloud, Google, ByteDance, Meta, phoenixNAP GLOBAL IT SERVICES


MemVerge
Memorize the future.
Please visit our booth for the live demos