G2M Research Multi-Vendor Webinar: Composable Infrastructure – What is It, and Why is It Important?

Tuesday July 30, 2019

Western Digital
LIqid
GigaIO
Webinar Agenda

9:00-9:05  Ground Rules and Webinar Topic Introduction (G2M Research)
9:06-9:26  Sponsoring Vendor presentations on topic (7 minute each)
9:27-9:28  Audience Survey 1 (2 minutes)
9:29-9:39  Key Question 1 (2-minute question; 2 minutes response per vendor)
9:40-9:41  Audience Survey 2 (2 minutes)
9:42-9:52  Key Question 2 (2-minute question; 3 minutes response per vendor)
9:53-9:54  Audience Survey 3 (2 minutes)
9:55-10:05 Key Question 3 (2-minute question; 3 minutes response per vendor)
10:06-10:18  Audience Q&A (13 minutes)
10:19-10:20  Wrap-Up
G2M Research Introduction and Ground Rules

Mike Heumann
Managing Partner, G2M Research
Panelists

Host/Emcee:
Mike Heumann
Managing Partner
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Dave Montgomery
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(www.liqid.com)

Alan Benjamin
President and CEO
(www.gigaio.com)
Composable Infrastructure (CI) allows compute platforms (both servers and workstations) to share a variety of datacenter resources, such as:
- General-Purpose Graphics Processing Units (GPGPUs)
- FPGA and ASIC-based accelerator cards
- Storage Elements (SSDs, Optane Memory, etc.)

A network or fabric is utilized to connect the compute nodes to the resources. Possible networks/fabrics:
- PCI Express (PCIe) – InfiniBand
- Ethernet

A management system is utilized to set up and tear down connections between compute nodes and resources.
Is Composable Infrastructure a New Concept?

Like most things in Information Technology (IT), Composable Infrastructure (CI) has had predecessor concepts and systems.

I/O Virtualization (2001-2013) was the most recent predecessor of CI
- Focused on sharing of I/O resources (Ethernet NICs, Fibre Channel HBAs, InfiniBand HCAs)
- Some vendors extended it to include GPGPUs and PCIe flash cards
- Sharing was generally across PCIe or InfiniBand

Composable Infrastructure has added several key elements:
- Ability to add and delete resources from the overall resource pool
- Ability to add and delete resources to compute elements without reboot
- Ability to automate dynamic provisioning of resources
Composable Infrastructure Use Cases

- In general, CI works where expensive resources are used intermittently by a given user/set of users, but which are critical to the task(s) of the user(s).

- Example: 4K or 8K digital video pre-production/mastering. Key resources:
  - GPGPUs: NVIDIA Titan RTX ($2,499)
  - GPUs: NVIDIA GeForce RTX 2080 ($820; need 2)
  - Storage: Intel Optane DC SSD 280GB ($255; need 8)
  - Total cost per instance: $6,200

- If you have a team of 100 users that each use the config 10% of the time:
  - Dedicated resources for each user: $620,000
  - Shared resources using CI: $62,000 (not including CI HW/SW costs)
Western Digital’s Open Composability Vision

**Devices**
- Storage
- Compute Processors
- Network VLANs
- Memory Modules

**Resources**
- Storage Volumes
- Compute Processors
- Network VLANs
- Memory Modules
- Flash
- Disk
- Central Processor
- Accelerator Processor
- Field Programmable Processor
- Data Fabric
- Memory Fabric
- Dynamic RAM
- Persistent Memory

**Composites**
- Virtually Composed Systems
- Virtual System 1

**Physically Disaggregated Devices**
**Logically Shared Resources**
Example: Flash Intensive Workload

Underutilized resources

Scalability
Efficiency
Agility
Performance
Composability → disaggregate hardware elements

Provides the advantages of Hardware Composed Infrastructure with no vendor lock-in

**Hardware Disaggregation**
Disaggregate hardware components from the server so they can be efficiently pooled

**Composability**
Orchestrate virtual systems that can be optimally sized to the task
Open Composability

NVMe-over-Fabric Attached Devices

- No physical systems – Only virtual systems – Procured from separate suppliers
- Each device provides a resource that is offered over the network
- No established hierarchy – CPU doesn’t ‘own’ the GPU or the Memory
- All devices are peers on the network & they communicate with each other
Orchestrate Virtual Systems Using Fabric Attached Devices

Virtual System #1

Virtual System #2

Virtual System #3

Virtual System #4
OpenFlex™ Composable Infrastructure

All-Flash Fabric Device and Enclosure

High-capacity for big data (disk)

OpenFlex D4000

High performance, low latency for fast data (flash)

OpenFlex F3000

High-Capacity Fabric & High-Performance Compute Devices

High capacity for big data (disk)

OpenFlex C2000

High performance compute (CPU, memory)

OpenFlex

NVMe-over-Fabric | Infrastructure Disaggregation | Software Composable
Objectives
- Create interoperability across eco-system
- Enable customers to confidently purchase Fabric Attached Devices
- Enable composition / orchestration providers to focus on their value add
- Provide an environment for multiple companies to debug interoperability issues

Principals
- All Fabric Attached Devices are peers
- All Vendors benefit when customers can confidently purchase
- Provide an open environment to debug
- Collaborate with UNH-IOL

• NVMe-oF Compliance Testing
• Ethernet Compliance Testing
Western Digital®
Data Center Efficiency

Industry Wide Average: 12% Data Center Utilization

Google Averages: 30% Data Center Utilization

Liqid Enables: 90% Data Center Utilization

Liqid Enables Significant Improvement in Resource Utilization
“Composable infrastructures will provide I&O leaders with simple, flexible resource utilization and faster application deployment.” - Gartner
Dynamic Infrastructure Platform
Use Case: Dynamic Bare Metal Cloud

Dynamic Bare Metal Machines

Server-1

Server-2

Server-N

Fabric Switch

Storage Pool

Networking Pool

Compute Pool

GPU Pool

Dynamic Bare Metal Cloud Infrastructure as a Service
Benefits of On-Premise with Flexibility of Cloud

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*Image and text from Amazon Web Services.*
Future A.I. Market

"Over the next 10 years, virtually every app, application and service will incorporate some level of AI," - Gartner

A.I. driven business value

2022 $3.9 TN

Use Case: Composable A.I. Platform

Dynamic Resource Allocation for Each Stage of A.I. Workflow
Use Case: Media & Entertainment

Dynamic Reallocate Resources to Enable Improved Hardware Utilization
Benefits of Composable Disaggregated Infrastructure

- Dynamically Configured Servers
- Independent Scaling of Resources
- Extended Product Life Cycle
- Decouple Purchase Decisions
- Pay as You Grow
- Enable New Server Configurations
- Software License Efficiency

Composable Infrastructure
Go-to-Market

Liqid GTM focused on Leveraged Partnership Model
Markets & Customers

**AI & Deep Learning**
- GPU Scale out
- Enable GPU Peer-2-Peer at scale
- GPU Dynamic Reallocation/Sharing

**Dynamic Cloud**
- CSP, ISP, Private Cloud
- Flexibility, Resource Utilization, TCO
- Bare Metal Cloud Product Offering

**HPC & Clustering**
- High Performance Computing
- Lowest Latency Interconnect
- Enables Massive Scale Out

**5G Edge**
- Utilization & Reduced Foot Print
- High Performance Edge Compute
- Flexibility and Ease of Scale Out
Thank You
GigaIO

Alan Benjamin
President and CEO
www.gigaio.com
The Legacy Architecture is Being Forced Apart

HUGE surge in data
- More storage
- Big Data Analytics & Databases
- Emergence of AI / DL / ML

End of Moore’s Law
- Heterogeneous compute
- New faster, larger storage

“Tomorrow’s advances will come from architectures optimized for specific workloads.”  - John Patterson, John Hennessy
Evolving into A Rack Scale Architecture
Rack Scale Systems and Disaggregation

- Drive better performance
- Enable more capable configurations
- Run converged workloads
- Reduce Costs – Capex & Opex

“For all the value disaggregation brings, it is useless, unless we can re-aggregate the pieces without getting killed in performance”
Rack Scale: Approach One – Bigger Servers

Network

Rack Scale System

Server

Bigger Server

+ Great performance
- Limited ability to scale the size / power in a single box
- Cost
- Utilization

Example: DGX2 Hana Servers
Rack Scale: Approach Two – Use the Network

- Scales well – through individual servers – storage
- Latency is a problem
  - Limits use beyond storage
- Complexity of SW & HW
- Proprietary
- Expensive
Rack Scale: Approach Three - PCIe Switching

A better “Big” server....
+ Very good performance, particularly latency
+ Works for storage and compute
+ Better sharing and utilization
+ Cost effective

- Fundamental limitations in building scale
- Still need to network the servers
FabreX™: P2P Networking via non-transparent bridges

+ Great Performance - latency AND bandwidth
+ Works for all types of storage and compute
+ Scales without limits; Resource Boxes and server based via NVMe-oF and GDR
+ Open-program platform via Redfish APIs
+ Easy Application / Framework / Container integration

Solves Both Scale AND Performance
FabreX: Scale Up and Scale Out

Application Servers

PCIe

PCIe
FabreX: Scale Up and Scale Out

Application Servers

PCIe

JBOF / Computational Storage

PCIe

PCIe

NVMe
FabreX: Scale Up and Scale Out

Application Servers

PCIe

JBOF / Computational Storage

NVMe

Storage Server NVMe-oF Target

PCIe

NVMe-oF
FabreX: Scale Up and Scale Out

Application Servers

PCIe

GPU Direct

JBOG

JBOF / Computational Storage

Storage Server NVMe-oF Target

PCIe

NVMe

NVMe-oF
FabreX: Scale Up and Scale Out

Application Servers

GPU Direct

GDR

PCIe

NVMe

NVMe-oF

Storage Server

JBOG

JBOF / Computational Storage

Storage Server NVMe-oF Target

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FabreX: Scale Up and Scale Out

Application Servers

PCIe

GDR

GPU Direct

PCIe

NVMe

PCIe

NVMe-oF

GPU Server

JBOG

JBOF / Computational Storage

Storage Server

NVMe-oF Target
FabreX: Scale Up and Scale Out

Application Servers

GDR

PCIe

GPU Direct

PCIe

PCIe NVMe

NVMe-oF

SCM

Memory Semantics

GPU Server

JBOG

JBOX

Storage Server

NVMe-oF Target

JBOF / Computational Storage

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Easy Integration into All Software Environments

Virtual Machines
- App A
- App B
- App C
- App D
- Bins/Libs
- Guest OS
- Hypervisor
- Host OS
- Server

Containers
- Kubernetes
- App A
- App B
- App C
- App D
- Bins/Libs
- Docker engine
- Host OS
- Server

Bare metal
- App A
- Bins/Libs
- Host OS
- Server

Cluster / Orchestration & Workflow

FabreX APIs & DMTF Redfish® APIs

Hardware Resource Pools
The Network is *Finally* the Computer
Panel Discussion
Audience Survey Question #1

Where is your organization in the process of investigating composable infrastructure (check one):

- We have deployed CI in production environments: %
- We have deployed CI for limited “test” applications: %
- We are engaged in a CI proof of concept evaluation: %
- We are talking to CI vendors: %
- We are identifying possible use cases for CI: %
- We don’t know enough about CI to know if it is applicable to us: %
- We don’t see any application of CI for our organization: %
Panel Question #1

How does composable infrastructure today differ from the technologies that preceded it 10-15 years ago?

- Western Digital
- Liqid
- GigaIO
What use cases for composable infrastructure is your company interested in (check all that apply):

- Shared GPGPU (computing):
- Shared GPUs (graphics/video mastering):
- Shared high-performance storage pools ("data lakes"):
- Workflow-based shared storage pools:
- Sharing FPGA or ASIC-based resources (AI, FinTech, etc.):
- Other:
- None:
Panel Question #2

What composable infrastructure use case have you seen the most interest in from your customers so far in 2019?

- Liqid
- GigaIO
- Western Digital
What are the greatest concerns that your organization has about utilizing composable infrastructure? (select all that apply):

- Overall maturity/lack of maturity of CI: %
- How much can we save? %
- Will CI impact resource performance? %
- Choosing the right CI network(s)/fabric(s): %
- Availability/support of CI by major server vendors: %
- Maturity/scale of CI go-to-market channels: %
- Other: %
Panel Question #3

How do you see composable infrastructure evolving over the next 5-10 years?
- GigaIO
- Western Digital
- Liqid
Audience Q&A
Thank You For Attending