LIQID

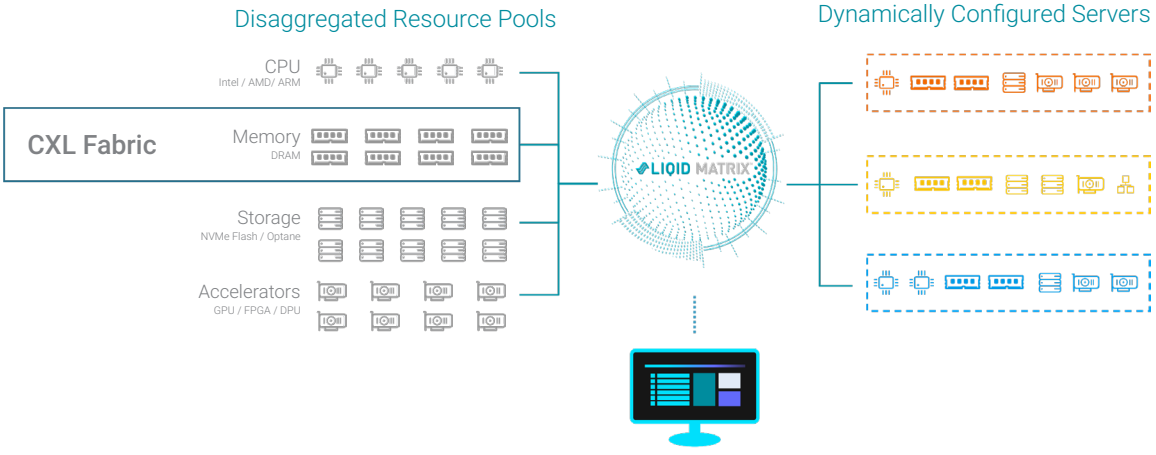
Next Generation Composable Memory

Technology Preview - Composable Memory via CXL

Conventional server design has remained fairly unchanged for years. Performance and capacity are limited by formfactor (1U, 2U or 4U) and the quantity of peripheral available slots. As modern workloads continue to progress, especially GPU-centric ones, traditional options to address them become more limited. Composable Disaggregated Infrastructure (CDI) allows organizations to create bare metal servers in seconds via software that meet the most challenging workloads and eliminate the lack of flexibility and efficiency found in traditional server design. For example, GPU-optimized servers are generally 4U and support a maximum of 8 GPUs. With CDI 20 GPUs can be composed into a 1U server for massive GPU-compute performance demands, and can be moved to other servers, hands-free, as performance demands decrease.

PCI Express® (PCIe®) devices such as GPUs, NVMe SSDs, Storage Class Memory (SCM), FPGAs and NICs are able to be composed into servers. Using a process called disaggregation, devices are pooled into PCIe enclosures, and along with host servers, are connected to a PCIe fabric switch. CDI software, like Liqid Matrixtm, is then used to compose PCIe resources to a server or blade system, via UI or API.

Today, CDI enables the disaggregating and composing of PCIe devices into servers (CPU/DRAM). However, DRAM itself cannot currently be disaggregated from CPU. If possible, complete datacenter disaggregation would be a reality, and organizations could compose systems from discrete pools of compute, memory, accelerators, and storage.



Tech Brief

Enter CXL. Based on the PCIe 5.0 physical layer infrastructure, Compute Express Link (CXL) is an open industry standard interconnect that offers high-bandwidth/low-latency connectivity between the host processor and devices such as accelerators, memory buffers, and smart I/O devices. CXL supports multiplexing between I/O, caching and memory protocols, and maintains a unified coherent memory space between CPU and memory for higher performance and less complexity. CXL offers the following multiprotocol support for multiple use cases:

- CXL.io: Allows device discovery, configuration, initialization, I/O virtualization, and direct memory access (DMA). CXL.io is based on PCIe.
- CXL.cache: Allows devices to cache data from host memory.
- CXL.memory: Allows host processor to access memory attached to CXL device.

One feature that ensures interoperability is that CXL uses the PCIe Gen5 link infrastructure, and supports x16, x8, and x4 link widths, at 32 GT/s and 64 GB/s bandwidth in each direction.

Liqid's CXL Strategy

Liqid's strategy for CXL support is three-fold:

1) Embrace the CXL standard for composable memory,
2) Enhance Liqid Matrix software to support CXL as a fabric-type and CXL memory endpoints as devices and
3) Engage with leading hardware partners to support a vast range of composable memory solutions.

Liqid is a Contributing Member of the CXL specification. Currently, Liqid supports a variety of fabrics for composable devices today, including PCIe, Ethernet and InfiniBand, as well as a range of endpoint devices for composability, including GPUs, FPGAs, NVMe storage and NICs.

At the heart of a composable system is software that enables the orchestration of disaggregated devices connected via a fabric to host servers. Liqid has updated the Liqid Matrix software to support CXL as a new fabric type and CXL connected memory endpoint devices as a new resource category that can be composed into a host server.

Liqid has also engaged with innovative companies delivering CXL-based fabric and endpoint technologies to further a proof-of-concept demonstration of the Liqid

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Matrix software in action with composable memory devices. For initial prototyping, Liqid has partnered with Samsung and Tanzanite to demonstrate the power of disaggregated memory and composability via CXL.

SAMSUNG TANZANITE SILICON SOLUTIONS

CXL Technology Preview / Demo

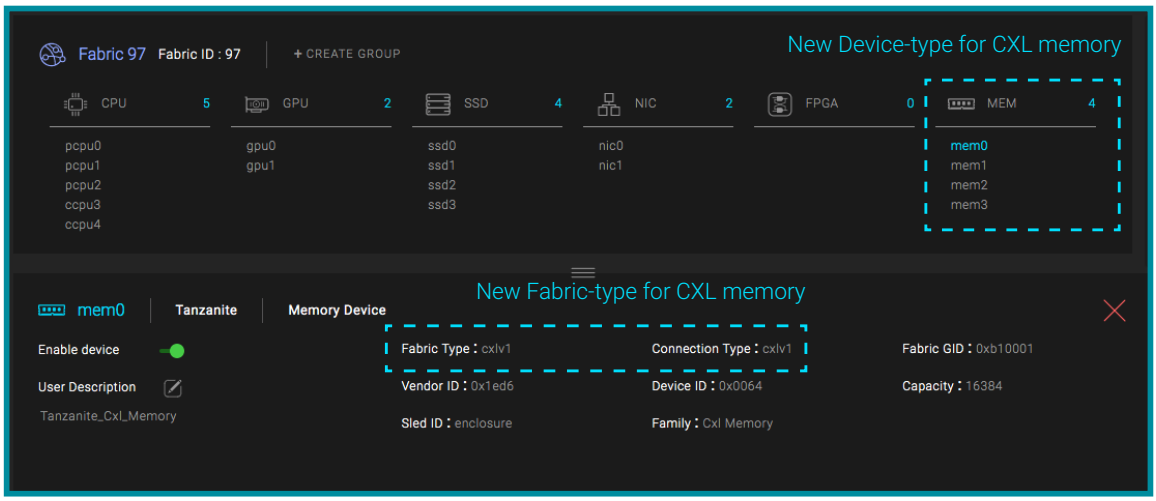
As part of proving out emerging technologies, Liqid has created a technology preview demo of composable memory via CXL. A demo video is available here.

Key Demonstration Components:

- Liqid Matrix software updated to support CXL fabric type and CXL connected memory endpoints
- CXL connected hosts
- CXL fabric interconnects
- CXL connected memory devices

Working closely with our technology partners, Liqid has extended Liqid Matrix software to compose CXL memory device endpoints to CXL connected hosts. The net result is that memory disaggregated from the host server CPU complex can be connected via CXL to a server where the DRAM memory is accessed directly by the server for applications and workloads to utilize.

The following screenshot from the Liqid Command Center UI highlights the new device type for CXL memory ("MEM") as well as a Tanzanite memory device connected via the CXL fabric.



The results of the Liqid CXL Technology Preview / Demo include the following:

- Integrate CXL fabric-type into the Liqid Matrix software for composable infrastructure
- Utilize a CXL fabric for memory composition to a host
- Demonstrate the disaggregation of DRAM from the CPU complex
- Proof of concept for end-to-end composable DRAM memory from host to memory endpoint device

The Benefits of Composable Memory for Modern Workloads

The benefits of composable memory can be characterized into three categories:

- Increased Flexibility – Meet precise memory requirements in seconds
- Increased Agility – Add/remove memory real-time as demand changes
- Increased Efficiency – Improve memory utilization and reduce admin costs

A major factor driving composable memory adoption will be the economics. Imagine the ability to share pooled DRAM across host servers. With current technology each host must be outfitted with the maximum high-water of require DRAM to meet peak workload requirements. If most servers average under 30% utilization, the most expensive resource (DRAM memory) goes under utilized most of the time. By pooling memory and sharing it across servers, Liqid composable memory will increase overall memory utilization, thus reducing overall DRAM capacity in the data center.

What Next?

Putting this information into context.

- This paper demonstrates preview only, and not a generally available product.
- CXL based servers and device endpoints will start to be generally available in 2023.
- Liqid Matrix software is ready to enable composable memory once the ecosystem is ready.
- Visit www.liqid.com for more information on composable memory solutions.