SOLUTION BRIEF

ENHANCED PERFORMANCE ACHIEVED ON SUPERMICRO® SERVERS FOR HIGH-PERFORMANCE FILE STORAGE SYSTEM POWERED BY WEKA

Industry-leading Multi-node Architecture Design With Intel 4th Gen Xeon Scalable Processors

Supermicro X13 BigTwin® Server

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Executive Summary

Unstructured data has become integral to IT infrastructure in consumer apps, enterprise databases, medical research, and military operations. Despite users' high demand for current information and seamless service, enterprise IT systems face immense pressure due to escalating global data volumes. The dynamic nature of data sets (hot, warm, and cold) presents challenges in meeting service level agreements for data processing and analytics. This data hierarchy affects telecommunications, enterprises, and tech companies supporting business operations, mobile apps, IoT, and AI.

WekaIO™ (Weka) was founded on the belief that current storage solutions force IT organizations into choosing complex systems that prioritize their most significant storage demands at the expense of other crucial capabilities. These solutions are centered around three key architectures—block, file, and object—each addressing specific needs: speed, shareability, and scalability, respectively. In today's "data-as-a-service" environment, organizations seek a flexible infrastructure capable of accommodating various business requirements within a unified

framework. WekaFS, the foundational design of the Weka file system, aims to create a unified storage architecture suitable for deployment in on-premises or public cloud settings. It combines the high performance of all-flash arrays, the simplicity of network-attached storage (NAS), and the scalability and cost-effectiveness of object storage.

WEKA Solution Architecture Overview

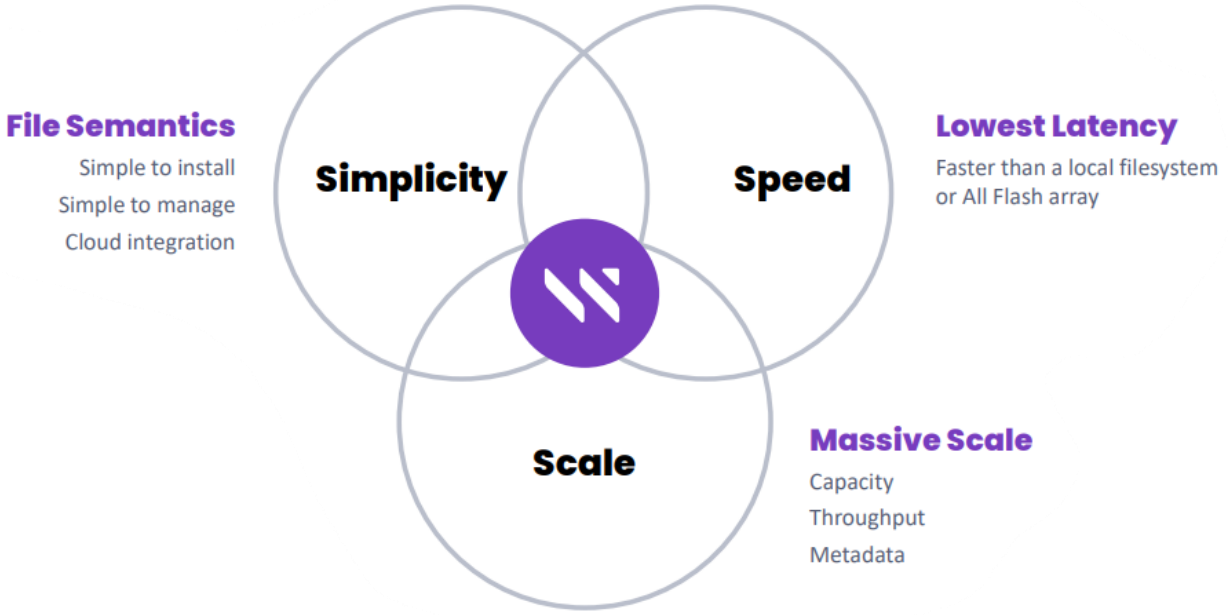

Figure 1 - Weka File System Structure Overview

Weka's file system (WekaFS) is a fully distributed, parallel file system written entirely from scratch to deliver the highest performance file and object services by leveraging NVMe flash as its primary storage for persistent data across a wide range of applications. WekaFS will also, transparent to the application layer, seamlessly expand the filesystem namespace to include an extended layer built on any S3 compliant object storage system. There is no need for data migration software or complex scripts; all data resides in a single global namespace for easy access and management while maintaining the best performance. The intuitive graphical user interface allows a single administrator to manage hundreds of petabytes of data quickly and easily without specialized storage training.

Leveraging existing technologies in new ways and augmenting them with engineering innovations, Weka's software delivers a more robust and straightforward solution that would have traditionally required several disparate storage systems. The resulting software solution provides high performance for all workloads (big and small files, reads and writes, random, sequential, and metadata heavy). Furthermore, it is designed to run on a server infrastructure without any specialized hardware assist. As future hardware innovations come to market, WekaFS is well-positioned to leverage emerging technologies for continued delivery of the best cost and performance. The system can be expanded online to handle more demanding performance or store more capacity without interruption.

Configuration

In the lab testing environment, we used the next generation of Supermicro BigTwin 2U4N servers featuring 4th Generation Xeon Scalable Processors. Supermicro X13 BigTwin can access data faster with twice the NVMe storage & I/O performance utilizing PCIe 5.0, increasing WekaFS by another 2X over the previous generation of systems.

- The raw capacity of the single BigTwin can be up to 368TB, using 15.3TB NVMe PCIe Gen5 - A minimum of a Weka cluster with two 2U 4-Node BigTwin (2 systems x 6 drives x 4 nodes x 15.3TB = 737 TB raw capacity)
- High-performance PCIe5 NVMe drives, such as Samsung PM1743 and Kioxia CM7-R with spec performance of 14 GB/s and 2.5~2.7 MIOPs
- Key Advantages:
    - SYS-221BT-HNR brings computing and storage density to another level, with 6 NVMe Gen5 per node paired with 2x 4th and 5th Gen Intel Xeon processors perfect for Weka environments.
    - 2U 4-Node Supermicro BigTwin is expected to reduce power consumption by up to 9% compared to traditional 1U servers,

The architecture of the X13 Supermicro BigTwin doubles the compute power within the confines of a single rack space, surpassing the capabilities of traditional 1U servers.

An example of a validated high-density cluster solution using SYS-221BT-HNR quad-node servers:

Type	Description	Per System	Per Cluster
System	SYS-221BT-HNR X13 BigTwin 2U 4-Node, 6x U.2 NVMe PCIe Gen5	1	2
CPU	4th Gen Xeon Scalable Processors 6442Y 24C 2.6G 225W	8	16
Memory	16GB DDR5-4800 1RX8 LP (16Gb) ECC RDIMM	64	128
Boot Drive	Micron 7450 PRO 960GB NVMe PCIe 4.0 M.2 22x110mm 3D TLC,	8	16
Storage Drive	SamsungPM1743 3.8TB NVMe PCIeGen5 U.2 15mm 1DWPD 5YR SED or Kioxia CM7-R 3.84TB NVMe PCIe 5x4 2.5" 15mm SIE 1DWPD,HF	24	48
NIC1 & NIC2: Data Traffic	Mellanox ConnectX-7, Single-port VPI NDR 400GbE, OSFP, PCIe5x 16	4[1]	8
AIOM Slot: OS Access	AIOM 2-port 10GBase-T, Intel X550	4	8

1 - In our lab environment, one single-port CX7 NIC is used in each node; while in production, we recommend 2x ports for HA purposes.

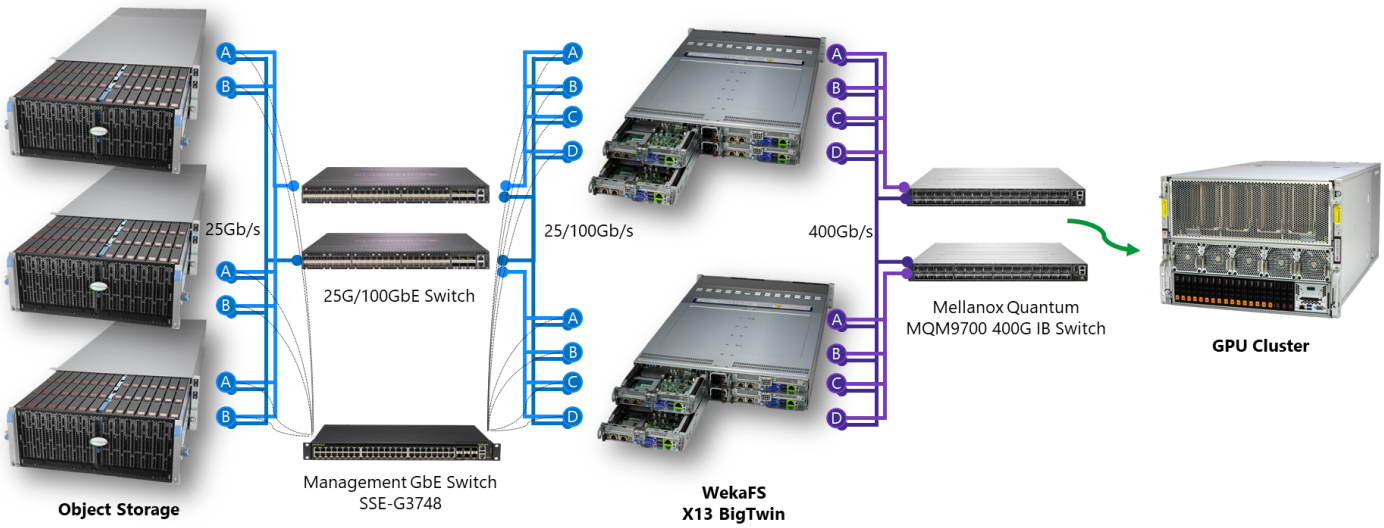

Figure 2 - Cluster Network Topology with WekaFS on SYS-221BT-HNR

Quality, Serviceability, and Remote Management

Since the introduction of Supermicro's Intel-based Twin system architecture in 2007, the dedicated hardware and firmware design teams have built in many Enterprise features into the Twin Product Family along with its long-standing partners, continuing to develop purpose-built appliances and private cloud infrastructure with X13 Supermicro BigTwin. Key use cases include scale-out file systems, hyper-converged infrastructure, scale-out object storage, and scale-out block storage.

Throughout Supermicro's enduring partnerships and notable achievements in the enterprise server market, our design team has moved beyond just performance optimization. Supermicro has significantly emphasized enhancing build quality, ensuring serviceability, and implementing robust remote management capabilities.

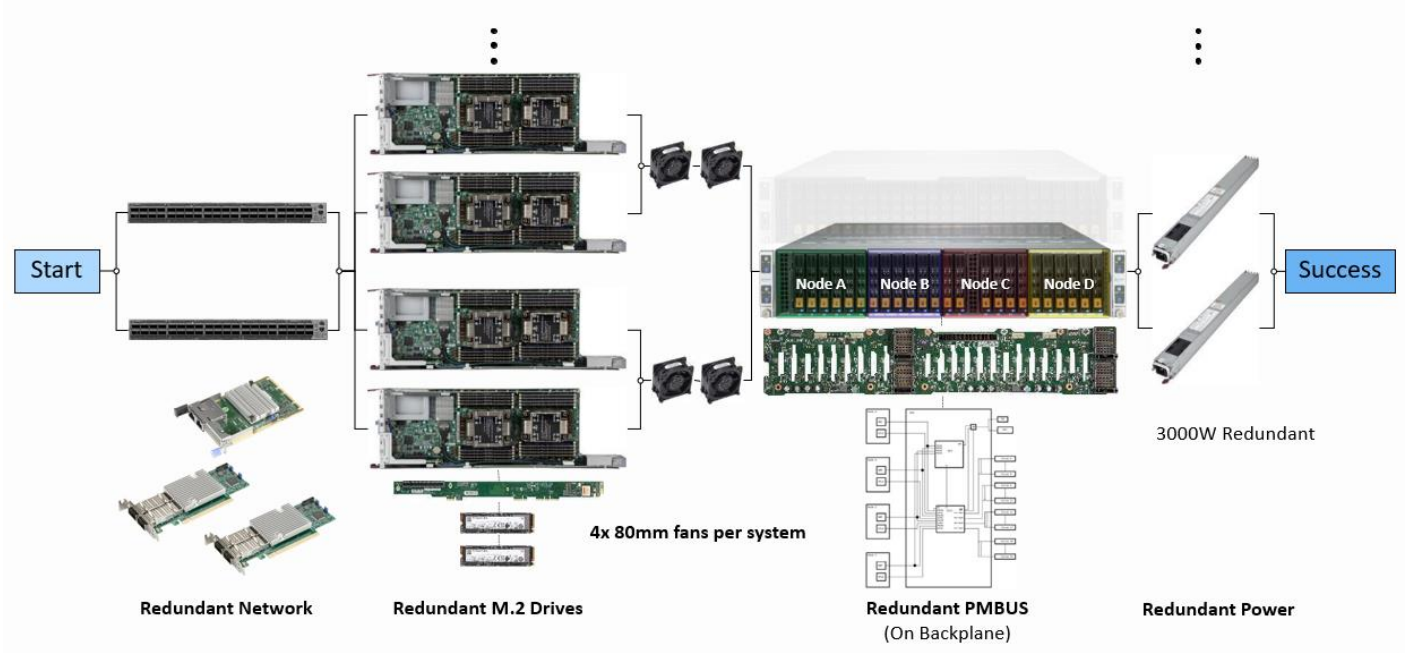

Figure 3 - 2U 4-Node System Reliability Diagram

The X13 2U 4-Node BigTwin features built-in redundancies for networking, power, PMBus, NVMe management, and M.2 boot drives, shown in Figure 4. Supermicro was one of the 1st server manufacturers to support NVMe technologies and has developed advanced capabilities for power controls, re-drivers, and re-timers. In the case of SYS-221BT-HNR, the incorporation of 6 NVMe PCIe Gen5 drives delivers balanced performance that optimizes the capabilities of the dual processors. Not only did this help break record-breaking storage performance, but it also ensured strong signal integrity and reliability to manage the NVMe drive through the BMC's web management interface, as shown in Figure 5.

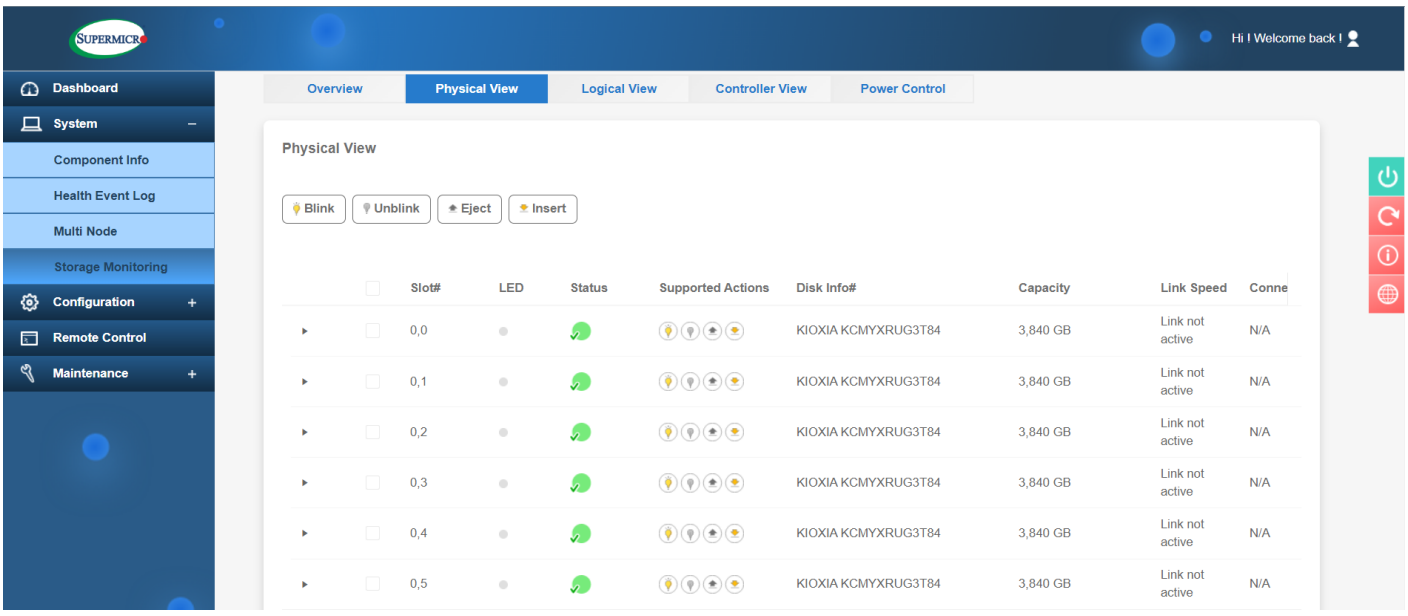

Figure 4 –Physical View of NVMe PCIe Gen5 Drives

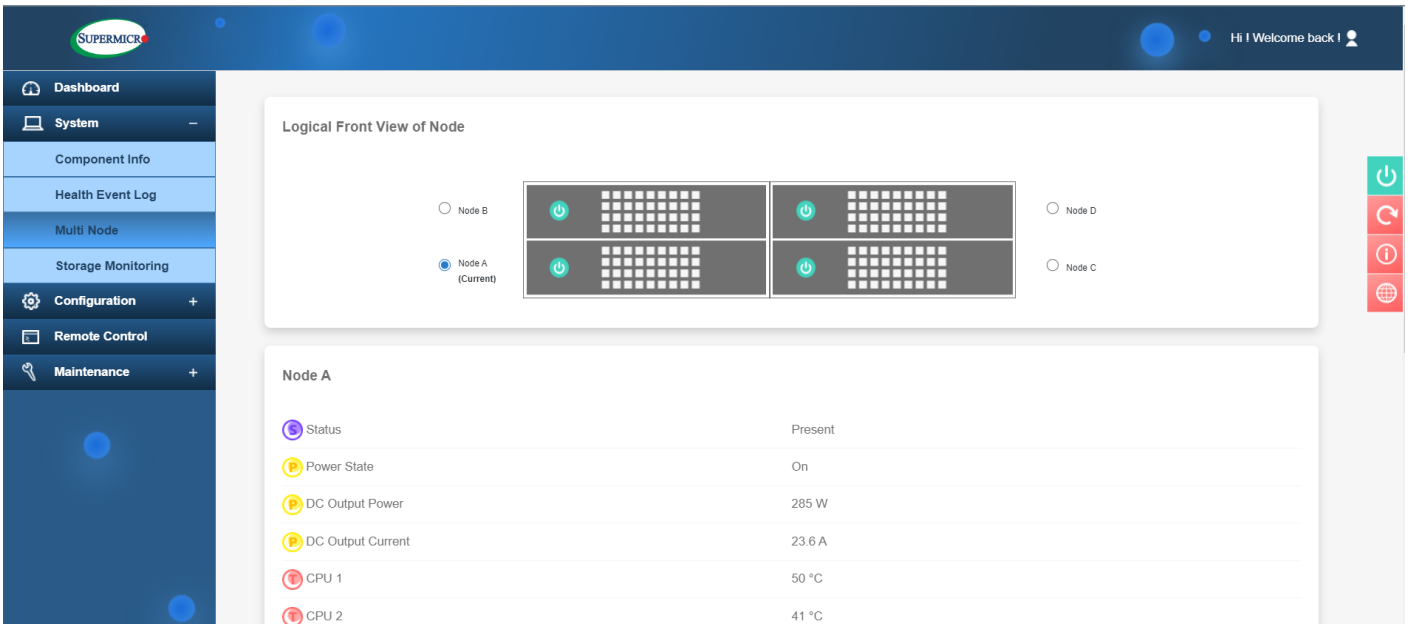

Figure 5 – Multi-Node Remote Management

For both WEKA reference configurations, each system comes with a redundant boot controller for M.2 NVMe drives per node, easily accessible through the Multi-Node Logical View via the BMC web interface shown in Figure 6. The NVMe boot controller features a Human Interface Infrastructure (HII) for easy RAID configuration. The X13Supermicro BigTwin also offers Redfish support, enabling seamless integration with infrastructure orchestration tools. Regarding reliability, the backplane's CPLD plays a crucial role by quickly recovering stalled buses. This resilience guarantees that the Embedded Controller (EC) can effectively handle firmware updates through the dedicated Firmware Management panel, as shown in Figure 7. This reinforces the system's commitment to reliable performance.

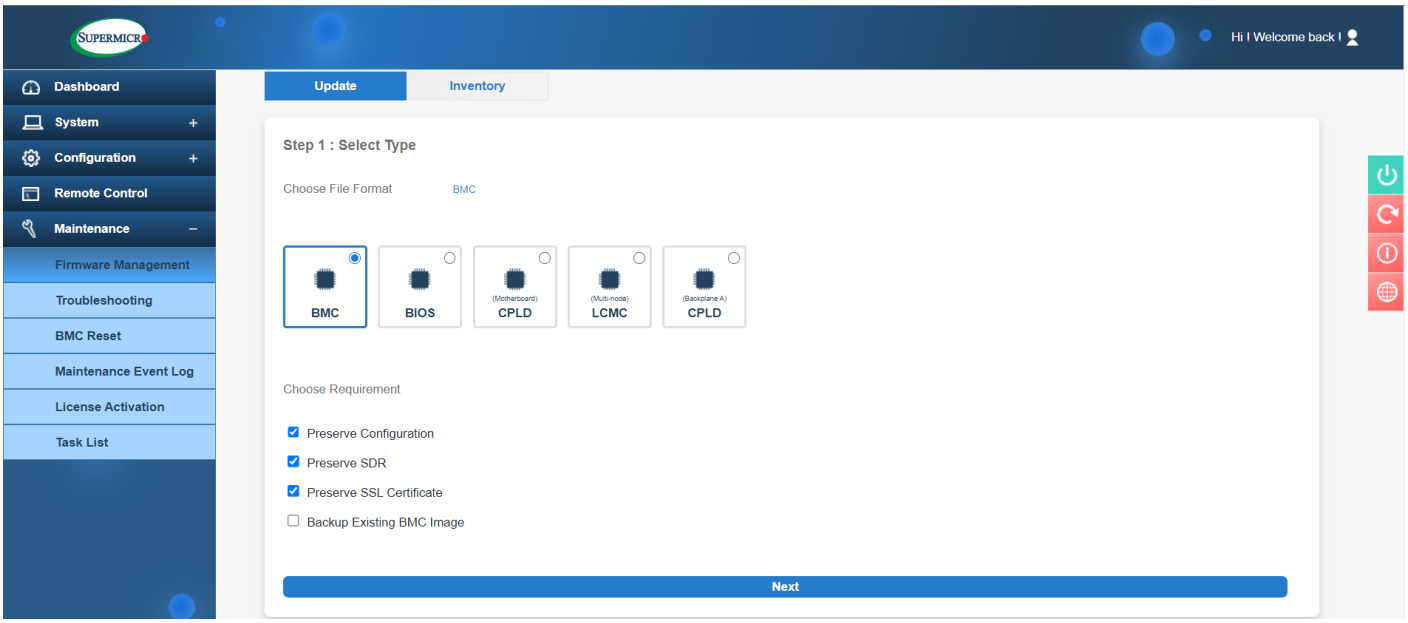

Figure 6 – Dedicated Firmware Management

X13 2U 4-Node BigTwin includes a 3000W Redundant Power Supply with Titanium Level 96% Power Efficiency, which is shared among the four nodes. This shared power and backplane design offers a notable 8-10% power efficiency advantage over standard 1U servers, reducing e-waste by approximately 30%. The system supports Smart Ride Through (SmarT) Power to smoothly navigate momentary AC power losses while maintaining the highest possible power supply efficiency, which can be analyzed through the Power monitor shown in Figure 7. In the event of a failure, each hot-swap node is easily accessible, making service calls a breeze, i.e., swapping out a memory DIMM or installing a standard low-profile card without any tools. A DR 200Gb/s Infiniband host channel adapter can easily be installed into the AIOM slot without removing a compute node.

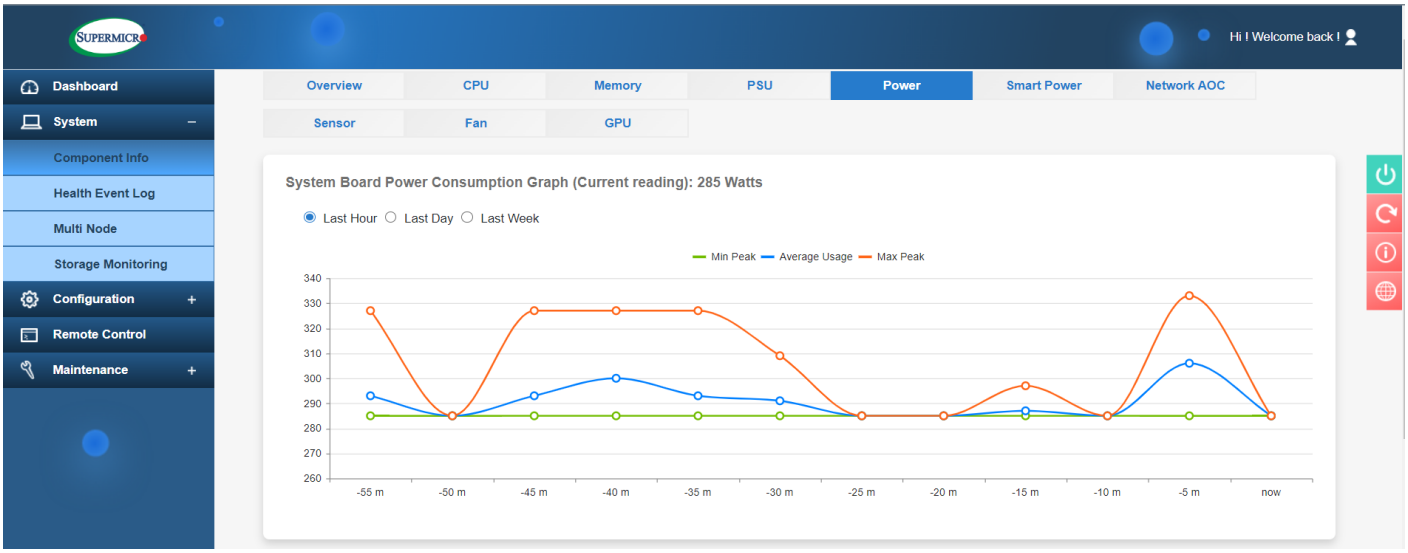

Figure 7 – Power monitor over BMC

WEKA Performance Overview

Using FIO IO generators on eight PCIe gen5 Intel clients, a massive performance of 242.54 GB/s (40.4GB/s per node) was measured on just six nodes of Supermicro BigTwin platform, each node with dual Intel 4th Gen Xeon Scalable Processors 6442Y, one 400 Gb/s CX7 IO, six Samsung/Kioxia PCIe 5.0 NVMe, and WekaIO (4.2.1). Note that higher performance is possible with some minimal tuning.

Supermicro Server Overview

Specifications

CPU (per node)
Dual Socket E (LGA-4677) 4th Gen Intel® Xeon® Scalable processors

System Memory (per node)
Slot Count: 16 DIMM slots
Max Memory (1DPC): Up to 4TB 5600MT/s ECC DDR5 RDIMM

Drive Bays / Storage (per node)
6x 2.5" hot-swap NVMe drive bays (All Flash NVMe Gen5)
2x M.2 NVMe Slots

Networking (per node)
1x AIOM PCIe 5.0 x16 Slot
1x RJ45 1GbE IPMI

Expansion Slots (per node)
2 PCI-E 5.0 x16 (LP)

Power Supply
1+1 Redundant
2x 3000W Redundant Titanium Level power supplies

Summary

Dramatic improvements in computational power and exascale needs for storage in today's digital mediums have meant that typical file systems traditionally used to address complex workloads are often impractical or inadequate for the task. WekaIO, combined with Supermicro servers, provides a stunning performance, protection, and data management story for Deep Learning, High-Performance Compute, and high-throughput, low-latency storage workloads. WekaIO removes your computational storage bottlenecks by leveraging the power of NVMe and task-optimized servers, along with software designed for performance, scalability, and flexibility. The combination of Supermicro SuperSevers and WekaIO software provides customers with solutions leveraging our building block architecture to provide the most optimized CAPEX and OPEX. With Supermicro's professional services, our Rack Integration Team can fully rack, integrate, pre-test, and tune, allowing you to be operational less than 30 minutes after receiving.

Additional Resources

Supermicro BigTwin Servers: https://www.supermicro.com/en/products/system/bigtwin/2u/sys-221bt-hnr

WEKAIO: https://www.weka.io/how-it-works/

Contact Weka-PM@supermicro.com

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WEKA

WekaIO (Weka) is used by eight of the Fortune 50 enterprise organizations to uniquely solve the newest, biggest problems holding back innovation and discovery. Weka solutions are purpose-built to future-ready the accelerated and agile data center. Optimized for NVMe-flash and the hybrid cloud, its advanced architecture handles the most demanding storage challenges in the most data-intensive technical computing environments, delivering truly epic performance at any scale, enabling organizations to maximize the full value of their data center investments. Weka helps the enterprise solve big IT infrastructure problems to accelerate business outcomes and speed productivity.

Learn more at: https://www.weka.io