WARP 38001-M "MemoryMatrix" Unified SSD Storage

The **WARP 38001-M** is an ultra-dense all-flash unified storage appliance (file/block) ideally suited for extreme performance applications where access patterns are weighted towards streaming I/O, big data analytics, or virtualization. A full system can contain ~3.0 petabytes of raw SSD storage in a single standard data center cabinet. With dual-parity protection, this still yields more than 2.2 petabytes of usable space.

Truly turnkey, all software is pre-loaded and pre-configured at the factory, so only site-specific parameters need to be configured by the customer. Simply rack the appliance, cable it, and go. In fact, customers purchasing large configurations can order the system pre-racked and cabled in a WARP Mechanics supplied cabinet.

It is *possible* to build your own storage server out of free software, and install it on commodity hardware. Getting it to run efficiently and be easy to manage is a different story. Creating a do-it-yourself NAS system that is sustainable and supportable is impractical for most IT organizations in these days of doing more work with fewer IT personnel.

The historical alternative – to acquire an appliance from a legacy OEM – fails to meet modern cost expectations.

To balance these scenarios, WARP Mechanics uses reliable OEM-grade storage hardware and SAS drive modules, with best in class open storage software. Then, the entire system is supported by WARP Mechanics and its resellers, so you have a single contact for all support.

The software and firmware on the appliance are not merely low cost, open source systems, however. The WARP 38001-M also has advanced features such as thin provisioning, de-duplication, block-level checksums, copy-on-write, snapshots, replication, and more.

- Optimized for performance sensitive workloads
- Pay as you grow starting from 24TB
- Typical 600TB+ usable with RAID6 (~768TB raw) per rack
- Maximum 2.2PB+ usable (~3.0PB raw) with high-cap SSDs
- Supports NFS, SMB, iSCSI target mode, and FTP
- Turnkey deployment
- Enterprise support and service
- Simple but powerful GUI and CLI management
- Advanced data integrity protections
- Replication with WAN optimization

Whether you deploy it as a stand-alone storage system, or as part of a comprehensive WARP Mechanics data center architecture, the WARP 38001-M will provide unmatched density and performance in a turnkey package.

Versatile Application Platform

Central to the appliance sits the storage controller platform that runs the embedded appliance software, provides I/O connectivity to all storage expansion shelves, and network connectivity to storage clients. The **WARP Mechanics AP-2214** is the hardware framework and may include one or more chassis each with 12-24 drive slots capable of housing SSD or NVMe devices, depending on customer requirements. When configured for maximum performance, each 2U shelf can deliver over 1M IOPS and over 100Gbps of network throughput.

Each AP-2214 platform contains up to 36 cores in dual high-speed Intel Broadwell processors, up to 1.5TB RAM, four built-in 10GbE ports, and a high count of external SAS-3 ports for disk access and client-facing network interfaces. That's 3TB of RAM and 384Gb total SAS bandwidth in a maximum 2-node HA configuration.

The all-SSD system removes the need for a separate read cache for active files, leaving more RAM for advanced features such as clustering, replication, de-duplication, thin provisioning, and snapshots.

Each controller can be ordered with a variety of additional interfaces, including 1Gb, 10Gb, or 40Gb Ethernet, more external SAS connectivity, 40Gb/56Gb InfiniBand or 100Gb InfiniBand/Omnipath ports. For larger configurations, these I/O cards deliver redundant, load-balanced access to many terabytes of storage.

Performance-Intensive Storage

IT architects require much larger building blocks to meet modern data growth rates. To access such giant data sets, storage must also be faster in terms of IOPS and throughput. The **WARP Mechanics WDS-2224** fills these needs in an efficient and light-weight package.

Every customer is different, but for applications where *performance* is vital, there are several requirements that always seem to apply:

- High throughput/price ratio
- High total IOPS or throughput per system
- High density of capacity per RU
- Reliability / Availability / Serviceability
- High total system scalability
- Low power and cooling requirements

The WARP 38001-M uses the WDS-2224 JBOD to expand the capacity provided within the central storage controller platform. A pair of redundant SAS IO modules per shelf provides up to 192Gbps of SAS throughput from each shelf to each controller. In a full rack, the total SAS bandwidth is hundreds of Gbps.

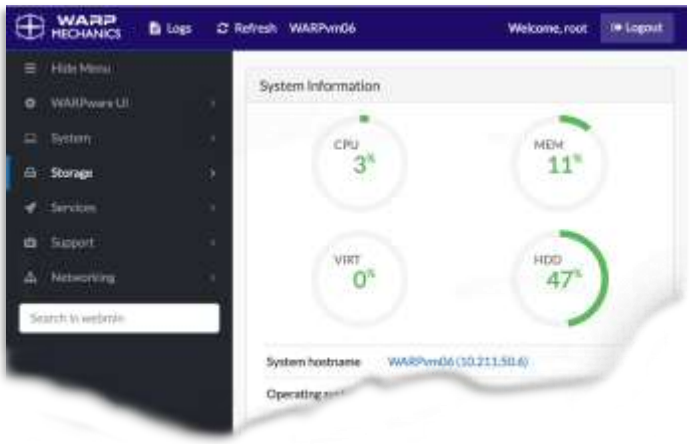
SSD modules achieve maximum write and read performance while still supporting high capacity.

Each SSD can sustain ~500MBps, for high throughput designs with <3ms response time latency. If you're counting IOPS, our 2TB SSD module exceeds 100,000 read and 100,000 write IOPS per module, making the WARP 38001-M easily capable of over 1 Million IOPS per shelf.

Simple but Powerful Management Software

Like all OEM-class product companies, WARP Mechanics leverages existing software where appropriate. This approach benefits customers through lower pricing, higher reliability, and faster delivery of new features and updates.

The WARP*ware* stack starts out as an enhanced version of CentOS Linux: the leading supercomputing operating system deployed at Lawrence Livermore National Lab, Sandia National Lab, Los Alamos National Lab, and many other top-ranked HPC facilities.



WARP then adds a web-based GUI and a powerful CLI to the tools already included in Linux. The complete management stack is integrated with WARP*nas* hardware and software layers, and the combined turnkey appliance is fully supported by WARP Mechanics.

At a lower level, this strategy gives WARP*ware* the benefits of ZFS, which brings scalability, performance, and enterprise storage features.

For instance, WARP*ware* supports effectively **unlimited file system sizes**. It is practical to scale one appliance beyond a petabyte in a single filesystem with current disk densities. Livermore, for example, is running a ~**70 petabyte** filesystem using this ZFS code.

It also supports virtually **unlimited snapshots**. Many legacy solutions are limited to e.g. 255 snapshots, but WARP*ware* can accommodate 2 x 10^{48}. Run hourly snapshots if desired, to support extremely granular recover points.

Of particular interest in large configurations, WARP Mechanics has features intended to stop **silent data corruption.** WARP*ware* provides end-to-end checksums and transactional copy-on-write IO operations. CoW eliminates RAID write-holes and checksums eliminate the silent data corruption that has plagued legacy storage solutions at this scale. This is increasingly important, as individual disk sizes get larger and lower-reliability SATA moves into the Enterprise.

In fact, the software supports too many features to list in this document: numerous monitoring and reporting tools, iSCSI target mode, mirroring and replication for disaster recovery and remote site backups, thin provisioning, upgradability to pNFS or Lustre to provide a global namespace, Ceph for object storage, and more.

For a complete list, or to schedule an evaluation, contact your WARP Mechanics authorized reseller.

Application-Centric Performance Optimization

The WARP Mechanics name is synonymous with ultimate power and performance. However, not all data access needs to take place at those speeds: There simply is no “one size fits all” performance formula. The goal of the WARP appliance portfolio is to allow customers to match the cost to performance ratio appropriate for their application’s specific data sets.

The **WARP Mechanics 38001-M** appliance delivers a truly massive amount of storage for a reasonable price. It is an ideal choice for customers who need:

- High capacity
- SSD and RAM performance for IO
- Optimal cost per terabyte
- Turnkey deployment model
- Simple management interface

It is targeted at customers who serve large amounts of frequently accessed, high-performance data such as big data analytics, media streaming IO, or virtual infrastructure. Any organization considering a new NAS rollout, or adding to an existing NAS environment, should consider this appliance for the job. It can also be paired with other WARP Mechanics appliances to create a complete solution for all levels of enterprise storage.

WARP Mechanics Ultra-Dense SSD
Appliance Architecture

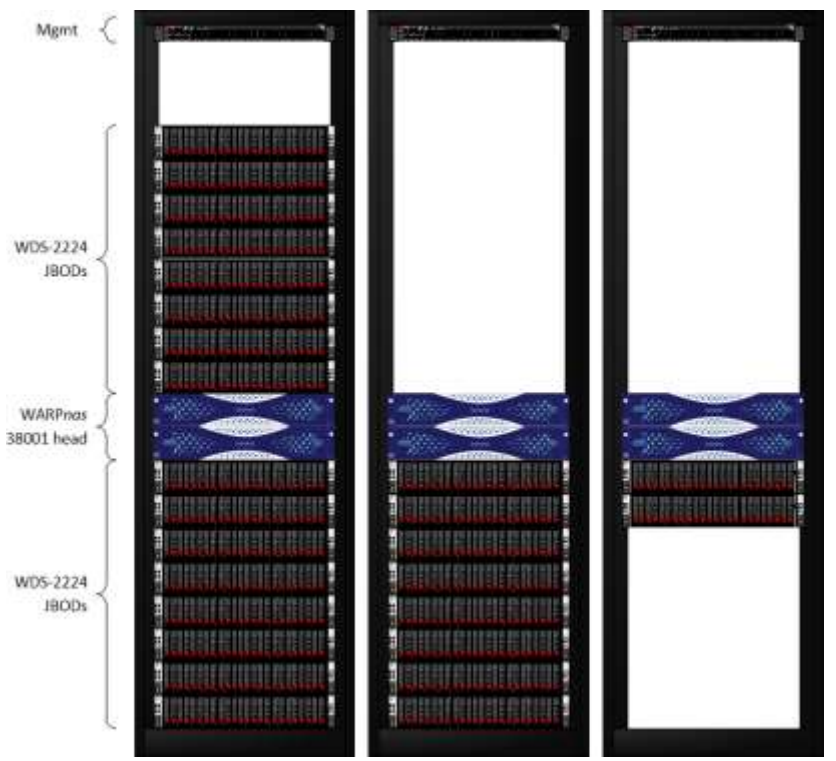
The appliance is constructed using WARP Mechanics hardware platforms, a variety of WARP-tuned and certified SSD modules, WARP software, and fully-embedded partner software.

The WARP 38001-M intelligent controllers leverage widely deployed, industry-standard hardware with the latest components such as CPU, memory, and IO bus. Each appliance includes up to two controllers. With each expansion enclosure attached, another 48TB of enterprise SSD storage capacity is added. Each 38001-M head can be outfitted with multiple network interface types for the intended environment, such as 1/10/40Gb Ethernet, or 40/56Gb Infiniband, and even 100Gbps EDR and Omnipath.

A customer can start with a single 38001-M head using only a portion of its drive slots. The starting point is just a few TB of main storage. Yet it can grow to multiple petabytes without architectural changes or even downtime. Simply scale vertically by adding more JBODs connected to the head.

It is also possible to scale outward by adding controller heads for additional performance *and* capacity. Plus, the exact same head units may also be deployed in parallel using a WARP-certified filesystem such as Lustre or Ceph. This can produce a scale-out storage solution delivering more than a Tera**byte** per second (>100Terabits/s).

This system can be combined with the other WARP Mechanics appliances such as the HybridMatrix and StorageMatrix systems. Using tiering software, data can be migrated between the systems as its business value changes over time.



Full Rack, 36U
3.0PB

Half Rack, 20U
2.2PB

Base Unit, 8U
384TB