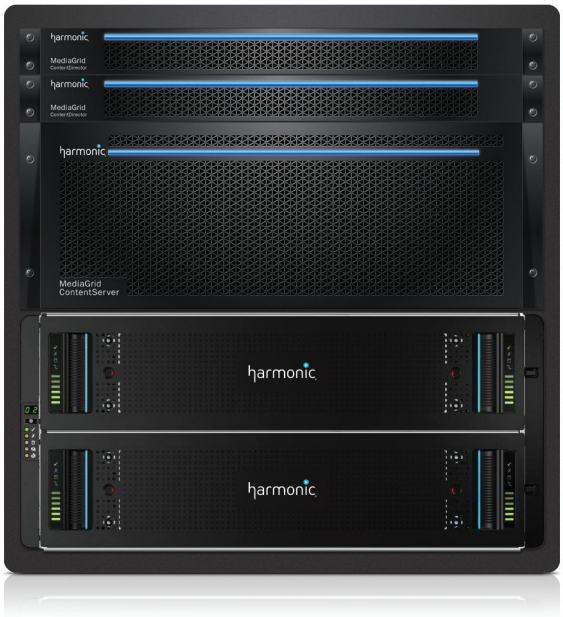
Harmonic MediaGrid

SHARED STORAGE



Harmonic MediaGrid is a highly scalable, Ethernet-based shared storage system optimized for digital media workflows.

Proven in the world's most-demanding video environments, MediaGrid is an ideal fit for digital media applications requiring shared, real-time storage, such as ingest, playout, archive, edit-in-place, collaborative editing, transcoding and over-the-top (OTT) adaptive bitrate streaming. Simple to deploy, manage and scale, MediaGrid storage accelerates file-based workflows and provides the ability to manage the entire asset lifecycle. The system reduces the cost of storing media nearline, making it practical to economically deploy multi-petabyte digital media libraries and archives for video on demand (VOD) and other applications.

MediaGrid is purpose-built from the ground up to deliver high bandwidth and consistent low latency for video. Its exceptional performance is enabled by a proprietary distributed file system and the installation of the MediaGrid file system driver (FSD) on each client computer. Unlike competing clustered NAS systems, which can only access data through one path at a time, the Harmonic FSD enables MediaGrid to deliver maximum performance through true parallel access across many storage nodes and network connections.

MediaGrid systems can be built in a variety of configurations to meet the exacting requirements of diverse use cases. Media operations can start with smaller MediaGrid systems —as little as 48 TB of capacity — and seamlessly scale to petabytes of capacity and tens of gigabytes per second of throughput. An industry-leading, high-density storage option — up to 672 TB of raw capacity in 5-RU — can reduce rack space and lower storage-related costs, minimizing total cost of ownership (TCO) through its exceptional price and performance capabilities.

SSD ContentServers are now available to enable higher bandwidth workflow requirements such as graphics, frame-based media formats and the emerging 4K/UHD workflows. Each SSD ContentServer can deliver an incredible aggregated read/write bandwidth of 4GB/s and can be expanded by adding more ContentServers to bring unparalleled speed for today's and tomorrow's workflows.

Use Cases		
Ingest	Color grading	Production/OTT streaming
Editing	Transcoding	Playout staging
Archive/Nearline	Media asset management	Spectrum™ X direct playout

HIGHLIGHTS

- Ethernet-based, scale-out shared storage
- Superior, consistent performance for media workflows
- High-density, up to 672 TB of raw capacity in 5 RU
- Unique file system technology enables exceptionally high bandwidth across all capacity points
- Simple and cost-effective to deploy, manage and scale
- RecycleBin feature provides data protection
- Integrates with Spectrum™ media servers and Harmonic VOS SW Cluster origin streaming video server
- Qualified and optimized with dozens of leading media applications
- Stretch Cluster provides synchronous replication for metropolitan distances

High Scalability

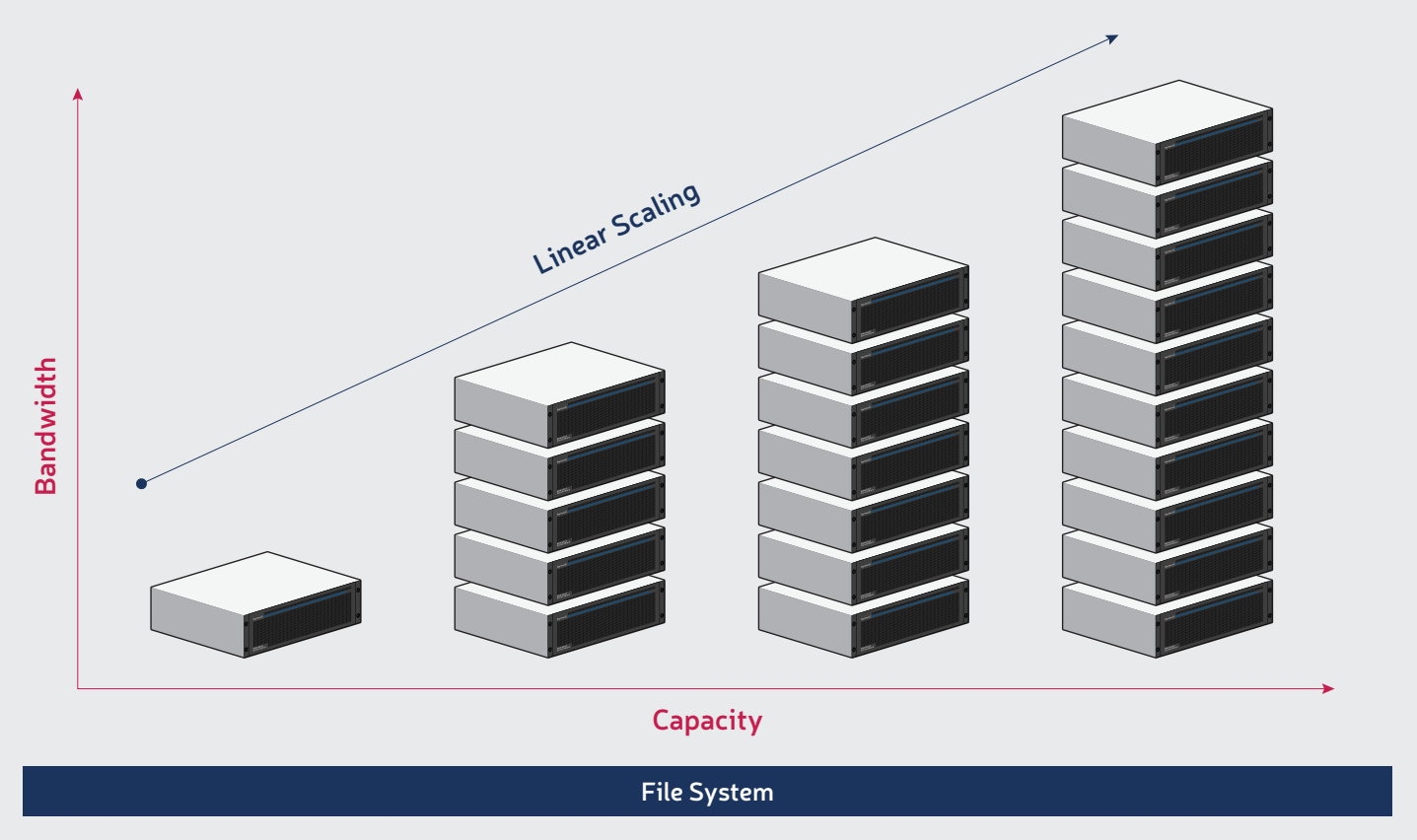
MediaGrid is based on a fully distributed scale-out architecture, resulting in increased performance as additional storage nodes are added. Nearly 2 GBps of bandwidth can be delivered to a single client, with aggregate bandwidth reaching tens of gigabytes per second. As the system is expanded, bandwidth and capacity increase linearly, actually improving access speed to the content already on the system. The high performance of MediaGrid even enables the transfer of uncompressed files over Ethernet.

Bandwidth consistency also sets MediaGrid apart. On competing storage systems, performance may significantly degrade over time due to data fragmentation. The MediaGrid file system stripes data across all system servers, and clients then access the servers in parallel, ensuring reliable performance for any application, at any time.

Simple and Cost-Effective

MediaGrid is remarkably simple to deploy. Based on standard hardware components and cost-effective Ethernet technology, the system is also economical to purchase and maintain. Many alternative media storage systems utilize Fibre Channel SANs to deliver the required levels of performance, but Fibre Channel is far more complex than Ethernet and requires expensive, specialized personnel to manage it. In many cases, these competing systems require a forklift upgrade to expand beyond the performance or capacity limits on a single controller, leading to higher costs upon initial deployment and when adding capacity. This is not the case with MediaGrid.

Media workflows often demand the ability to quickly and continuously add new content, necessitating scalability. On some systems, scaling can be management-intensive and highly disruptive to users and applications alike. With MediaGrid, scaling is fast and unobtrusive: storage nodes and enclosures are added, the additional capacity is absorbed by the file system, and existing data is transparently rebalanced across the new nodes as a background task. There's no need for file system reconfiguration as you scale, or for file system defragmentation as the file system ages.



MediaGrid enables simple online scaling of both bandwidth and capacity.

Harmonic MediaGrid SHARED STORAGE

Optimized for Media Workflows

MediaGrid was designed from the ground up for the demanding requirements of digital media workflows, and is tested and optimized with dozens of leading media systems, including Harmonic Spectrum media servers and VOS SW Cluster origin multiscreen media servers. It also enables collaborative editing workflows with nonlinear editors, such as Apple® Final Cut Pro®, Avid® Media Composer®, and Adobe® Premiere® Pro.

The advanced media-specific functionality delivered by MediaGrid reflects Harmonic's deep expertise with media applications and workflows. For example, MediaGrid enables editing of growing files, a critical capability in environments such as news broadcasting, and variable block sizes to optimize performance for different types of media workloads. The MediaGrid FSD intelligently uses client-side memory to adapt to formats to read ahead and store portions of media files before they are requested by the application, providing high-speed access to media.

The MediaGrid FSD has the ability to use solid state drives (SSD) present in the client system or workstation as a media cache. The SSD MediaCache feature provides users significant improvements to performance during editing activities, such as scrubbing or shuttling of content on a timeline, by caching content for any previously read files. Subsequent reads of the content will not be fetched over the network thus ensuring a seamless and smooth editing experience for the user.

Reliability and Availability

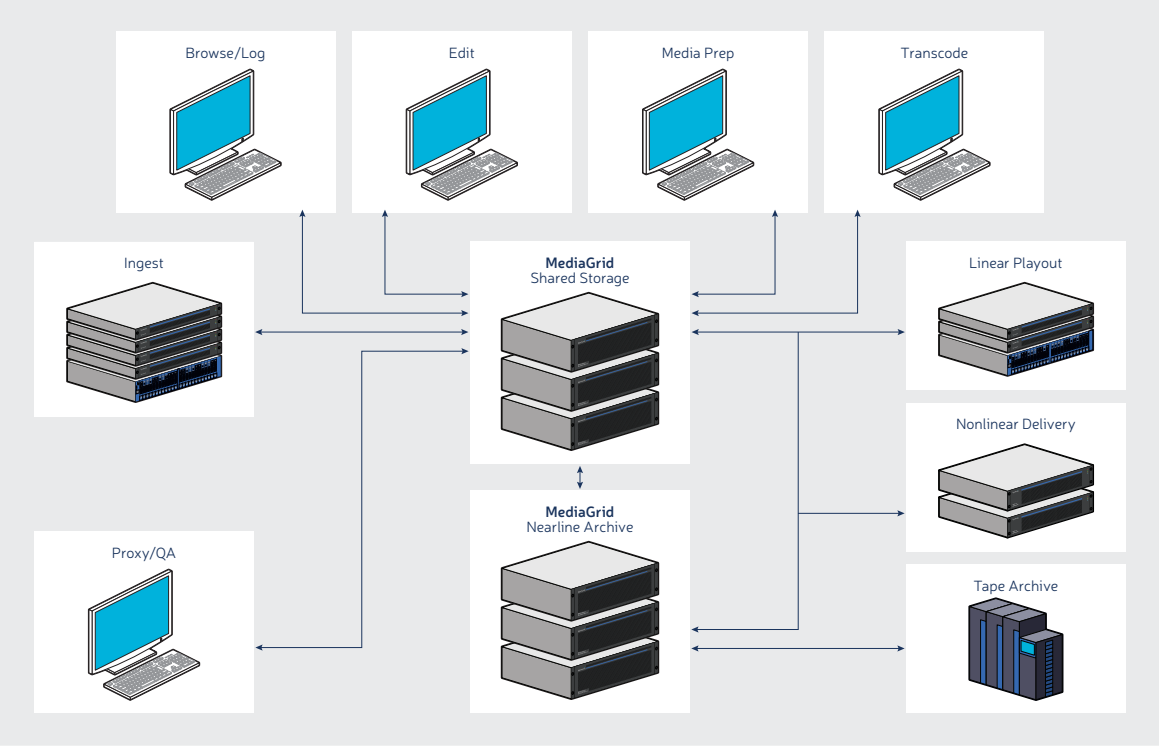
Shared storage is a critical resource in file-based workflows, and MediaGrid is built for the task. MediaGrid systems have no single point of failure, and leverage features such as dual active-active controllers with transparent failover, redundant data paths to protect against storage node failures, and transparent client failover to protect against controller failures. Software RAID options include RAID 4 and RAID 6, offering protection against unlikely events such as multiple drive failures within a RAID group.

In addition to the powerful fault resiliency capabilities of MediaGrid, the system is built to eliminate downtime associated with planned maintenance activities. Storage nodes can be added to the system while it is running, and no downtime is required for activities such as software and firmware upgrades.

To protect business-critical assets, MediaGrid offers an advanced disaster recovery configuration called Stretch Cluster. Data in a MediaGrid system can be transparently replicated across different physical locations on a campus while remaining under a single file system. In the event of a site outage, clients will transparently and automatically route to alternative storage, providing extreme levels of data and workflow protection. In addition, MediaGrid supports a RecycleBin functionality to protect data and files from accidental deletion.

World-Class Service and Support

Harmonic stands behind MediaGrid shared storage systems with comprehensive service and support programs, including system design, service deployment, technical support and network maintenance. World-class service plans and a global network of flexible and responsive support professionals help ensure your ability to deliver outstanding "anytime, anywhere, any-device" customer experiences.



MediaGrid shared storage is designed specifically for file-based media workflows.

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MediaGrid shared storage is available in a variety of configurations to meet the exacting requirements of diverse use cases. All MediaGrid systems begin with ContentDirector and ContentServer systems. Storage capacity is expanded by adding ContentStore chassis. ContentBridge systems are used to connect to NAS networks.

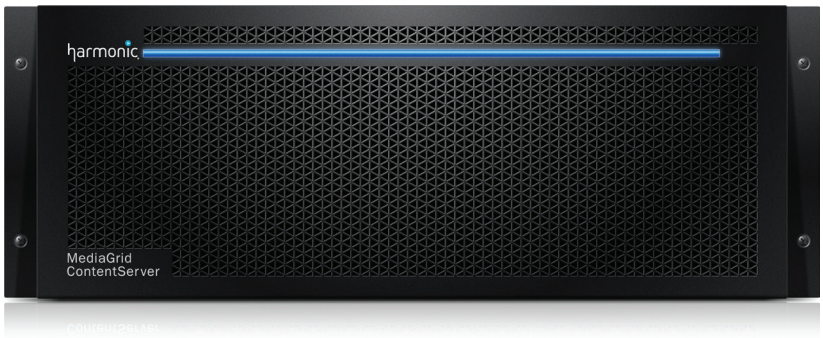
BASE SYSTEM COMPONENTS

ContentDirectors

ContentDirectors store, manage and serve file system metadata, and present a single global namespace. Each MediaGrid system includes two ContentDirectors in an active-active failover configuration. Solid-state metadata storage provides high performance and resiliency.

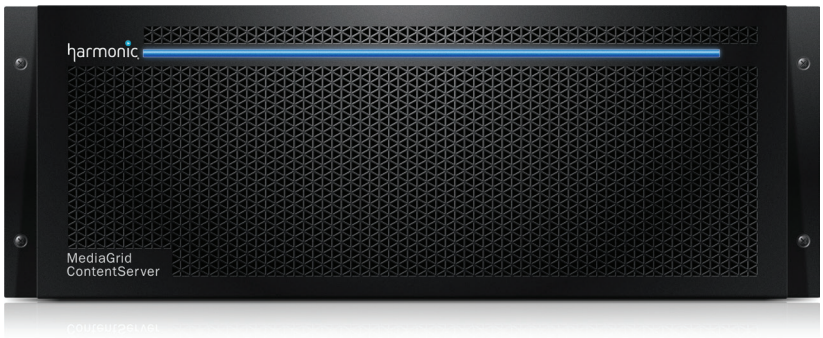
ContentServer 4000 - HDD

ContentServer 4000 nodes provide processing power and storage capacity for MediaGrid with 24 hot-swappable enterprise SAS drives and a choice of 48 TB, 96 TB, or 192 TB of raw storage per 4-RU chassis. Connectivity is via eight 10-GbE ports. Dual active-active controllers are included in each unit.



ContentServer 4000 - SSD

ContentServer 4000 nodes provide processing power and storage capacity for MediaGrid with 24 hot-swappable enterprise SAS SSD drives with 38.4 TB of raw storage per 4-RU chassis. Connectivity is via eight 10-GbE ports. Dual active-active controllers are included in each unit. SSD's are supplied in ContentServers only, expandable by adding more ContentServers to the cluster. This is ideal for high bandwidth requirements such as graphics, 4K/UHD and frame-based workflows.



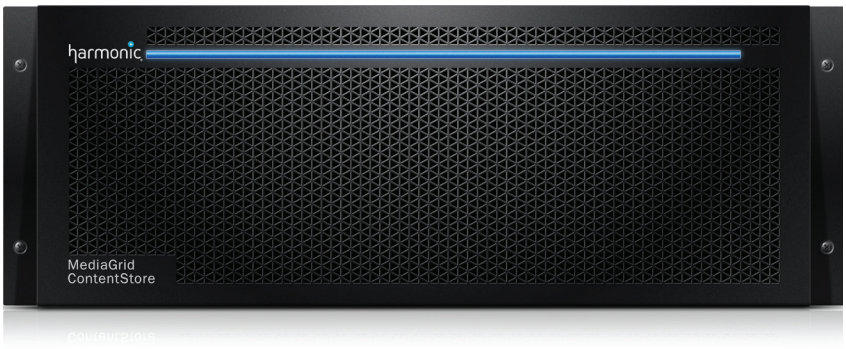
STORAGE EXPANSION

ContentStore 5840A - HDD

ContentStores are individual storage-only nodes featuring dual active-active SAS expanders and a choice of RAID 4 or RAID 6 protection. Up to four ContentStores can be connected to each ContentServer to provide cost-efficient scaling. The high-density, 5-RU ContentStore 5840A system includes 84 drives with 4 TB or 8 TB options for up to 672 TB of raw storage capacity. Convenient drawer-based, hot-swap access to the drives simplifies storage expansion and maintenance.

ContentStore 4240 - HDD

The 4-RU ContentStore 4240 provides raw storage capacity of 48 TB, 96 TB, or 192 TB via 24 hot-swappable 2 TB, 4 TB, or 8 TB enterprise drives.



NAS ACCESS

ContentBridge

Optional ContentBridge modules can be added to MediaGrid to provide access to NAS protocols via two 10 GbE ports, including SMB and FTP with the CLB-4000; with the CLB-2010F version also providing NFS connectivity.

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MediaGrid BasePacks

To provide convenient configurations from which to build a MediaGrid system, several BasePacks are available. MediaGrid BasePacks are complete entry-level system configurations, and include two ContentDirectors, one ContentServer with 24 drives, and all system software.

BasePack Model	(Raw)	10 GbE Ports	ContentDirectors	SystemManager, ContentManager
MG-BASE4000-1.6TB-SSD-8XO	36.4 TB	8	2	✓
MG-BASE4000-2TB-8XO	48 TB	8	2	✓
MG-BASE4000-4TB-8XO	96 TB	8	2	✓
MG-BASE4000-8TB-8XO	192 TB	8	2	✓

Small BasePacks

Designed for regional news bureaus, small post production facilities and OB vehicles, Harmonic MediaGrid is now available in a smaller, low cost package. Packages are based on a single ContentServer and a single non-redundant ContentDirector, with small storage capacity options. Users can take advantage of MediaGrid's leading shared storage technology at a lower entry price. With the option to upgrade to a full MediaGrid system if needed.

Small Base Pack	(Usable)	10 Gb Ports	ContentDirectors	SystemManager
MG-SMBASE4000-2TB-36TB	36 TB	8 available 4 supported	1	✓
MG-SMBASE4000-4TB-54TB	54 TB	8 available 4 supported	1	✓
MG-SMBASE4000-4TB-72TB	72 TB	8 available 4 supported	1	✓
MG-SMBASE4000-8TB-90TB	90 TB	8 available 4 supported	1	✓

MediaGrid Component Specifications

	ContentDirector 2000C	ContentServer 4000 - HDD	ContentServer 4000 - SSD	ContentStore 5840A	ContentStore 4240	ContentBridge 2010F/4000
Function	Processor and Metadata server	Processor and Storage node	Processor and Storage node	Storage node	Storage node	NAS gateway CLB-2010F: SMB, NFS, FTP CLB-4000: SMB 2/3, FTP
Disk Drives	Two 960 GB SSDs	24 hot-swap 3.5" SAS drives: 2 TB, 4 TB, 8 TB, HDD enterprise	24 hot-swap 2.5" SAS drives: 1.6 TB, SSD enterprise	84 drawer-based hot-swap drives: 4 TB, 8 TB	24 hot-swap 3.5" SAS drives: 2 TB, 4 TB, 8 TB HDD enterprise	Two 240 GB SSDs
Raw Capacity (per chassis)	N/A	48 TB, 96 TB, 192 TB	38.4 TB	336 TB, 672 TB	48 TB, 96 TB, 192 TB	N/A
Network Connectivity	Four 1 GbE ports	Eight 10 GbE ports	Eight 10 GbE ports	N/A	N/A	Two 10 GbE ports
Form Factor	1–RU	4–RU	4– RU	5–RU	4–RU	1–RU
Controller Configuration	Single controller	Two controllers per unit, active-active	Two controllers per unit, active-active	Two 12 GB SAS expanders per unit, active-active	Two 12 GB SAS expanders per unit, active-active	Single controller
Power Supplies	Dual redundant 750W Power Supplies	Dual redundant 1200W Power Supplies	Dual redundant 1200W Power Supplies	Dual redundant 2200W Power Supplies	Dual redundant 549W Power Supplies	Dual redundant 750W Power Supplies
RAM Memory	64 GB RDIMM, DDR4	120 GB RDIMM + 8 GB NVDIMM per controller	120 GB RDIMM + 8 GB NVDIMM per controller	N/A	N/A	32 GB DIMM, DDR4
Storage Connectivity	N/A	Eight 12 Gbit SAS connections for expansion	N/A	Dual redundant 6x 12 Gbit SAS fabric	Dual redundant 6x 12 Gbit SAS fabric	N/A

Component Environmental Specifications

By using the environmental specifications for each individual component provided below, aggregate system-level environmental specifications can be generated for any MediaGrid configuration.

	ContentDirector 2000C	ContentServer 4000 - HDD	ContentServer 4000 - SSD	ContentStore 5840A	ContentStore 4240	ContentBridge 2010F/4000
Width	17.25 in / 43.9 cm	19 in / 48.3 cm	19 in / 48.3 cm	17.2 in / 43.7 cm	19 in / 48.3 cm	17.25 in / 43.9 cm
Height	1.7 in / 4.3 cm	7 in / 17.8 cm	7 in / 17.8 cm	8.6 in / 21.9 cm	6.9 in / 17.4 cm	1.7 in / 4.3 cm
Depth	28 in / 71.2 cm	27.5 in / 69.9 cm	27.5 in / 69.9 cm	38.0 in / 96.5 cm	21 in / 53.4 cm	28 in / 71.2 cm
Weight (max)	35 lbs / 15.9 kg	104 lbs / 47 kg	88 lbs / 40 kg	288.9 lbs / 131 kg	63.9 lbs / 29 kg	35 lbs / 15.9 kg
Input Power	100-240 V, 50-60 Hz	100-240 V, 50-60 Hz	100-240 V, 50-60 Hz	200-240 V, 50-60 Hz	100-240 V, 50-60 Hz	100-240 V, 50-60 Hz
Cooling	853 BTU / hr @ 250 W	3047 BTU / hr @ 893 W	3047 BTU / hr @ 893 W	6261 BTU / hr @ 1835 W	1436 BTU / hr @ 421 W	853 BTU / hr @ 250 W

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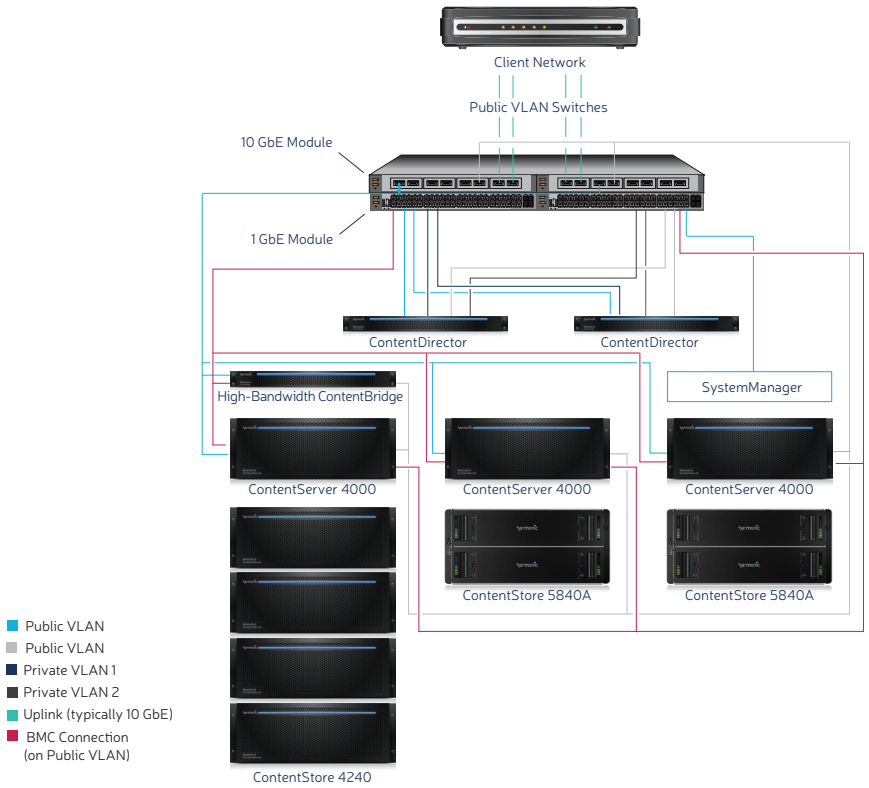
System-Level Specifications

Capacity (usable)	28 TB to multiple petabytes in a single file system
Performance	Bandwidth up to tens of GBps per system
Scaling	Linear, non-disruptive scaling by adding nodes
RAID support	RAID 4 or RAID 6
Operating System Support (with File System Driver)	Windows MacOS Linux
NAS Protocol Support	FTP, SMB/CIFS and NFS via optional ContentBridge
Network Interfaces	10 GB server interface with support for 10-, 40- and 100 GB clients
High Availability	No single point of failure Redundant hot-swap controllers Hot-swap disk drives Hot-swap power supplies Redundant SAS fabric Online software upgrades Online firmware upgrades Replication for disaster recovery
Included Software	File System Driver (unlimited license) for client access to data ContentManager for managing quotas and access MediaGrid System Manager Stretch Cluster Replication
Operating Temperature	32º to 95º F/0º to 35º C Max change 50º F/10º C per hour
Operating Humidity	20% to 80% non-condensing Max change 10% per hour
Compliance	RoHS compliant
Safety and EMC	USA: UL and FCC Canada: cUL Europe: CE Derivative certifications available for other countries



Harmonic MediaGrid 4000 system with ContentStore 4240 and 5840A storage expansion nodes