Spectrum™ X

ADVANCED MEDIA SERVER SYSTEM

The Harmonic Virtualized Spectrum™ X advanced media server system brings new levels of efficiency, simplicity and reliability to broadcast ingest, production and playout workflows. Available as an appliance or software-only solution to run on customer-provided hardware. Leveraging the power of commercial off-the-shelf (COTS) computing, the virtualized solution offers new deployment options and advanced features.

Designed for mission-critical production and playout applications, Spectrum X combines file, baseband and transport stream ingest with comprehensive integrated channel playout (ICP) capabilities, including HTML5 graphics, branding, DVE, and live switching of baseband and compressed IP sources. By reducing the number of discrete devices required to produce and distribute branded programming, Spectrum X lowers capital expenditures, simplifies workflows and reduces operational costs. The system's high density, low power consumption and rock-solid reliability further reduce operating expenses while providing high availability.

The software-based Spectrum X supports a broad range of SD and HD formats up to 1080p (3G). Ultra HD support includes SDR/HDR conversion including tone mapping and tone expansion. It can operate as a true channel-in-a-box (CiaB) or as part of a Spectrum shared storage infrastructure that includes everything from simple ingest and playout to feature-rich ICP capabilities. All functionality is available via software license keying, resulting in a highly flexible system that allows the easy addition of new codecs, CiaB functionality, IP I/O and other advanced features to baseband I/O when needed.

Open APIs for the conventional Spectrum appliances and the new virtualized Spectrum X enable control of media workflows under a single user interface to suit exact workflow requirements, making it easier to deliver content on any platform to any end user.

Fully compatible with Spectrum MediaDirector and MediaCenter servers, and Harmonic's Polaris playout management system, Spectrum X fits seamlessly into existing broadcast infrastructures. In combination with the Harmonic MediaGrid, users have greater expansion possibilities for all workflows from Ingest to MCR playout, utilizing the same high availability shared storage and intelligent media management. By integrating SDI and IP I/O on the same chassis, Spectrum X also eases the migration to IP playout workflows, allowing broadcasters to transition away from baseband at their own pace.

The highly scalable Spectrum X system is ideal for a wide range of applications, including:

- CiaB and ICP workflows
- Studio production
- Hybrid baseband and IP playout environments
- Integrated master control room (iMCR) workflows
- News production
- Disaster recovery

As a next-generation media server system, Spectrum X offers a new approach to production and channel playout. With its function integration, workflow flexibility and cost-efficiency, this next-generation server powers new revenue-generating services while delivering low total cost of ownership. The virtualized Spectrum X solution allows users to utilize their IT budgets to get the Harmonic-compatible hardware they need while still getting the benefits of the industry-leading Spectrum X platform

HIGHLIGHTS

- Easy-to-deploy ingest and playout system for baseband and IP workflows
- Supports a broad range of SD, HD and Ultra HD formats with SDR/HDR tone mapping and tone expansion
- Integrates SDI and IP I/O on the same chassis to ease migration to IP workflows
- Adaptable to all production and playout applications, including integrated channel playout, channel- in-a-box and integrated master control
- Integrated video graphics and branding, using industry-standard authoring tools
- Single and dual integrated DVEs for sophisticated content presentation
- Plug and play compatibility with Harmonic Spectrum media servers and Harmonic MediaGrid shared storage
- Open control architecture makes CIAB/ICP available to Harmonic Polaris and third-party automation systems
- COTS HP 2-RU chassis running Spectrum X Linux-based core software

Virtualized Spectrum X ADVANCED MEDIA SERVER SYSTEM

SPECIFICATIONS

FEATURE SUMMARY

Branding & Graphics	Adobe® Creative Cloud compatibility Integrated DVE; single and dual 2D DVE mode Independent branding for each primary and simulcast channel Up to eight layers of graphics per channel Static and animated graphics, logo, full-screen slate, rolls, crawls, voice-over
Graphics Formats	PNG, JPG, TIFF, GIF, FLV, Targa, WEBM, MP4, with HTML5 or SWF
Master Control Switching (MCS)	1-6 live inputs (configurable) Switch between live and recorded clips Key + fill support
Typefaces	All standard font formats are supported
Automation Support	Polaris Play, Polaris Live All Oxtel protocol automation systems (Ethernet or RS-422) Clip playback control via Spectrum API or VDCP (RS-422)
Audio Watermarking	Kantar® Media Watermarking
Delay Service	Realtime program delay capability
Captions & Subtitles	Localized and customized open captions Live & file-based open- and closed-caption insertion
EAS Support (U.S. only)	Text and audio sourced from customer's EAS equipment.
Loop Record Service	Continuously records short clip segments from an incoming video feed

CODECS

SD	
MPEG-2	3-24.9 Mbps LGOP; 25-50 Mbps I-frame
DV	DV 25, DVCPRO25, DVCPRO50
HD 1.5 G (1080i 50/60, 720p 50/60)	
MPEG-2	18-85 Mbps LGOP; 50-100 Mbps I-frame
DV	DVCPRO HD
XDCAM HD	18, 25, 35, 50 Mbps
RP 2027 Class 50/100 (Generic)	Class 100, 1920x1080i (25/29.97 Hz); 1280x720p (50/59.94 Hz)
AVC-Ultra (Panasonic)	Class 50 and Class 100, 1920x1080i (25/29.97 Hz); 1280x720p (50/59.94 Hz)
XAVC-I Class 100 (Sony)	Class 100, 1920x1080i (25/29.97 Hz); 1280x720p (50/59.94 Hz)
XAVC-L	High 422, Level 4, 25, 50 Mbps
AVC-LongG	Record: 25, 50 Mbps; Playback: 12, 25, 50 Mbps
VC-3 (SMPTE 2019-1)	120, 145, 220 Mbps
ProRes	122, 147, 220 Mbps; SQ and HQ modes
HD 3G (1080p 50/60)	
AVC I-Frame	XAVC-I, AVC-Intra , AVC-I RP 2027 Class 100 (generic)
XAVC-L	XAVC, High 422, Level 4.2, up to 50 Mbps
AVC-LongG	35, 40, 45, 50 Mbps
AVCU-LongG	12, 25, 50 Mbps
VC-3 (SMPTE 2019-1)	190, 220, 367, 440 Mbps, HQX mode
ProRes	440 Mbps, LT mode
UHD	
XAVC	I-Frame, Class 300, 422, 10-bit, 50p/60p L-Gop 10bit 4.2.2 200mbs 50p/60p
AVCU	I-Frame, Level 5.2, 422, 10-bit, 50p/60p
VC-3 (SMPTE 2019-1)	145-180 Mbps, LB mode
ProRes	821 Mbps LT mode

RASTER

SD	525i @ 29.97 fps 625i @ 25 fps
HD 1.5 G	1080i @ 25, 29.97 fps 720p @ 50, 59.94 fps
HD 3G	1080p @ 50, 59.94 fps
UHD 4 x 3G	2160p @ 50, 59.94 fps

MEDIA STORAGE OPTIONS

Choice of four internal 3.5" 2-, 4-, or 6-TB HDDs or 1.9-TB SSDs
3+1 modified RAID 4 (single parity)
Connect to Spectrum MediaCenter (MCP-2200 series) via GbE
Connect to Spectrum SAN (MediaDirector, MCP-2250 series) via GbE
Ingest to Harmonic MediaGrid as MXF OP1a wrapped media
Preview/Playout from Harmonic MediaGrid via 1GbE or 10GbE

AUDIO PROCESSING

Channels	SMPTE 299M/272M, up to 16 embedded per video channel
Formats	Uncompressed: 16, 24, PCM @ 48 kHz Compressed: audio pass-through, Dolby® encode and decode
Features	Audio down-mix Audio track swapping; track tagging, language rules Audio mix effects; VO insertion

DATA

Closed, Open, Live Captions	EIA-608, EIA-708
Ancillary Data	VBI, VANC
Reference	Analog black with color burst, PTP for IP I/O

CONNECTIVITY

SDI Input	Up to four SD/HD channels, one UHD channel Up to two Live inputs in standard channel mode Up to six Live inputs in combined channel mode
SDI Output	Up to four SD/HD channels, one UHD channel Up to two simulcast outputs per channel Independently configurable up/down/crossconversion
IP I/O	Quad 1GE ports for TS ingest Optional dual 10GE ports for Ingest/Play from MediaGrid Optional dual 25GE ports for UHD/HD 2022-6 / 2110 IP I/O
Connectors	RS-422, AES, LTC and GPIO (multi-pin connector; available adapter cable) Two 1GE ports for connection to the Server, SystemManager, file transfer or API control
Server Interface	Private, point-to-point, non-switchable gigabit Ethernet to MediaDirector or MediaCenter Server

POWER

Power Supplies	Dual, hot-swappable Platinum efficiency
Power Consumption	580W at 30C, 680W at 35C (max)

PHYSICAL

Dimensions (W x H x D)	17.53 in x 3.44 in x 28.75 in 2RU 44.55 cm x 8.74 cm x 73.03 cm
Weight	46 lbs/20.8 kg (with HDDs) 38.5 lbs/17.5 kg (without HDDs)

Spectrum XE

PLAYOUT SYSTEM

Combining a full channel-in-a-box system with a premium-quality software encoder, the Harmonic Spectrum™ XE defines a new breed of IT-based playout solution tailored for HD/SD broadcast and multiscreen channel origination, manipulation and delivery.

In today's complex media environment, TV broadcasters and operators must support ever-larger channel lineups, including regional or international variants of existing channels, new thematic linear programs, and over-the-top (OTT) versions of established channels. The Spectrum XE addresses this challenge with integrated playout, encoding and rendering, as well as high scalability and availability. With Spectrum XE's innovative IT-based design, operators can define flexible playout workflows in either the compressed or the uncompressed domain.

Spectrum XE provides a complete array of channel-in-a-box (CiaB) features to control and deliver new channels — and meet broadcasters' requirements for easy-to-deploy, easy-to-operate and easy-to-monitor facilities. It's the perfect solution for originating channels for both broadcast and multiscreen delivery, and for cost-effectively regionalizing downstream programs (with ad replacement and branding).

Flexible Multichannel Playout

With a heritage based on the widely deployed Sapphire™ video server, Spectrum XE extends playout to the uncompressed domain with premium re-encoding capabilities and advanced audio/video processing. The platform runs on a next-generation video operating system, which provides a library of audio/video processing software modules that can be assembled in a near-infinite variety of playout workflows.

Spectrum XE enables uncompressed channel playout via a complete, dynamic decode and re-encode workflow. By operating in the uncompressed domain, the system delivers significant advantages. Various input file or live formats can be combined, and numerous advanced audio and video processing operations (such as HD/SD up- and down-conversion or audio loudness control) can be applied before playout. Graphics overlay capabilities are expanded, with the ability to add static bitmaps, animations and text crawls, and to apply powerful video effects such as fade in/out and squeezeback.

Spectrum XE can re-encode a channel in a wide variety of formats (HD, SD and multiscreen), and make it available over ASI or IP networks. The integrated software encoder delivers premium video quality in MPEG-2, MPEG-4 AVC and HEVC formats, and supports CBR encoding as well as on-board statistical multiplexing.

With Spectrum XE, operators can also remain in the compressed domain. This playout mode is dedicated to splicing MPEG-2, MPEG-4 AVC and HEVC transport streams and brings two main advantages: it keeps the quality of the incoming live or file sources intact, and offers high channel density. Of course, Spectrum XE can operate multiple independent channels simultaneously in both uncompressed and compressed playout modes.

HIGHLIGHTS

- Multiple MPEG interfaces
  - SDI, IP, ASI inputs
  - IP, ASI outputs
- Multiple user-selectable playout modes
  - Compressed domain splicing
  - Baseband switching with dynamic decoding and re-encoding
- Multiple A/V processing features
  - SD/HD up/down-conversion
  - Audio loudness control
- Advanced graphics overlays
  - Logo, animation, text crawl
  - Video effects (fade, squeezeback, etc.)
- Built-in automation with advanced playlist controls
- Media asset management
- Premium-quality MPEG-2/MPEG-4 AVC/HEVC software encoder
- CBR, statistical multiplexing, remultiplexing and streaming
- Advanced transport stream content acquisition capabilities

Spectrum™ XE PLAYOUT SYSTEM

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Intuitive Automation

Spectrum XE comes with built-in automation, which manages all channel schedules frame-accurately and provides powerful control and monitoring utilities. The automation system drives each channel with one or more playlists that define live or file-based events, as well as graphics overlays, as either primary or secondary events. Spectrum XE supports multiple types of event triggers such as time scheduling, SCTE 35 in-band cue tones, GPI signals and input signal loss.

The Spectrum XE graphical user interface includes intuitive playlist editing and control features, and a set of advanced monitoring views for reporting the status of multiple, simultaneous channels, including timelines, video thumbnail mosaics, bitrate charts and transport stream snapshots. Spectrum XE automation can also interface with external traffic and billing or master control systems via a BXF-standard interface. BXF defines detailed event information through the use of a comprehensive structure that supports multiple scheduling actions.

Transport Stream Content Acquisition

Spectrum XE is able to record incoming transport stream (TS) feeds in a very flexible and reliable way. A record list registers any kind of TS or on-demand program. The built-in automation of the Spectrum XE uses these record lists to schedule the recording of events. TS files, generated by dynamic re-encoding, become immediately available in the media library for editing or play-back.

By combining its playout and record capabilities, Spectrum XE is the perfect fit for time-delay, disaster recovery or censorship in a compressed domain.

Smart Asset Manager

Possessing the ability to ingest compressed transport streams and baseband streams over SDI, Spectrum XE also allows transport-stream file provisioning through an FTP interface. The Spectrum XE Media Library makes all these sources available for editing and playback, and also receives all overlay graphics.

In addition, Spectrum XE features a native Smart Asset Manager tool that handles video clip provisioning according to the channel schedules. The system automatically detects any missing asset from a channel playlist and then accordingly initiates video file transfers from external storage for on-time provisioning of assets.

Reliable and Scalable

Spectrum XE runs on a best-of-breed, IT-based 1-RU server featuring a secure dual RAID system, hot-swappable redundant power supplies, and scalable storage consisting of high-reliability hard drives. Optional gigabit Ethernet ASI and SDI physical interfaces are available.

World-Class Service and Support

Harmonic stands behind the Spectrum XE playout system 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.

SPECIFICATIONS

INPUT/OUTPUT

Input Interfaces	Up to four TS-over-ASI ports Up to two TS-over-IP ports Up to four SDI ports
Output Interfaces	Up to four TS-over-ASI ports Up to two TS-over-IP ports

INPUT/OUTPUT

Video Processing Capabilities	HEVC SD/HD decoding MPEG-2 SD/HD decoding MPEG-4 AVC SD/HD decoding SD/HD up/down-conversion Internal statistical multiplexing
Video Encoding	MPEG-2 SD/HD 4:2:0 MPEG-4 AVC SD/HD 4:2:0 HEVC 4:2:0 8/10-bit
Audio Processing Capabilities	MPEG-1 Layer II decoding Dolby® Digital Plus (E-AC-3) decoding AAC-LC/HE-AAC decoding Up/down-mixing Audio loudness control
Audio Encoding	MPEG-1 Layer II E-AC-3 AAC-LC/HE-AAC v1/v2

STORAGE

Dual RAID system
Extensible storage capacity
FTP TS file provisioning

PLAYOUT

Live and TS file playback
Uncompressed switching
Compressed splicing

GRAPHICS & BRANDING

Static bitmaps
Animations
Dynamic text crawls
In/out effects
Squeezeback
EAS
Video (PiP)

Spectrum™ XE PLAYOUT SYSTEM

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SPECIFICATIONS

CONTENT ACQUISITION

- Continuous or event-based capture from TS feeds
- Advanced time-delay capabilities
- Clip editing, trimming and concatenation

AUTOMATION

- Primary and secondary events
- Time-scheduling
- SCTE 35 and GPI triggering
- Playlist and record-list editing and control
- BXF native interface

CONTROL & COMMAND INTERFACES

- SNMP agent
- SOAP API
- Web-Based Graphical User Interface

ORDERING INFORMATION

BASE SYSTEM

Part Number	Description
SPC-XE-1U-2CPU-2XC	Spectrum XE 1-RU server
SPC-XE-SW-VOSFLEX	Next-generation video OS license

INTERFACES

Part Number	Description
SPC-XE-HW-1U-ASISDI	SDI in and ASI in/out card

STORAGE

Part Number	Description
SPC-XE-HW-1U-HDD-XGB	Media storage volume HDD (X GB)
SPC-XE-OPT-ADD-XGB	Additional HDD (X GB)

PLAYOUT & RECORD LICENSES

Part Number	Description
SPC-XE-LIC-PLAYOUT	Channel playout
SPC-XE-LIC-GRAPHIC	Graphic overlay
SPC-XE-LIC-RECORD	Recording one program in a TS, or a whole MPTS
SPC-XE-LIC-DELAY	Delaying 1 channel (or 1 multiplex)

DECODING LICENSES

Part Number	Description
SPC-XE-LIC-DEC-HEVCHD	HEVC HD decoding
SPC-XE-LIC-DEC-HEVCSD	HEVC SD decoding
SPC-XE-LIC-DEC-HD	MPEG-2/H264 HD decoding
SPC-XE-LIC-DEC SD	MPEG-2/H264 SD decoding
SPC-XE-LIC-DEC-HD-MEZZA	HD mezzanine decoding
SPC-XE-LIC-DEC-SD-MEZZA	SD mezzanine decoding
SPC-XE-LIC-DEC-AUD20	MPEG-1/AAC 2.0 stereo decoding
SPC-XE-DEC-AAC51	MPEG-1/AAC multichannel 5.1 decoding
SPC-XE-LIC-DEC-DD51	E-AC-3 5.1 surround decoding

ENCODING LICENSES

Part Number	Description
SPC-XE-LIC-ENC-HEVCHD	HEVC HD encoding
SPC-XE-LIC-ENC-HEVCSD	HEVC SD encoding
SPC-XE-LIC-ENC-HEVCQVGA	HEVC QVGA encoding
SPC-XE-LIC-ENC-MP4HD	MPEG-4 AVC (H.264) HD encoding
SPC-XE-LIC-ENC-MP4SD	MPEG-4 AVC (H.264) SD encoding
SPC-XE-LIC-ENC-MP4QVGA	MPEG-4 AVC (H.264) QVGA encoding
SPC-XE-LIC-ENC-MP2HD	MPEG-2 HD encoding
SPC-XE-LIC-ENC-MP2SD	MPEG-2 SD encoding
SPC-XE-LIC-ENC-AUD20	MPEG-1/AAC 2.0 stereo encoding
SPC-XE-LIC-ENC-AAC51	MPEG-1/AAC multichannel 5.1 encoding
SPC-XE-LIC-ENC-DD51	E-AC-3 2.0 5.1 surround encoding
SPC-XE-LIC-FILE	File Encoding

ADVANCED FEATURES

Part Number	Description
SPC-XE-LIC-ALC20	2.0 stereo audio loudness control
SPC-XE-LIC-ALC51	5.1 surround audio loudness control
SPC-XE-LIC-FLX	Internal Flexstream
SPC-XE-LIC-SAM	Smart Asset Manager agent
SPC-XE-LIC-EAS	EAS interface

EXTERNAL CONTROL

Part Number	Description
57730	External device providing 12 x GPI input ports
EBOX	External device for interface (GPI + RS232) to EAS legacy unit

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

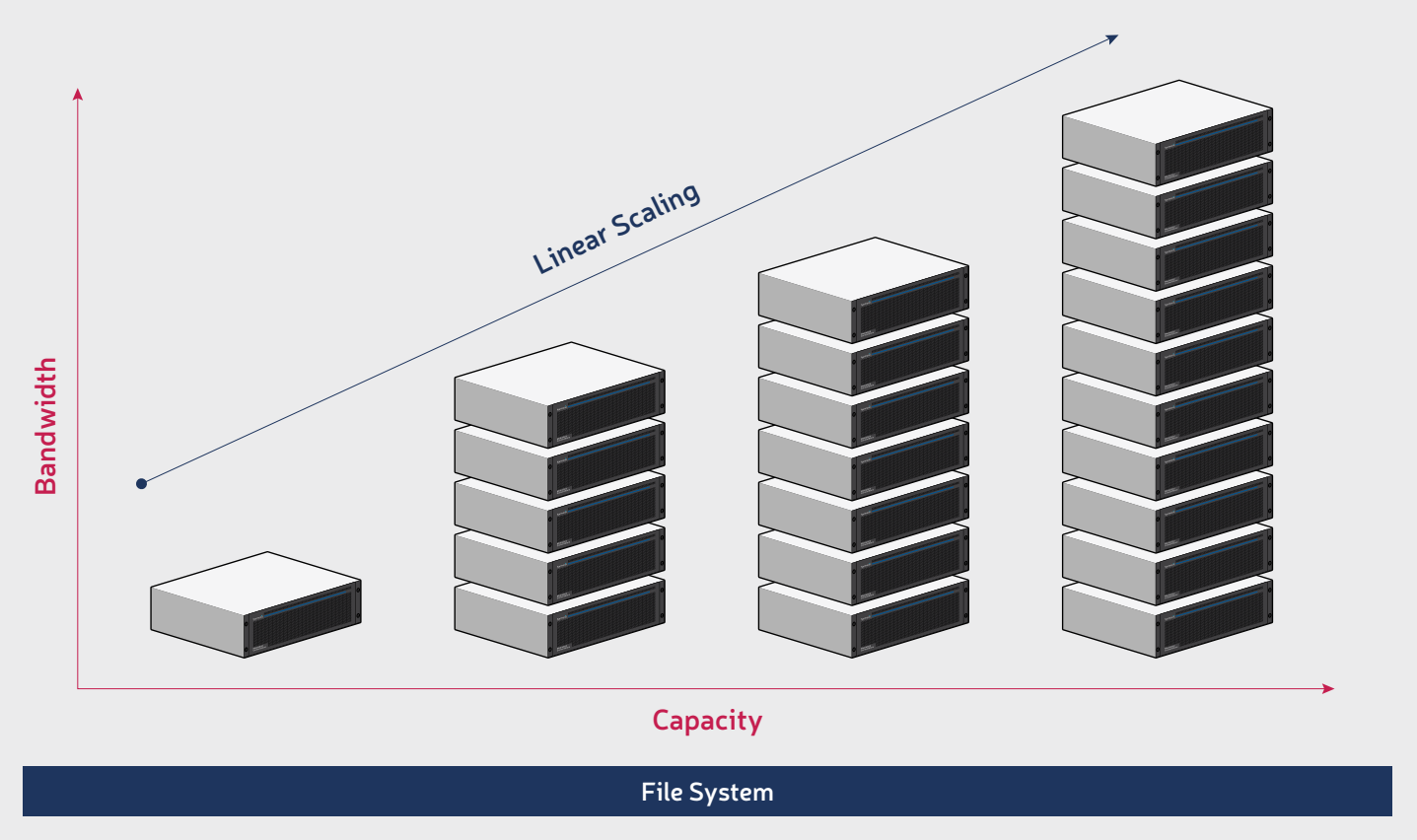
MediaGrid is based on a fully distributed scale-out architecture, resulting in increased performance as additional storage nodes are added. Nearly 2 GBps of bandwidth can be delivered to a single client, with aggregate bandwidth reaching tens of gigabytes per second. As the system is expanded, bandwidth 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

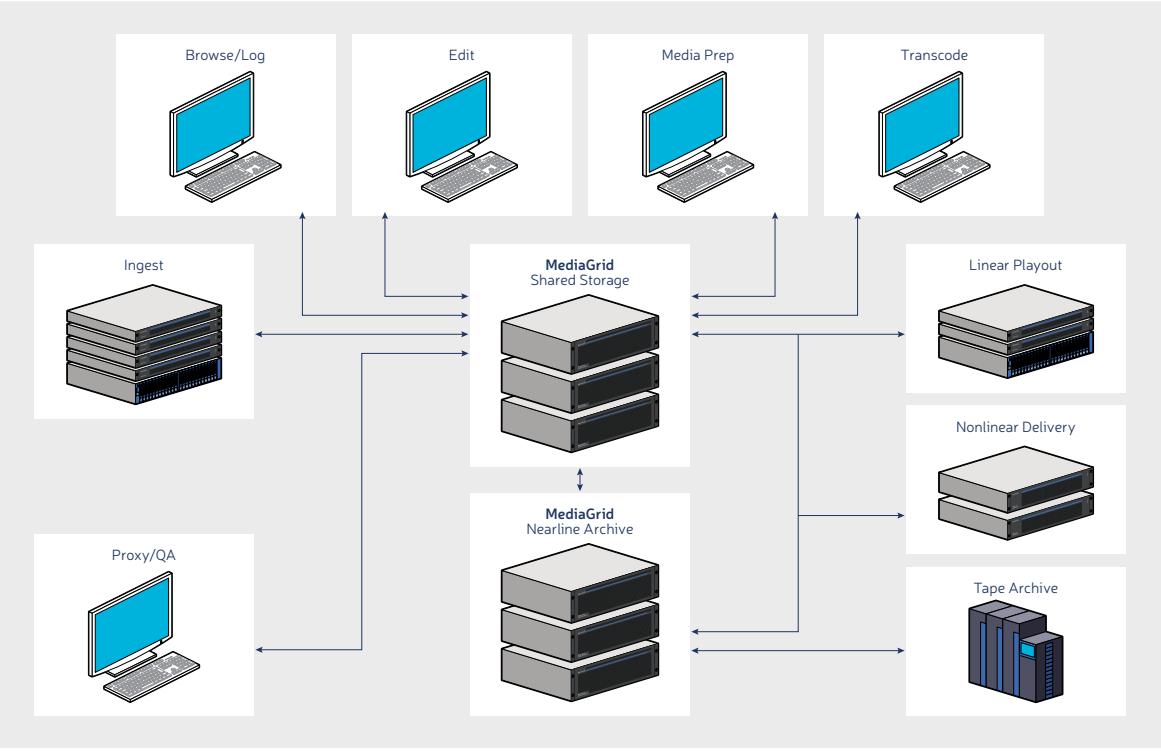
storage node failures, and transparent client failover to protect against controller failures. Software RAID options include RAID 4 and RAID 6, offering protection against unlikely events such as multiple drive failures within a RAID group.

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.

Harmonic MediaGrid SHARED STORAGE

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 MediaGrid over SMB and FTP protocols. A proprietary File System Driver (FSD) is used to connect to MediaGrid for high bandwidth access needs.

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 Ethernet Ports. Dual active-active controllers are included in each for load balancing and high availability.

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 or 76.8 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.

Harmonic MediaGrid SHARED STORAGE

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-BASE4000A-1.6TB-SSD-8XO	38.4TB	8	2	✓
MG-BASE4000A-3.2TB-SSD-8XO	76.8TB	8	2	✓
MG-BASE4000A-2TB-2XO	48TB	8	2	✓
MG-BASE4000A-4TB-2XO	96TB	8	2	✓
MG-BASE4000A-4TB-2XO	192TB	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-SMBASE4000A-2TB-36TB	36TB	8 available 4 supported	1	✓
MG-SMBASE4000A-4TB-54TB	54TB	8 available 4 supported	1	✓
MG-SMBASE4000A-4TB-72TB	72TB	8 available 4 supported	1	✓
MG-SMBASE4000A-8TB-90TB	90TB	8 available 4 supported	1	✓

MediaGrid Component Specifications

	ContentDirector 4000A	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	Four 480 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, 3.2 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, 76.8 TB	336 TB, 672 TB	48 TB, 96 TB, 192 TB	N/A
Network Connectivity	Four 1GbE 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 800W 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	96 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

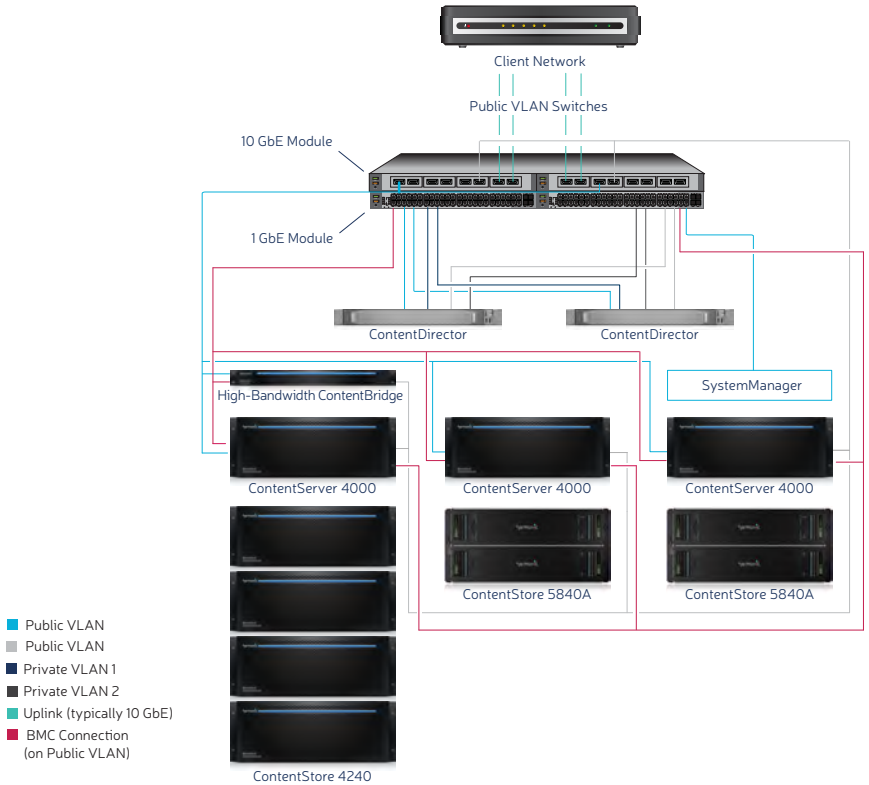
By using the environmental specifications for each individual component provided below, aggregate system-level environmental specifications can be generated for any MediaGrid configuration.

	ContentDirector 4000A	ContentServer 4000 - HDD	ContentServer 4000 - SSD	ContentStore 5840A	ContentStore 4240	ContentBridge 2010F/4000
Width	17.11 in / 43.6 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	1.69 in / 4.29 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	29.5 in / 74.98 cm	27.5 in / 69.9 cm	27.5 in / 69.9 cm	38 in / 96.5 cm	21 in / 53.4 cm	28 in / 71.2 cm
Weight (max)	37 lb/16.78 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	1330 BTU / hr @ 390 W	3047 BTU / hr @ 893 W	3047 BTU / hr @ 893 W	5797 BTU / hr @ 1700 W	1436 BTU / hr @ 421 W	853 BTU / hr @ 250 W

Harmonic MediaGrid SHARED STORAGE

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 via optional ContentBridge
Network Interfaces	10GbE server interface with support for 10-, 40- and 100 GbE 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