SeaChange®

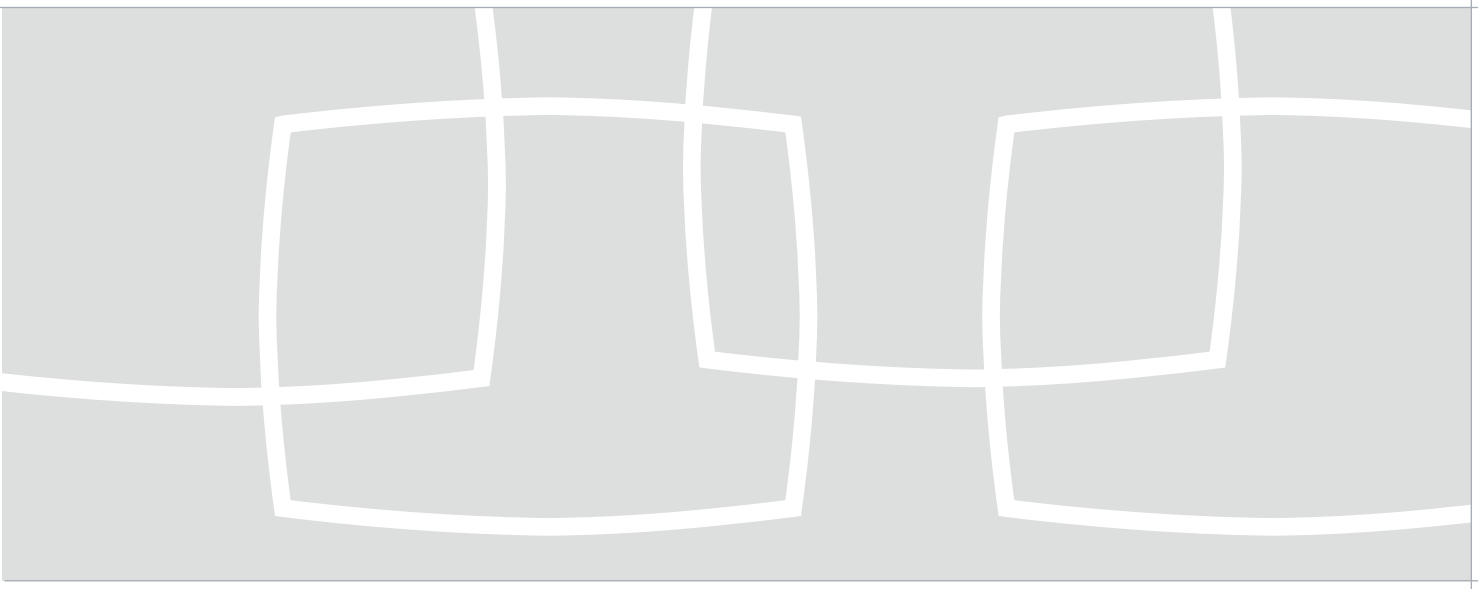
SOLUTION BRIEF

The new SeaChange® Broadcast MediaLibrary™ and MediaClient™ architecture maintains SeaChange's excellence in multichannel transmission video servers.

With the industry's only single copy storage redundancy, multi-format playback support and highly expandable balanced architecture – television operators can be confident their future needs are covered.

SeaChange Broadcast MediaLibrary and MediaClient

The foundation of "all media, on line, all the time"



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SeaChange International: Core Competency

For over a decade the SeaChange name has been synonymous with large, reliable, multi-channel transmission video servers. Even today, SeaChange International remains the only video server manufacturer to deliver digital storage solutions that offer complete fault resilience using only a single copy of the media. Broadcasters facing the challenges of reliably storing and delivering multi-channel television, naturally turn to the SeaChange® MediaCluster® solution. This unique architecture of RAID^{2}® storage elegantly solves the challenges of providing reliable yet efficient storage, rock solid transmission, while at the same time allowing for simple future expansion.

SeaChange International media storage and distribution solutions are un-challenged as the most storage efficient in the television industry. In a SeaChange MediaCluster, only a single copy of media is required, yet it is stored and delivered with the reliability of a mirrored system. With ever increasing channel-count and storage requirements, the inefficiency of mirroring media becomes a heavy overhead for any television facility. Furthermore, the simplicity of the MediaCluster design results in more simple controlling systems for playout and archiving. Since SeaChange's core MediaCluster architecture is based on distributed storage and distributed bandwidth, MediaCluster solutions scale easily and gracefully, while providing uninterrupted online service. As SeaChange storage systems grow from hundreds of online gigabytes to hundreds of terabytes, the incremental costs remain linear – which translates into significant cost savings.

These core strengths have made SeaChange International a strong leader in the delivery of large multi-channel transmission video servers and it is upon these strengths that SeaChange has built the next generation of the MediaCluster – a multi-format, multi-channel transmission server to meet the current and future needs of every television facility.

This brief examines the evolution from the original MPEG-2 based Broadcast MediaCluster to the new SeaChange® Broadcast MediaLibrary™ (BMLe) and SeaChange® MediaClient™ (MCL) architecture to deliver improved storage stability, improved archiving throughput, and multi-format encoding and playback capabilities. This solution now also offers improved interoperability with popular production tools and other 3rd party applications and with its software-based encoders and decoders is architected to easily support current and future compression formats for both SD and HD services.

RAID² Explained

In 1996 SeaChange International introduced its first Broadcast MediaCluster, based on the company's revolutionary and patented RAID² technology.

Common RAID techniques such as RAID-3 and RAID-5 were designed to protect storage systems at the disk array stripe group level only, necessitating the mirroring of entire server systems to ensure protection of delivery and data. The unique SeaChange RAID² technology uses two applications of RAID-5, one at the disk array stripe group level to protect against individual disk drive failures, and then a second simultaneous application of RAID-5 at the server node level, to protect the entire clustered storage system against the failure of a complete cluster node. A MediaCluster is essentially a single RAID² storage system built from a minimum of three (and up to nine) inter-connected RAID arrays or nodes.

Data blocks from every media file are striped across every disk drive in the MediaCluster. Thus, every disk drive in a MediaCluster contributes to every record or replay process. For example, in a BMLe-24006 (a six-node Broadcast MediaLibrary, 144 disk drives are working in parallel to deliver enormous disk drive read/write bandwidth in a fully balanced fashion. Although each media file is stored as a single file across all drives on all nodes in the MediaCluster, it is immediately available to either be played out through dedicated decoders or as a file transfer through network interface cards.

The elegance of the MediaCluster architecture is further realized when increasing the size of the MediaCluster to provide, for example, more I/O. Adding another node to the MediaCluster adds an additional 24 drives of storage.

This not only increases storage capacity, but also increases the number of drives working in parallel for all file reads and writes from 144 to 168, thereby increasing aggregate disk drive bandwidth.

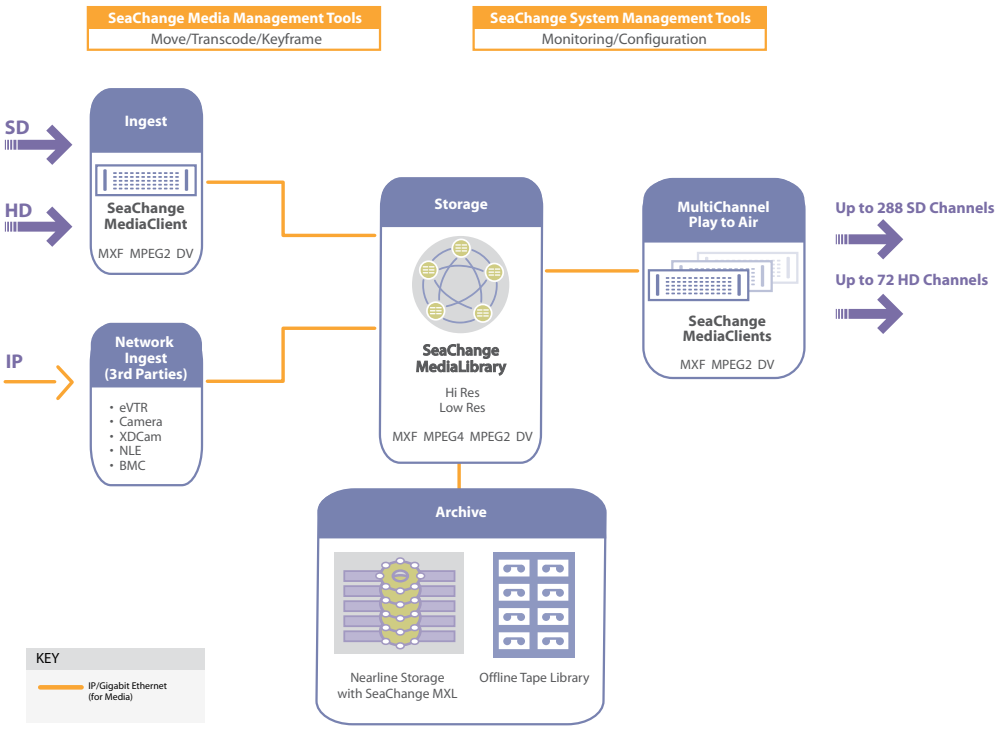
Also, instead of dividing existing server bandwidth as would occur when adding more I/O to conventional SAN-based server solutions, the additional node brings with it incremental intra-cluster bandwidth, with six additional dedicated links that connect this new node to every other node in the MediaCluster. *As a SeaChange system grows, so does the available disk drive and interconnect bandwidth.*

This approach of bundling disk drives and increments of network bandwidth into each node makes the SeaChange MediaCluster the first elegantly scalable storage solution. The use of RAID², to eliminate the dual copies of media needed in mirrored server solutions, has allowed SeaChange to build a highly reliable video server that uses only a single copy of media.

This is a unique and patented storage architecture that only SeaChange International can deliver. It is this same storage platform that is the basis of the new SeaChange BMLe/MCL solution.

BMLe/MCL System Overview – The Client/ Server Advantage

One of the key enhancements in the next generation SeaChange multi-channel transmission server is the development of a series of Media Client (MCL) platforms that are separate to the core MediaCluster storage system.



The high-performance MediaClient performs the real time encoding or decoding operations previously done by the hardware cards that were integrated into a BMC node.

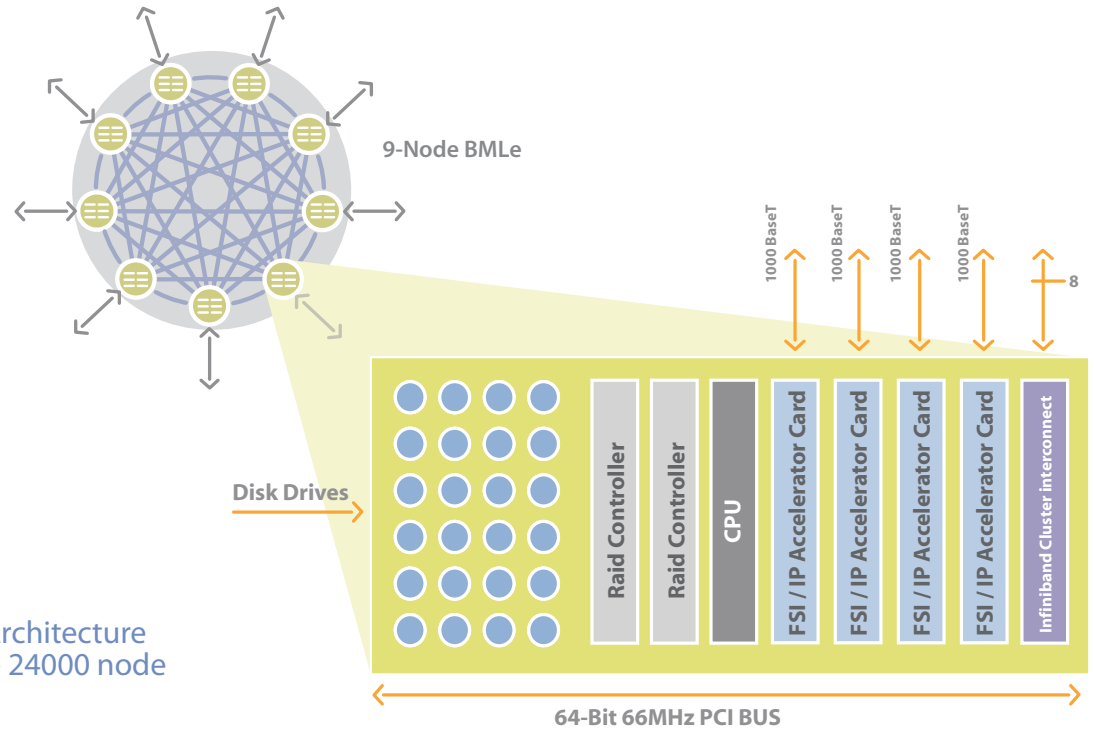
With support for a wide-range of compression formats and file wrappers, the MediaClient simplifies the production-to-transmission workflow in any television facility. With 100% support for frame accurate back-to-back replay of all different formats from the same decoder output, the MediaClient encourages the use of application specific compression formats.

For example, the highly efficient MPEG-2 long GOP format is perfect for program material, whereas frame-based formats such as I-Frame MXF or DV50, are more appropriate for material that requires editing in production servers. Any format will play back-to-back, frame accurately from the same decoder output thus avoiding automation control complexities.

Completed material from the production servers no longer needs to be transcoded or dubbed back to tape for ingest, before playout from the transmission server, thus reducing operator intervention and significantly shortening time from production to on-air.

With software encoding and decoding on the MediaClient platform, SeaChange has delivered a versatility previously unknown with hardware-based Codecs. Now time taken to support a future compression format is a matter of months rather than the years it takes to design, build and debug hardware-based cards. This versatility is already clearly seen by the number of currently supported SD and HD encoding/decoding formats. The ability to easily add support for new compression formats and file wrappers means that a customer's investment is protected.

Importantly, the BMLe/MCL solution is compatible with existing SeaChange Broadcast MediaClusters (BMC). Files originally encoded on a BMC can be replayed from a MCL, as well as MPEG-2 Program Streams encoded on an MCL may be replayed by existing BMCs. This allows existing SeaChange users to incorporate the new architecture into their facility, augmenting not replacing, their existing transmission infrastructure.



Internal Architecture of a BMLe 24000 node

Each node of a BMLe contains 4 new interface cards, called the FSI card (File System Interface) which is used for real-time streaming to SeaChange MediaClients for SD or HD transmission, or for network transfers to 3rd party applications such as archive data movers or NLE Production systems.

A MediaClient may directly connect to one of the four FSI cards on the BMLe node or via a Gigabit switch to allow more than 4 MediaClients per node. A maximum of 8 MediaClient decoders (@15Mb/s) can connect to a single FSI card. This translates to 32 MediaClients decoders (@15Mb/s) per node, or 288 MediaClient decoders (@15Mb/s) per 9-node BMLe. While this channel count is unrealistic for a broadcast server, it does illustrate an unprecedented expandability for a multi-channel transmission server where all channels are able to simultaneously access the same RAID^2–redundant storage system. With systems running MediaClient decoders at higher bit rates, the channel count numbers are reduced accordingly – for example when supporting 50Mb/s a 4-Node BMLe is able to support up to 32 channels.

By implementing common file transfer protocols such as CIFS or FTP, the FSI cards also provide direct access for archives or other 3rd party applications. Therefore an operator relying on high network bandwidth between archive and the playout server is able to dedicate entire FSI cards or entire nodes of the MediaCluster for transfers to and from the archive. As requirements grow, the simple addition of more nodes to the BMLe provides linear increments of storage capacity, MediaClient interconnects or archive network bandwidth without changing the inherent balanced architecture of the MediaCluster design.

The range of MediaClient engines includes support for both SD and HD encoding and playout in a wide range of compression formats and file wrappers and in various input/output configurations. For example the MCL-4004 has 4 SD decoders while the MCL-4012 has one SD encoder and 2 SD decoders.

MODEL	INPUTS	OUTPUTS	SD OR HD	SUPPORTED COMPRESSION FORMATS AND FILE WRAPPERS
MCL-4012	1	2	SD	**Compression:** MPEG-2, IMX 30/40/50, DV25/50. **Mux/wrapper:** MXF OP1a, Quicktime (self contained), MPEG-2 Program Stream, MPEG-2 Transport Stream
MCL-4004	0	4	SD	SAME AS ABOVE
MCL-4201	0	1-SD + 1-HD	SD & HD SIMULCAST	SD: MPEG-2, IMX30/40/50, DV25/DV50 HD: MPEG-2 4:2:2 or 4:2:0 up to 50Mb/s
MCL-4102	0	2	HD	MPEG-2 4:2:2 or 4:2:0 up to 50Mb/s
MCL-5110	1	0	HD	MPEG-2 4:2:2 or 4:2:0 up to 50Mb/s

For more detailed specifications of the MCL range of products, please refer to the individual product brochures.

BMLe Specifics

The BMLe Cluster system is now scalable from three server nodes to a maximum of nine nodes, with each BMLe node containing up to twenty-four 146 or 300 GB SCSI drives each running at 10,000 RPM. Note that SCSI drives are used for the maximum throughput and reliability required in a play-to-air server – SeaChange does use Serial ATA drives in their 2nd tier Near Online MediaCluster storage solution.

At the maximum configuration, this translates to almost 6 terabytes (TB) of usable RAID-5 storage per node, or over 48 TB of usable RAID_ storage per nine-node BMLe. In real terms, this is equivalent to sixteen months of storage for MPEG-2 encoded material at 10 Mbps.

The 24 disk drives in a BMLe node are arranged in two stripe groups with only one drive of each twelve-drive stripe group dedicated to RAID-5 parity. In specific instances, up to two drives in a node can fail (one in each stripe set) without causing the data on the node to be lost. Each of the twelve-drive stripe groups is connected to an internal RAID controller.

Each BMLe-24000 node comes equipped with four FSI-1000 (File System Interface) cards as standard equipment, providing direct pipelines into and out of the storage subsystem. An FSI card provides 250Mb/s aggregate bandwidth read-only (or 200Mb/s write only), for MediaClient connections or for archive transfers via standard file transfer protocols such as FTP and CIFS.

The MediaCluster drive size and node count is configured to balance the customer's requirements of storage, MCL interconnects and archiving bandwidth.

The benefit of separating the MediaCluster storage from the real time codecs is increased storage system stability during system upgrades or reconfiguration. When adding hardware Codecs to an original BMC node, the MediaCluster would be in a vulnerable N-1 state while the new hardware was fitted.

With the new BMLe/MCL architecture, MediaClients may be added or removed from any node without having any effect on the storage sub-system or on other MCLs that are already connected.

Scalability – MediaCluster vs. Storage Area Networks

SeaChange's distributed MediaCluster architecture has no single bottleneck that would limit the high-speed flow of data into and out of the BMLe. As the system grows, incremental disk bandwidth, cluster interconnect bandwidth, and network interconnect are bundled with each additional node.

Bottlenecks in the form of large and expensive Fibre Channel switches ultimately limit the scalability of SAN solutions. This is further exacerbated when expanding the SAN storage sub-system. As more storage is added to the SAN, available bandwidth is divided. To maintain bandwidth scalability, the existing Fibre Channel network must be expanded, either by replacing the existing switch with a larger, more expensive version, or by installing additional switches and management systems to support them. For mirrored SANs the cost of the upgrade instantly doubles.

The need for centralized switches and the necessity for mirrored storage and networks to eliminate single points-of-failure are the principal factors that essentially double the cost of a SAN solution compared to the MediaCluster advantage of a BMLe.

Cost of Ownership

An online library can clearly deliver new operational efficiencies and operational methodologies to every media operation. For content creators, having their media stored digitally online opens up many new revenue possibilities. However, the decision whether or not to deploy such large online disk-based libraries simply comes down to the cost of ownership.

With its "single-copy" RAID^2 reliability and its distributed network bandwidth architecture, the SeaChange BMLe delivers significant operational advantages that, by their nature, translate to significant cost advantages over any other competitive disk-based library solution.

In a BMLe, the RAID^2 overhead (providing the ability to continue delivery of media *even when an entire node is offline*) is 11% for a 9 node BMLe (see table below).

This is a significant cost advantage when compared to the fixed 50% overhead for a mirrored SAN.

3 NODE BML	5 NODE BML	9 NODE BML	ANY MIRRORED SAN
33% RAID^2 Overhead	20% RAID^2 Overhead	11% RAID^2 Overhead	50% Fixed Overhead

NOTE: In addition, BMLe and mirrored SAN's both have inherent overhead for the implementation of RAID-3 or RAID-5 in individual stripe group arrays. Typically, the overhead is between 8% and 13% per stripe group. However, some SAN architectures sacrifice over 20% of their usable storage for parity data per stripe group array.

The cost advantage of the MediaCluster is further augmented when the cost of network bandwidth is considered. The distributed internal architecture of the MediaCluster is implemented by means of small inexpensive network switches integrated into each node's Cluster Interconnect card. The cost of an eight-port network switch used in each BML node is effectively the cost of the silicon itself. When a number of these switches are deployed in a MediaCluster, they create a distributed switched network with performance and functionality that far exceed that of centralized single switch architectures, such as those employed in SANs, and also eliminate that critical single point of failure. Furthermore, when a BMLe is expanded with additional nodes, *bandwidth increases linearly with each additional node.*

The significant cost benefits of these SeaChange advantages translate directly into the best price/performance metrics in the industry.

Summary

The raw cost of disk drives is approximately the same for all media server manufacturers. However, it is the architecture and technology that a manufacturer wraps around the disk drives that ultimately determines price and performance.

In 1996, SeaChange engineers invented the RAID^2 MediaCluster architecture that uniquely provides fault resilience with only a single copy of media. Today, MediaCluster powers tens of thousands of broadcast, cable, satellite, and interactive-television channels all around the world.

It is this market-proven, rock-solid technology that forms the heart of the new SeaChange BMLe/MCL Broadcast transmission platform, an enhanced solution that continues SeaChange's excellence in providing reliable, easily-expandable, storage-efficient, multi-channel transmission video servers.

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For more information please contact sales@schange.com or visit our website at www.schange.com