Blade Solutions

May 2006

Digital Media in a Box

A Combined Solution from

IBM and Tarari

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Executive Summary/Introduction

With the advent of high-definition (HD) content comes the compute-intensive operation of encoding streams of extremely high-resolution video. The process of encoding a few minutes of footage in HD can take several hours and generate files tens of gigabytes in size. As high-definition video (HD) gains traction, and more editors, publishers and broadcasters use it, the work of encoding it will become more demanding, and requirements to accelerate this work will blossom.

IBM and Tarari have teamed to make it easier to create more powerful encoding solutions for the media and entertainment industry. The combination of the IBM eServer™ BladeCenter™ platform and IBM IntelliStation® workstations with the Tarari® Encoder Accelerator delivers the speed, compute resources, scalability, and reliability to meet the exploding demand for high-quality digital content encoding.

1) The demand for encoding video in higher-resolution formats is increasing.

2) The process of encoding content into media files is prohibitively compute-intensive.

3) IBM's BladeCenter and Tarari's Encoder Accelerator offer a unique, combined solution.

This paper explains the Digital Media in a Box solution by describing:

- why, where and how IBM and Tarari work together to solve the encoding bottleneck
- how IBM's BladeCenter and IntelliStation combine with Tarari to add value to digital media applications
- the performance benefits from the combined solution

Solution Overview

The IBM-Tarari Digital Media in a Box solution is designed to accelerate the process of encoding VC1 and Windows Media Video. At the heart of the solution is what we will call the "Turbo Blade" throughout this paper. A Turbo Blade consists of an IBM HS20 Blade server with Dual Intel Xeon processors, plus a PCI I/O Expansion unit (sometimes called a "sidecar") and a silicon-based Tarari Encoder Accelerator card – which together can accelerate the most processor-intensive operations associated with encoding digital media.

The Turbo Blade takes advantage of the Tarari Encoder Accelerator's dedicated resources to offload compute-intensive calculations from the Intel Xeon processors. This releases a significant percentage of the HS20 Blade's processing power – otherwise taken up by software-only encoding – and allows the Blade's dual Xeon processors to be used for other tasks. Digital Media in a Box accelerates Windows Media Video encoding for both standard-definition (SD) and high-definition (HD) in both Windows Media 9 and VC-1 formats. Tests have shown that a high definition 2 hour movie that previously could take 70 hours to encode can now be encoded in around 7 hours by the Turbo Blade – thus providing approximately a 10 fold increase in performance. Different content, different settings and different output formats all effect the Turbo Blades boost effect but typically a 2 to 10 fold increase has been seen.

One big advantage of the Turbo Blade is its seamless integration – literally any Microsoft Windows Media encoder implementation based on the Microsoft Windows Media Format SDK is accelerated by the Turbo Blade.

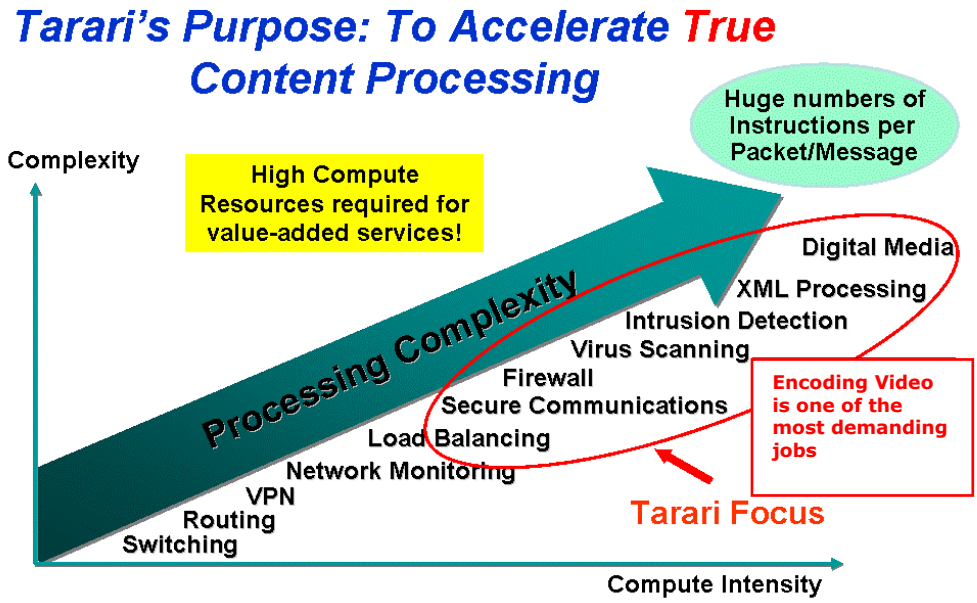
Faster turnaround of the encoding process means film and TV post-production facilities, broadcasters, and IPTV providers can now improve

throughput significantly, maximizing the return on encoding resources while cutting costs. It helps content creators and distributors solve workflow bottlenecks to deliver more media into the marketplace, increasing the demand for Windows Media Video encoded content.

The Problem

Digital Media encoding, especially HD encoding, represents one of the most compute-intensive and complex operations that has to be performed on content. In many situations (e.g., breaking news, sports, financial information) time is of the essence, and in some cases real-time encoding is an absolute requirement. And even when content is not required in a timely fashion it typically still needs to be transformed from the raw, Audio Video Interleave (AVI) file format into a more efficient compressed file format so that consumers can both receive and play them efficiently.

Digital Media in a Box combines the consolidation, power and manageability of BladeCenter with Tarari's years of experience in acceleration technology for the first, over-arching solution to the problem of encoding digital media.

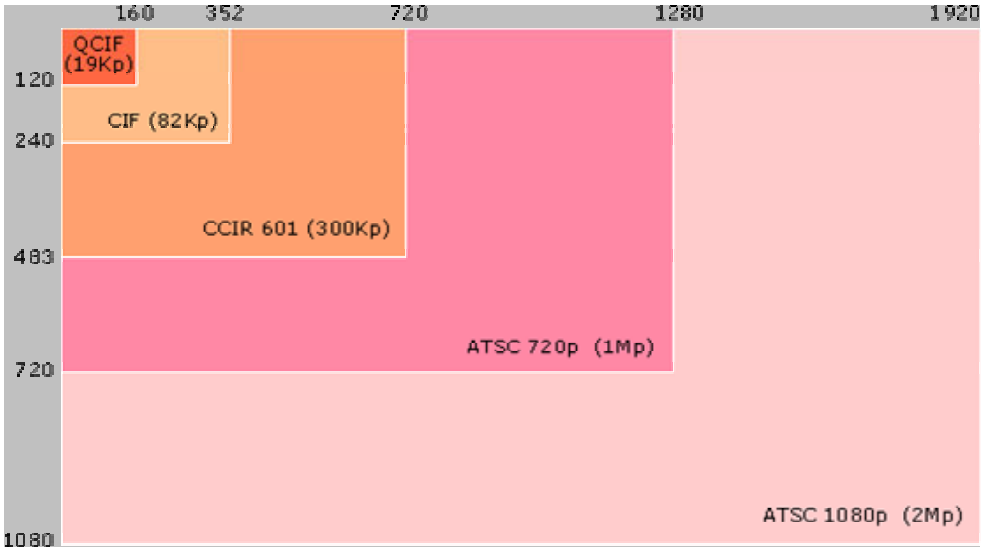


Why VC1?

The proposed Society of Motion Picture and Television Engineers (SMPTE) VC1 open standard is based on the Microsoft's Windows Media Video 9 (WMV9) format and promises to help bring HD to the masses, in a format workable even at the level of a PC or cell phone. It is one of the most advanced video codecs available, and offers:

- more than 30% greater speed and simplicity than H.264/AVC
- intrinsic, high-quality benefits for high-definition video in general
- end-to-end professional tools for broadcast and audio-visual

This unparalleled resolution and broad feature set, however, comes at a cost: The frame size for ATSC 1080p HD (1920 x 1080 = 2,019,600 pixels) counts almost six times the number of pixels of SD (720 x 483 = 347,760 pixels). Software-only approaches to encoding such high resolutions take too much time and consume too many processor cycles.

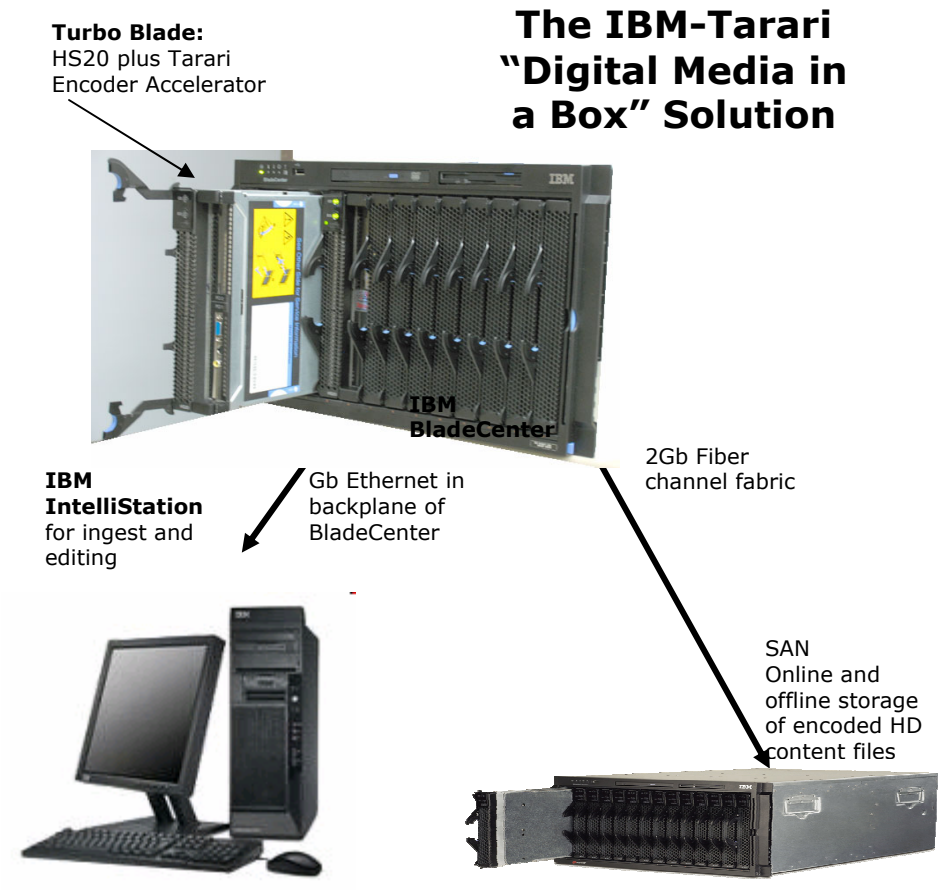


Tarari has analyzed over 250 algorithms in the VC1/WMV9 codec and determined that four of these algorithms consume 95% of CPU cycles during the encoding process. Of these, one in particular – motion estimation – consumes nearly 90% of those cycles.

Some approaches to the encoding problem drop information in a trade-off between encoding performance and output quality. The Digital Media in a Box solution does away with that trade-off by implementing Tarari's algorithm acceleration and the highest-quality VC1 video encoding algorithms within the IBM BladeCenter's high-processing, high-throughput environment. This ensures the highest-quality encoded video output, with greatly accelerated encoding.

VC1 compression technology has made HD possible; now Digital Media in a Box makes VC1 encoding practical.

Solution Outline



In this example;

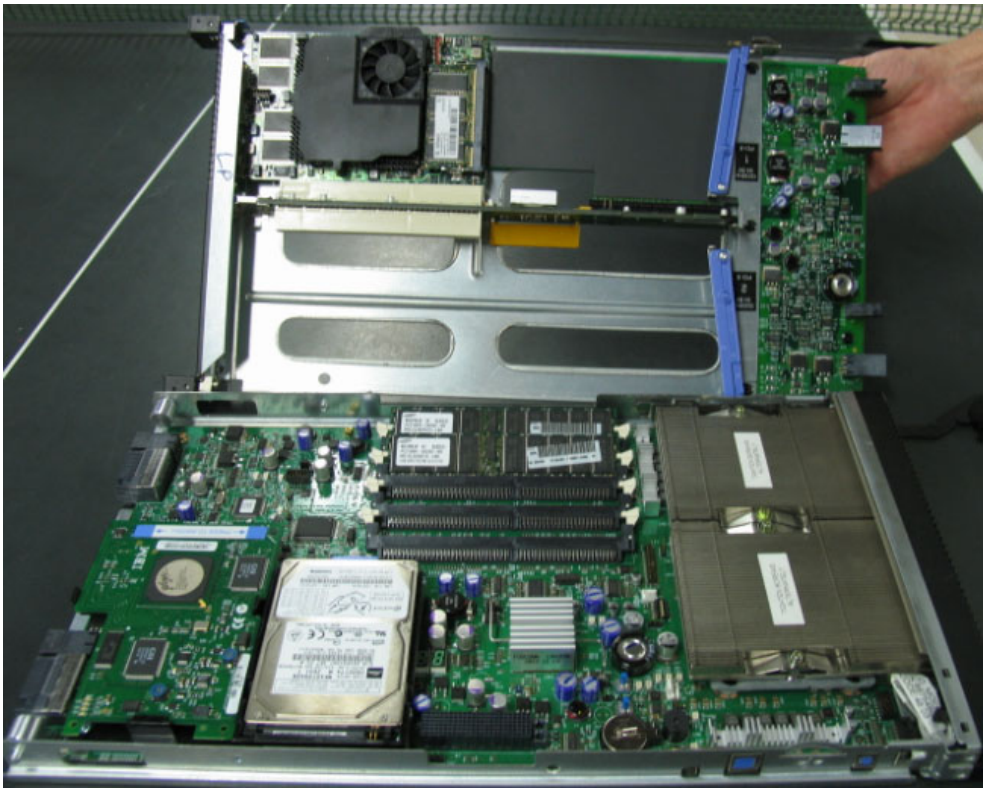
1) Raw, uncompressed video footage is first streamed from HD or SD tape on an IBM IntelliStation. Even for short segments of a movie these files can be several gigabytes in size, especially at HD resolution.
2) After the files are moved to the SAN, they are edited using any industry-standard editing tool.
3) When material is ready to be encoded into VC1 format, it is simply placed in a special watch folder on the SAN and any of

up to 7 IBM-Tarari Turbo Blades per chassis take over and handle the encoding job, freeing up the IntelliStation client to get on with other work.

4) The BladeCenter stores the encoded files on its storage area network (SAN), from which they are accessible over the network for editing and post-encoding production work, and for viewing on the IntelliStation.

Digital Media in a Box – Solution and Components

The Digital Media in a Box solution includes one or more Turbo Blades: IBM HS20s each equipped with a Tarari Encoder Accelerator.



The following sections provide an overview of the Digital Media in a Box solution, and a brief description of the two main components:

- IBM BladeCenter's HS20 blade running on Microsoft Windows Server 2003
- Tarari Encoder Accelerator connected via the PCI I/O Expansion Unit

IBM BladeCenter – HS20 blade

IBM BladeCenter is a superior implementation of the blade server concept of physical consolidation of servers into a smaller, more manageable environment to achieve efficiency of operation. The BladeCenter design brings the client's computing resources into a cost-effective, highly reliable, modular form factor at up to twice the density of comparable 1U Intel® processor-based servers. Coupled with Intel® Xeon™ processors (at over 3GHz), modular Fibre Channel (FC) and Ethernet switches (Layer 2, and Layer 2-7) built into the BladeCenter chassis and advanced management of storage, networking, servers, and applications through IBM Director 4.2, organizations can take control of the computing environment and potentially reduce costs. Physical costs alone can potentially be reduced with a smaller footprint for multiple servers (7) and up to an 83% reduction in cabling. BladeCenter supports IBM's TotalStorage® and networking solution in a common, fully managed architecture. Additionally, BladeCenter often takes less time to install, can require fewer people to manage and maintain, provides modular scalability and provides an environment with almost no single point of failure.

IBM HS20 Blade Features & Benefits

Feature	Benefits
Modular system delivering raw processing power	•Ultra-slim and powerful blade design delivers high density without sacrificing server processor performance •Up to 84 HS20 or 42 Turbo Blades in an industry-standard rack, packing more performance per square foot and saving valuable central office and/or data center real estate •Hot-swappable, designed for adding or changing servers without disrupting the operation of other servers in the chassis
Supports up to two Intel Xeon processors with 800 MHz front-side bus	•Equipped with Intel Hyper-Threading and NetBurst® technologies, the Intel Xeon processor delivers server performance ideal for compute-intensive, next-generation network and IT application workloads
Up to 8GB of DDR ECC Chipkill™ memory	•Double data rate, error checking and correction, and Chipkill offer high performance with mainframe-inspired fault protection •Able to handle data-hungry applications with memory to spare
64-bit extensions	•Supports Intel® Extended Memory 64 Technology (Intel® EM64T) with embedded Intel Xeon 3.06 GHz processor(s) on HS20 blade model 8832-XXX •Provides 64-bit addressability while supporting both 64- and 32-bit applications, a smooth transition to 64-bit enabled applications while leveraging the price and performance of existing applications
Integrated dual Gigabit Ethernet connections	•Enabled to transmit large amounts of data at high speeds for high-performance network applications •Robust design supports teaming and failover
Two high-availability midplane connections	•Provides durable and reliable connections to all chassis resources
Integrated System Management Processor	•Increases server availability by continuously monitoring the system and sending notification of potential system failures or changes
IBM Director and IBM Director Extensions comprehensive systems management tools	•Exploits hardware capabilities by returning pertinent system information, allowing automated response •Helps increase uptime, reduce costs and improve productivity via advanced server management capabilities •Provides intelligent system management for rock-solid reliability •Remote Deployment Manager simplifies and automates deployment and redeployment for efficient installation and startup of IBM eServer BladeCenter T

Feature	Benefits
Operating System Support	•Microsoft Windows Server 2003 or Microsoft Windows XP (SP2 or higher)
3-year on-site limited warranty[1] for parts and labor	•The IBM Global Services organization provides reliable, dedicated and skilled assistance when needed •Provides peace of mind for an extended period of time
Blade server interconnects	•Supports an optional 2-port (2Gb per port) FC Expansion Card (Host Bus Adapter) to deliver a high-performance, highly manageable Storage Area Network (SAN) •Supports an optional 2-port (1Gb per port) Gigabit Ethernet Expansion Card to enable additional Ethernet bandwidth and allows for connection to multiple LAN segments
Light path diagnostics self-diagnosis panel	•Provides quick and easy guide to troubleshoot server for higher availability and system uptime •Independently powered, allowing removal of the server from the chassis and persistent illumination of the light path LEDs
Predictive Failure Analysis™ (PFA)	•Helps save time and money by decreasing planned and unplanned downtime •Increases uptime by sending proactive alerts as much as 24-48 hours in advance

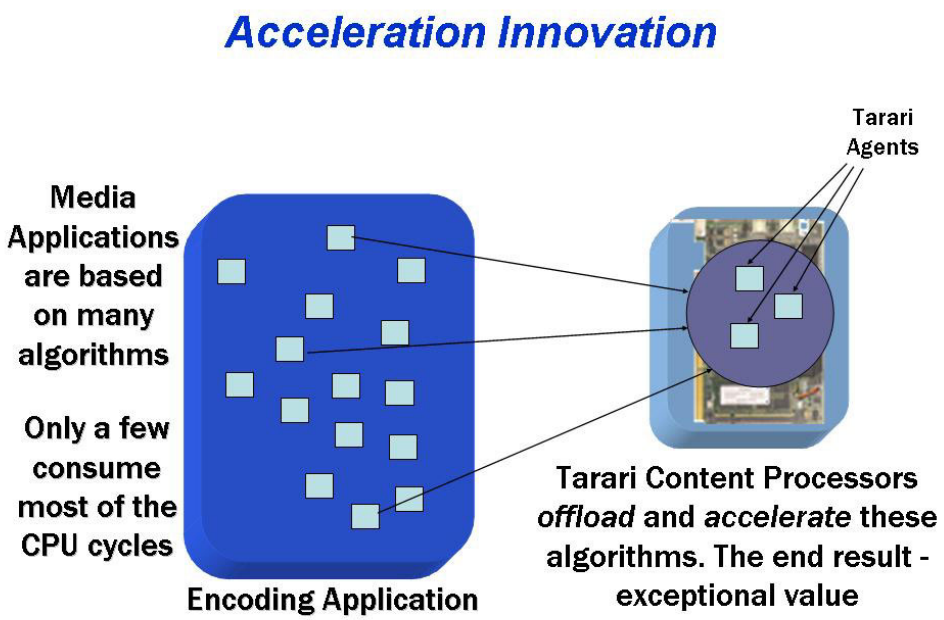
IBM IntelliStation

The IntelliStation is a high-end, workstation-class computer. Its roles in Digital Media in a Box are the ingestion of raw footage, and editing and display of the final encoded videos.

Processor	Intel FSB Xeon processor up to 3.6GHz/800MHz, dual-capable with Intel Extended Memory 64 and Hyper-Threading Technologies (1MB L2 cache)
Memory (standard/max)	1GB or 2GB/16GB PC2-3200 ECC DDR2 RDIMM; dual-channel; 6 DIMM slots total
Hard disk drive (HDD)	Choice of 73GB 10000rpm Ultra320 SCSI or dual-channel Ultra320 SCSI or SATA hard disk drives; HostRAID support Level 0, 1 integrated
Networking	Integrated Broadcom 10/100/1000MBPS high-bandwidth Gigabit Ethernet with Wake on LAN

Tarari Encoder Accelerator

The silicon-based Tarari Encoder Accelerator uses dedicated logic and customizable silicon to run Tarari agents especially designed to accelerate the process of encoding VC1 Video. The Tarari Encoder Accelerator fits in the PCI slot of the PCI I/O Expansion Unit to accelerate the encoding as well as freeing up a significant percentage of the blade's processing power – otherwise taken up by software-only processing – for other tasks – especially motion estimation from one frame of video to the next. Tarari accelerates video encoding (Simple, Main and Advanced Profiles) for both SD and HD Windows Media 9 and VC-1 video content.



The flexible architecture of the Tarari Encoder Accelerator allows the product to work seamlessly with any VC1 or Windows Media encoder implementation based on the Microsoft Windows Media Format SDK.

Advantages

Faster turnaround with hardware-assisted acceleration from the IBM-Tarari Digital Media in a Box solution means film and TV post-production facilities, broadcasters, and IPTV providers can now provide significantly more throughput, maximizing the return on encoding resources while cutting costs. The Turbo Blade helps content creators and distributors solve workflow bottlenecks to get more media into the marketplace in a timely manner, which helps grow demand for even more content.

The result is that film and TV post-production facilities, broadcasters, and IPTV providers can encode their highest definition products much faster and without quality loss. The Tarari Encoder Accelerator bears the Windows Hardware Quality Labs (WHQL) certification and supports 720p and 1080p HD content, as well as 2K and 4K digital cinema formats.[1] Its technology also prepares producers for the next generation of DVD content based on both HD-DVD and Blu-Ray formats.

Installation

The Turbo Blade is installed in two simple steps:

- Hardware

Fit the Tarari Encoder Accelerator into the side card Extender Module, snap the PCI I/O Expansion Unit on the IBM HS20 closed and replace it in the BladeCenter chassis.

- Software

Install Microsoft Windows XP Professional (SP2 or higher) or Windows Server 2003 on the IBM HS20. Then install the software package which

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[1] Tarari's product roadmap calls for a software-upgrade to support 1080i output by Sept 2006.

comes on a single CD that will intercept VC1 encoding jobs and run them on the Tarari Encoder Accelerator.

Optional: Install your preferred ingest/editing software on the IntelliStation and preferred encoding software on the Turbo Blade. The Turbo Blade supports Adobe Premier, Microsoft Windows Encoder, Canopus Encoder and a host of other digital media software.

Major Features and Benefits

Reduced cost per hour for encoding of standard and high-definition content

Digital Media in a Box is more than technically interesting; it is also a compelling business case rooted in high performance. Encoding jobs that previously took days to perform can now be executed in hours. With jobs executed at 2-10x speedup over comparable software approaches, the cost per hour of encoded content drops dramatically and the opportunity to encode and deliver greater quantities of high-quality content rises correspondingly.

Reconfigurable assets

Digital Media in a Box is designed for flexibility and migration. As hardware and throughput requirements grow, the modular nature of BladeCenter allows for upgrades to processors, memory, storage and connectivity. The Turbo Blade utilizes reprogrammable logic so that, as the VC1 and Windows Media applications evolve, software updates to the Turbo Blade can improve performance and/or add features to existing deployments. These updates take place in the field in as little as 30 milliseconds, resulting in less downtime, less obsolescence of purchased hardware and lower inventory of spare parts.

Flexible platform for independent software vendors (ISVs)

Digital Media in a Box represents a robust platform for the software most commonly used in pre- and post-production. Tarari and its

partners have already successfully demonstrated acceleration of a number of applications including Adobe After Effects, Adobe Premiere Pro, Anystream Agility, Canopus ProCoder 2.0, Digital Rapids Stream Encoder, Microsoft Windows Media 9 Series Encoder and Telestream Flip Factory.

Simple network topology

The Digital Media in a Box solution makes high-performance, high-quality VC1 encoding available to multiple teams and projects, whether pre- or post-production.

Performance

The IBM-Tarari Digital Media in a Box Solution does the heavy lifting, keeping the encoding work from bogging down other applications.

Applies dedicated hardware to compute-intensive processes

Since the Turbo Blade is designed to execute key video encoding functions such as motion estimation, encoding is much faster than on general-purpose CPUs. Depending on the content to be encoded and the software settings, a Turbo Blade can deliver the performance of two to ten servers. The Turbo Blade also frees the BladeCenter and the IntelliStations for other tasks, resulting in increased overall productivity.

Consumes much less power

The IBM BladeCenter offers 20% to 40% savings in power consumption over traditional standalone systems, according to the Gartner Power Usage Report[2]. This not only results in lower costs for raw electricity but also reduces the cooling requirements over traditional 1U servers, while offering higher availability and fault-tolerance. Furthermore, because of the Tarari Encoder Accelerator, Turbo Blades make for even

[2] Electrical Requirements for Blade Servers. Written by Jane Wright (G00120690) released April 24, 2004. Available from Gartner Research.

lower power consumption. Seven Turbo Blades in a BladeCenter chassis would deliver similar encoding performance to 14 -70 normal HS20 blades, yet consume only one-half to one-tenth the power of that configuration.

	1U server	HP BL20p G2	IBM BladeCenter HS20
Max config/rack	84 Xeon DP 3.2Ghz	96 Xeon DP 3.2Ghz	168 Xeon DP 3.2Ghz
Equalized rack fulfillment	36 servers, 72 processors	5 enclosures, 36 servers, 72 processors	3 enclosures, 36 servers, 72 processors
U space required	36U	30U	21U
Power requirement	15,912W	13,891W	**8,872W**
Heat output	54,260 BTU	47,365 BTU	**30,255 BTU**

Encodes multiple streams simultaneously

The IBM-Tarari Digital Media in a Box Solution provides improved efficiency when encoding multiple video streams using a single Turbo Blade. Multiple Turbo Blades in the same BladeCenter increase encoding speed and efficiency even further.

Key Messages

1. Digital Media in a Box consolidates the encoding, processing and network functions at the heart of delivering digital media to consumers.
2. The IBM eServer BladeCenter provides the muscle and infrastructure optimal for pre- and post-processing of standard- and high-definition digital content.
3. The Turbo Blade combines general-purpose Intel Xeon processors with the dedicated Tarari Encoder Accelerator to speed the encoding of digital media into VC1 and Windows Media Video 9 (WMV9) formats for cost-effective delivery and distribution.

4. No special configuration of the Turbo Blade is necessary. The drivers for the Tarari Encoder Accelerator automatically offload and accelerate WMV9 and VC1 encoding tasks.

Summary

The IBM-Tarari Digital Media in a Box architecture provides an excellent solution that can accelerate best-of-breed digital media applications from companies such as Adobe, Canopus, Digital Rapids, Microsoft and others. The resulting Digital Media in a Box integration-tested solution provides an open, industry standard-based hardware model that is cost-effective, highly available, high-performing and scalable, on demand.

This integrated solution delivers high performance at a fraction of the cost of competing approaches. It delivers automated performance and response monitoring, system wide automated rollback, disaster recovery, replication and auditing.

Additional Information

IBM eServer BladeCenter
www.ibm.com/servers/eserver/bladecenter/

BladeCenter HS20
www-1.ibm.com/servers/eserver/bladecenter/blade_servers_overview.html

Tarari, Inc.
www.tarari.com/products-digitalmedia.html

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