VIA VT310-DP

Dual Processing — Mini-ITX

VIA VT310-DP Mini-ITX Mainboard

Redefining the
High Density Server Market

VIA Technologies, Inc.
October 2005

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Introduction

High density servers are one of the fastest growing segments in the server market today.

The ever-increasing demands for processing power in the enterprise coupled with the growing complexity of IT infrastructures as organizations transition to more network-centric computing models are stretching physical space and cost limitations for many enterprises. As a result, organizations are looking to increase the density of processing power yet avoid spiraling costs typical of the traditional high performance server market, as well as keep infrastructure costs to a minimum.

High density servers meet these needs by efficiently utilizing a number of inexpensive interconnected server nodes controlled by intelligent middleware to deliver a variety of services to client computing devices. Compared to other high performance servers, such as mainframes and vector supercomputers, high density server solutions offer similar computational throughput, but significantly reduce the cost of implementation and operation.

For this reason, enterprises are increasingly adopting this type of solution to handle their increased computational requirements. So prevalent is this adoption, that the market expects a compound annual growth rate of more than 25 percent through 2006[1].

The VIA VT310-DP Mini-ITX mainboard is an innovative new platform optimized for high density servers, boasting VIA's signature energy efficiency and small form factor, and with a feature set and efficiencies that enhance the benefits of this server model, particularly in clusters and GRID computing solutions. This paper will discuss why the VIA VT310-DP Mini-ITX mainboard is the ideal solution for the burgeoning high density server market.

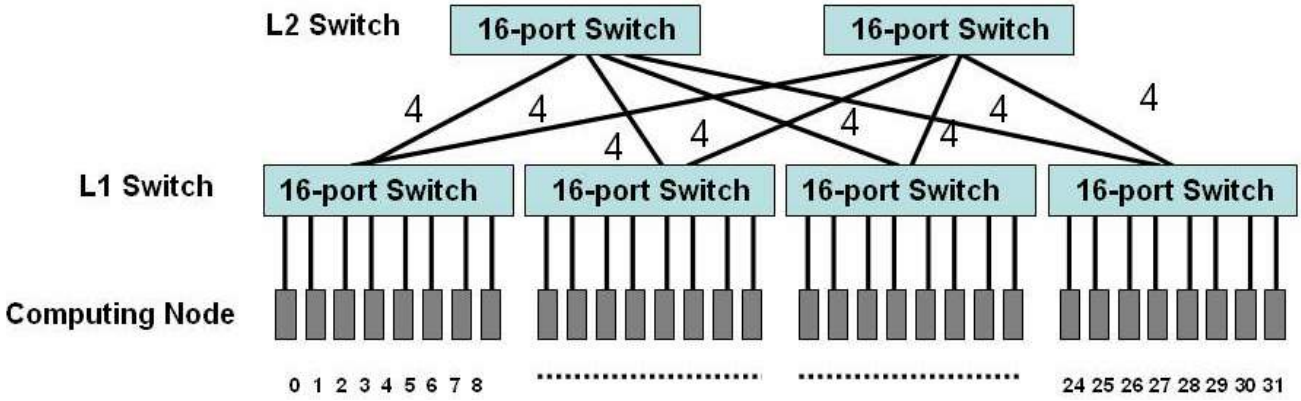
[1] The future of network computing - http://www.sgi.com/pdfs/3767.pdf

I Cluster Solutions

A Cluster is commonly defined as a type of parallel or distributed system, which is a collection of interconnected whole computers that are used as a single computing resource[2]. Clusters use a combination of server nodes, middleware and management software to control, distribute, compute and deliver services to a high number of users in a cost effective and efficient way.

There are three principal types of clusters: High Performance Clusters, High Availability Clusters and Load Balancing Clusters. All implement a similar topology, but use different middleware to perform their functions. Figure 1 illustrates a typical cluster topology:

Figure 1: A Typical Cluster Topology: 32-Node Cluster with 1GBit Ethernet



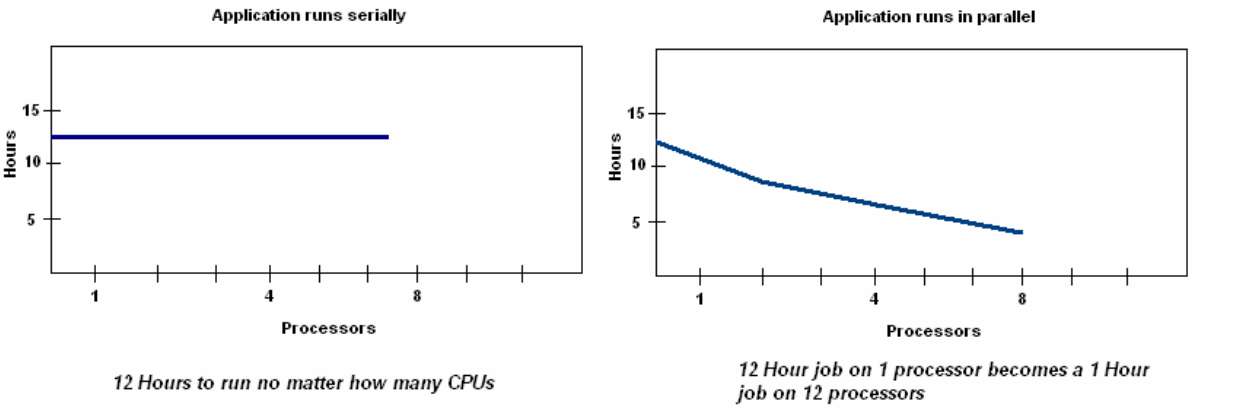
I.a High Performance Clusters

High Performance Clusters are tightly coupled server nodes with middleware and management software that receive and compute a task efficiently on behalf of an end user. They perform the computations necessary to execute the task by dividing the task up and giving the sections to individual server nodes to process. This type of cluster is mainly used in medical, scientific and government research. High Performance Clusters allow these organizations to conduct research more efficiently and at a substantially lower cost than other server solutions.

Parallel computing is the foundation on which High Performance Clusters are based. The parallel computing model works by receiving tasks from users and dividing them into smaller tasks or processes. These processes are then run in parallel to each other, such that the task can be performed more efficiently and in significantly less time.

[2] Force10 Networks, Inc. – Ethernet in High Performance Computing Clusters Page 4.

Figure 2: Time Savings with Parallel Processing



Normally, parallel processes are performed on single or multiple processors in a system. However, High Performance Clusters use the concept of parallel computing to split tasks between individual computers called server nodes. These split tasks are small in size, which allows them to be processed on server nodes that are built with off the shelf components, reducing significantly the cost of implementation. When combined with efficient middleware, these individual nodes can run at close to maximum processor utilization, which makes the overall cluster model incredibly efficient when compared to single computer parallel computing models.

Whilst the concept of High Performance Clusters is to deliver economical and efficient parallel computing, most, however, use server nodes that inefficiently utilize power, physical size and other distributed resources. These inefficiencies increase the cost of operation and maintenance, and often require specially modified physical infrastructures to handle the cooling and space requirements.

The VIA VT310-DP Mini-ITX mainboard has been designed to help solve these inefficiencies. Using dual 1GHz VIA Eden-N processors, the VIA VT310-DP Mini-ITX mainboard further enhances the efficiency of the cluster model by allowing tasks sent to it to run as parallel processes.

The ultra low power consumption of the fanless VIA Eden-N processors minimizes the cooling infrastructure required and considerably lowers the total cost of ownership, both in terms of lower power consumption as well as in-field failures due to heat, while reducing the noise levels generated by the server node.

Developers can also use the VIA VT310-DP Mini-ITX mainboard as a server node to create clusters with smaller physical space requirements. This is made possible through the small form factor of the VIA VT310-DP Mini-ITX mainboard that measures just 17cm x 17cm. In fact, developers can install two VIA VT310-DP Mini-ITX mainboards into a single 1U unit.

I.b High Availability Clusters

High Availability Clusters are another example of cluster servers that, unlike High Performance Clusters, are designed to provide services redundantly to users. This means that its middleware and management software send the same task to a number of server nodes, preventing data loss in the event of a node failure. This is a key requirement of mission critical applications, and for this reason High Availability Clusters are often seen in government and important commercial applications such as traffic management systems, hospital management, and global positioning management systems.

The VIA VT310-DP Mini-ITX mainboard is an ideal solution for most High Availability Clusters. Using the dual processor capability of the VIA VT310-DP Mini-ITX mainboard, data integrity services and system tasks can be handled more efficiently. Small form factor and ultra low power consumption also assist, as they do in High Performance Clusters, to reduce the physical size of cluster housing and cooling infrastructures, and decrease significantly the amount of noise generated by the cluster.

I.c Load Balancing Clusters

Load Balancing Clusters combine the strengths of High Availability and High Performance Clusters to provide redundant parallel computation of services. These clusters are often referred to as server farms and are used in commercial applications such as graphic or video rendering and engineering. In operation, load balancing clusters receive client requests and balance the workload to backend server nodes.

With its dual processor capability the VIA VT310-DP Mini-ITX allows backend software to run on it more efficiently than single processor based nodes. When combined with its distributed performance, small factor and ultra low power consumption, efficient and economical server farms can be created.

I.d Grid Computing

Grid Computing is conceptually similar to cluster solutions; however, instead of using tightly coupled server nodes, Grid Computing utilizes loosely coupled server nodes that share task data through an external communication medium such as the Internet. Specifically the key differences are:

- Clusters are generally localized within a room or building, where Grids maybe dispersed over a local, metropolitan, or wide area network.
- Clusters have a single administration, whereas Grids can potentially span administrative boundaries.
- Grids can distribute workloads among a multitude of machine types and operating systems.
- Clusters are static in nature, with a fixed set of processors and resources. Grids are dynamic in nature with resources that change based on the nature of the availability of resources[3].

[3] Force10 Networks, Inc. – Building Scalable, High Performance Cluster and Grid Networks: The Role of Ethernet Page 4.

Security of information exchanged between loosely coupled server nodes is an important issue in Grid Computing. Information transferred between these distributed server nodes is often of mission-critical or significant commercial value, and for this reason must be protected from attacks by hackers and criminals.

With its inclusion of dual VIA PadLock Security Engines, the VIA VT310-DP Mini-ITX mainboard helps protect data exchanged by allowing server nodes to offset the US Government-standard AES encryption process used to safeguard inter-node communication to the hardware security features. This allows more tasks to be executed more efficiently by each server node when compared to server nodes that rely on the processor to compute the encryption process.

In all these high density server set-ups, the VIA VT310-DP Mini-ITX mainboard offers strategic advantages over traditional implementations in terms of cost, space and power savings. The next section will examine the mainboard in detail.

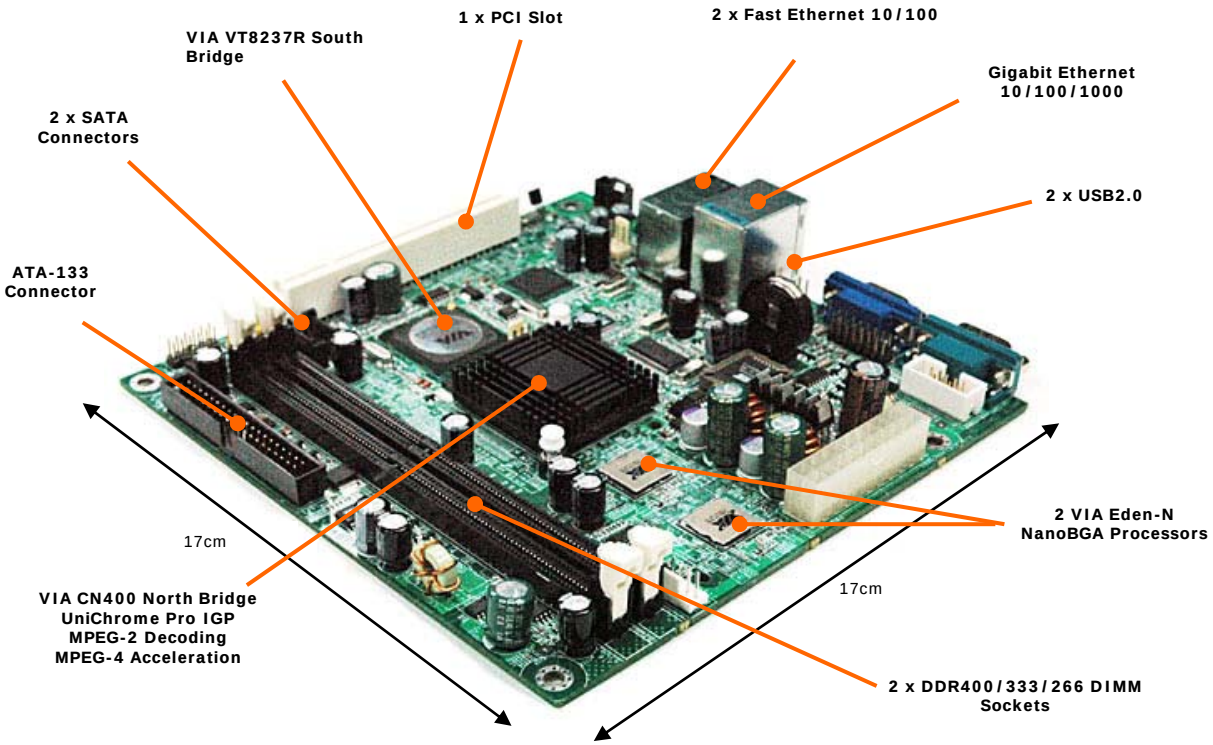
III The VIA VT310-DP Mini-ITX Mainboard

To meet the growing demand for economic, efficient and secure server nodes to power cluster and Grid server solutions, VIA has introduced the VIA VT310-DP Mini-ITX mainboard, the first dual processor Mini-ITX mainboard. The performance per watt leader of its class, the highly integrated VIA VT310-DP Mini-ITX mainboard enables economic and efficient implementation into most cluster and Grid computing scenarios.

The VIA VT310-DP Mini-ITX mainboard is powered by two VIA Eden™-N processors that have been designed for ultra low power consumption and operating temperatures, and features VIA PowerSaver 3.0 technology that dynamically adjusts the voltage and frequency of the processor according to load, enabling considerable power saving. Embedded into each VIA Eden-N processor is the VIA PadLock™ Security Engine that enables real-time encryption/decryption of data using the military-grade AES algorithm, as well as dual quantum based random number generators to provide an unshakable foundation for the encryption process.

The rich feature set of the VIA CN400 North Bridge and VIA 8237R South Bridge core logic chipset provides cluster and Grid computing server solution providers with a wide range of multimedia, connectivity and storage tools that reduce CPU utilization (thereby allowing the solution to handle more tasks faster) and reduce the requirement for peripheral equipment in creating a complete server node solution.

Figure 3: The VIA VT310-DP Mini-ITX mainboard



III.a Low Power Consumption

The energy efficiency of server node platforms that power cluster and Grid server solutions is of key importance in high density solutions for both operational and commercial reasons:

Lower operating costs

Reduced power consumption minimizes the operating costs of the server node and the solution it is powering. The VIA VT310-DP Mini-ITX uses dual VIA Eden-N processors that draw a maximum of just 14 watts.

Lower in-field failure rates

Low power consumption reduces the operating temperature of the processor and of the system. The VIA VT310-DP Mini-ITX mainboard is powered by the world's coolest running x86 processors, which eliminates the requirement for cooling fans to be installed into the server node, which in turn helps reduce in-field failure from overheating issues caused by seized fans and overheated circuits.

Lower cooling costs

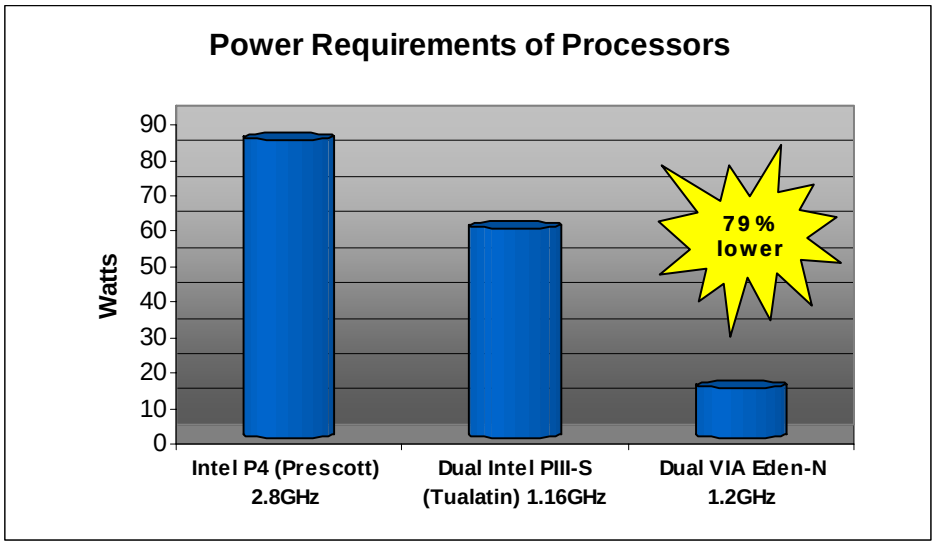
The energy efficiency and highly effective heat dissipation of VIA Eden-N processors generate far less heat than other x86 platforms, which in turn considerably reduces cooling requirements and eliminates the need for highly air-conditioned server facilities, contributing further to the reduction in total cost of ownership.

Longer battery life

Low power consumption combined with integrated power reduction technologies like VIA PowerSaver 3.0 allows VIA VT310-DP Mini-ITX based server nodes to operate longer on battery backup, which is especially important in high availability cluster solutions.

Figure 4 shows the power requirement of processors in the same class as the VIA Eden-N processors on the VIA VT310-DP Mini-ITX mainboard (lower is better).

Figure 4: Total Processor Power Consumption

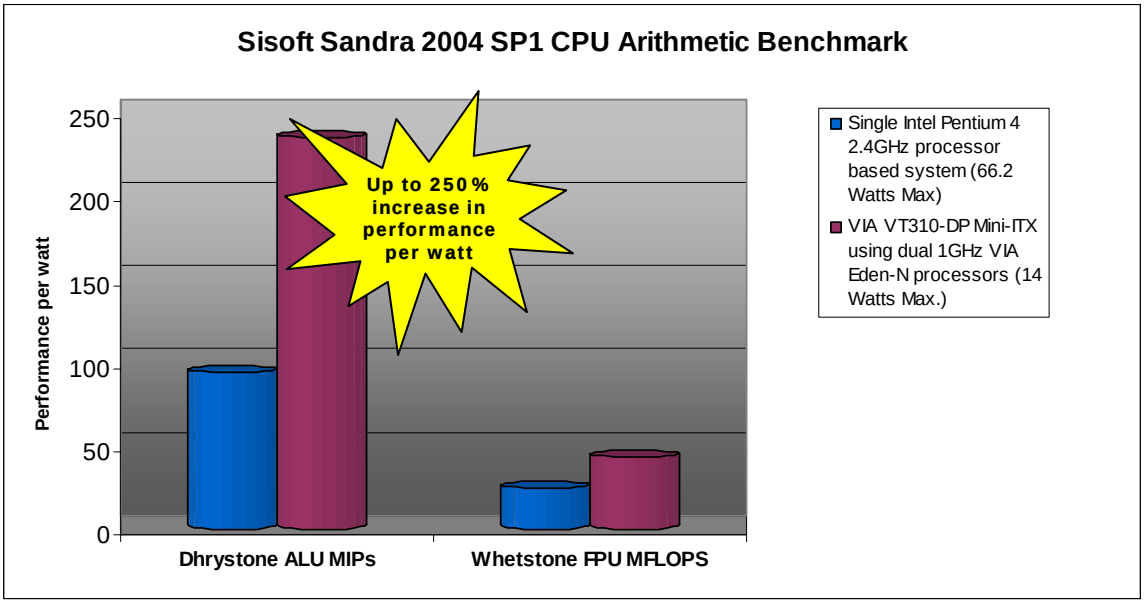


III.b Performance per Watt

With power consumption emerging as the new key deciding factor in the selection of server node technologies, a processor's performance per watt rating gives the best indication as to the computational efficiency of a server solution.

The VIA VT310-DP Mini-ITX mainboard is the performance per watt leader in its class with a total dual processor maximum power requirement of just 14 watts. Figure 5 shows how this increasingly important metric applies in standard benchmark tests.

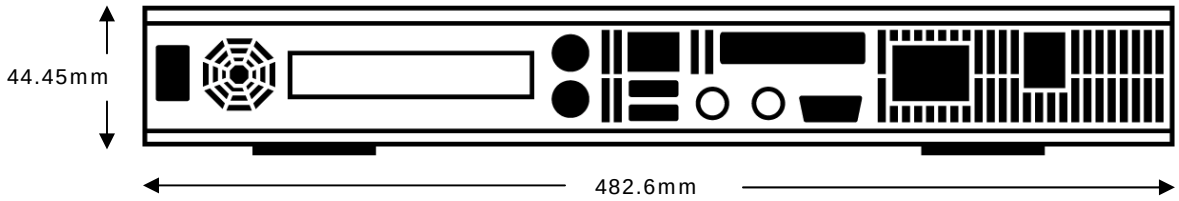
Figure 5: Sisoft Sandra 2004 Benchmark: Performance per Watt



III.c Small Form Factor

The VIA VT310-DP Mini-ITX mainboard has a compact form factor of just 17cm x17cm and features the world's smallest x86 processors (15mm x 15mm) to power its technologies. With such a small form factor, combined with the energy efficiency and effective heat dissipation across the platform, server solution developers can create lower profile 1U rack server unit, with a height of only 44.45mm, as shown in Figure 6.

Figure 6: Dimensions of Low Profile 1U Unit



The ultra compact size of the VIA VT310-DP Mini-ITX mainboard also makes possible the insertion of two hard disk drives into one 1U, as shown in Figure 7 below, enabling high density local storage for applications such as data mining.

Figure 7: 1U Server with Dual VIA VT310-DP Mini-ITX Mainboards and Dual Hard Drives

III.d Comprehensive Feature Set

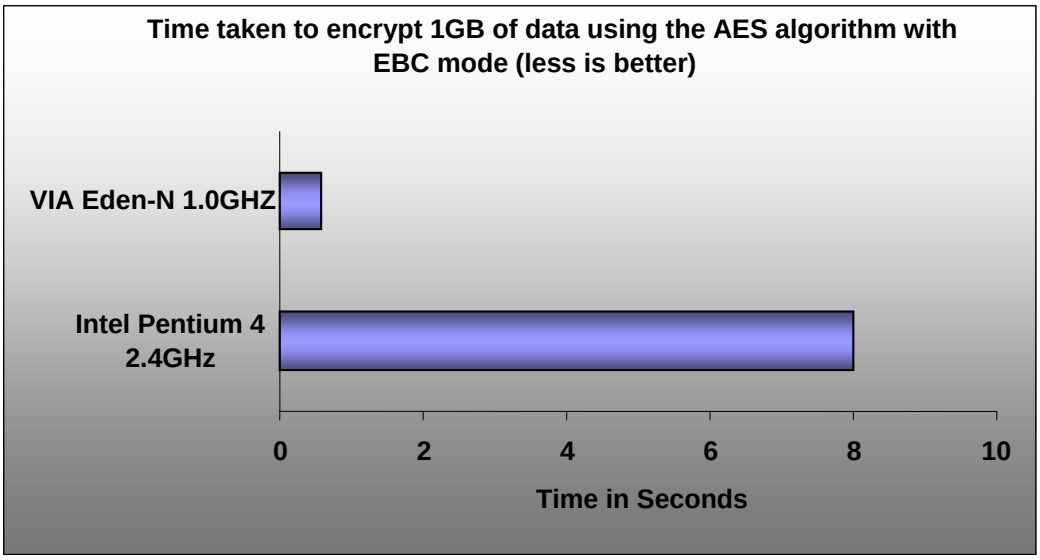
A server node's ability to integrate as much functionality into its design has an impact on a cluster solution's implementation costs, power and physical size requirements. The VIA VT310-DP Mini-ITX mainboard through its integration of the VIA CN400 North Bridge and VIA VT8237R South Bridge includes onboard a comprehensive feature set of digital media, storage and connectivity technologies that allows developers to include RAID technologies for data storage and redundancy, gigabit LAN for high bandwidth Ethernet networking and media accelerators for smooth transmission of video and sound, all without the use of separate controllers. Together, these features help reduce the implementation cost, physical size and overall power consumption of the high density server solution.

III.e Security

Security of data stored and transmitted is a key concern with the proliferation of hacking and identity theft in today's interconnected world. Grid computing which operates by using "loosely" coupled nodes that communicate through the Internet requires more than ever before to be secured from threats. The VIA VT310-DP Mini-ITX mainboard addresses this concern through the inclusion of dual VIA PadLock Security Engines that can protect data stored and transmitted in real-time using military-grade AES encryption. Also included with the security engines are two quantum based random number generators to give an unshakable foundation for encryption.

Figure 8 compares the industry-leading speed of the VIA PadLock Security Engine built into the VIA Eden-N Processor with software encryption processed by a 2.4GHz Intel Pentium 4. At speeds of up to 22GB/s, the VIA PadLock Security Engine can encrypt data in real time.

Figure 8: AES Encryption Speed Comparison: VIA Eden-N vs Intel Pentium 4



III.f Summary of Key Features and Benefits

The VIA VT310-DP Mini-ITX mainboard uses the world's smallest x86 processors with a fanless design, a comprehensive integrated feature set and small form factor to create an efficient, economic and secure server node. The complete set of features is summarized in Table 1:

Table 1: VIA VT310-DP Mini-ITX Mainboard Features and Benefits

Features	Benefits
Ultra compact form factor (17cm x 17cm)	Enables lower profile rack server units and innovative form factor servers
Ultra low power consumption	Maximum power consumption of 14 watts at 1GHz
VIA PadLock Security Engine - World's fastest AES encryption - Quantum-based random number generator	Real-time military-grade AES encryption & decryption of data RNG provides unshakable foundation for the encryption process
SSE Instructions	Enhanced 3D and multimedia performance
S3 Graphics UniChrome Pro IGP: -MPEG-2 decoding - MPEG-4 acceleration	Real-time video decoding for smooth, full-screen video playback with minimal impact on CPU utilization.
Advanced memory controller supports DDR266/333/400 DDR1 DRAM	Industry-standard support of RAM memory technologies
Integrated 10/100/1000 Base-T Ethernet controller	Enables high bandwidth solutions
VIA Vinyl Six-TRAC 6-channel Audio (AC'97)	High quality surround sound reproduction
Native SATA RAID Controller - RAID 0, 0+1, 1, JBOD - VIA V-RAID intuitive controller	High speed data storage and redundancy
VIA PowerSaver 3.0 Technology	Dynamically reduces voltage and frequency for considerable reductions in power consumption

IV Economic, Efficient and Secure Server Implementations

Using the VIA VT310-DP Mini-ITX mainboard as the server node for these servers, developers can produce economic, efficient and secure cluster and Grid server solutions.

IV.a Economical Solution

Implementation

The implementation cost of server nodes based on the VIA VT310-DP Mini-ITX mainboard is substantially lower than other solutions offered by other processor vendors. Moreover, the VIA VT310-DP Mini-ITX comes with an extensive set of on-board features such that the requirement to buy additional hardware to create a server node is minimal.

Operation

The VIA VT310-DP Mini-ITX mainboard's ultra low power consumption driven by the dual VIA Eden-N processors draws in total only 14 watts of power. This affords significant reductions in overall power consumption and thus operating power requirements for Cluster and Grid server solutions based on the VIA VT310-DP Mini-ITX mainboard compared to other solutions, which minimizes the cost of operation considerably.

Ultra low power consumption also allows the VIA VT310-DP Mini-ITX to operate within higher temperature environments, which enables cluster server solutions to be created with reduced requirements for cooling infrastructures.

These strategic power savings are clearly illustrated in Table 2, where despite a CPU density per 1U four times greater than traditional configurations, absolute power consumption of VIA VT310-DP Mini-ITX mainboard based servers is around a quarter of those levels.

Table 2: Diskless Rack Server Power Consumption Comparison: VIA VT310-DP Mainboard vs Intel D865GBF Mainboard (Intel Pentium 4 2.8GHz HT Processor)

Server Configuration		Intel D865GBF Mainboard (Pentium 4 2.8GHz) Single board, 1CPU/1U	VIA VT310-DP Mini-ITX Dual board, 4CPUs/1U
8 x 1U	CPUs/Rack	8	32
	Approx. Power	**1.6kW**	**0.47kW**
16 x 1U	CPUs/Rack	16	64
	Approx. Power	**3.2 kW**	**0.95 kW**
42 x 1U	CPUs/Rack	42	168
	Approx. Power	**8.5kW**	**2.5kW**

Maintenance

Ultra low power consumption eliminates the requirement for the VIA VT310-DP Mini-ITX mainboard to use processor and chipset cooling fans, which has an impact on potential in-field maintenance issues. One of the leading causes of in-field failure is from failure of components due to heat (i.e. through seized cooling fans) and by eliminating the need for cooling fans, cluster solutions based on the VIA VT310-DP Mini-ITX can lower their maintenance requirements.

IV.b Efficient Solution

Performance Per Watt Leader

The VIA VT310-DP Mini-ITX mainboard through the power and efficiency of the VIA Eden-N processor is the performance per watt leader of its class.

Distributed Performance

Included on-die with each VIA Eden-N processor is the VIA PadLock Security Engine that secures data stored and transmitted in real-time using the military-grade AES encryption standard, along with two quantum based random number generators. This allows developers to offset computationally intensive encryption calculations to the VIA PadLock Security Engine with little or no performance degradation.

Included within the VIA CN400 digital media chipset North Bridge is a hardware MPEG-4 and MPEG-2 accelerator, which enables the offset of decoding computations to North Bridge to enable smooth digital video playback with little or no performance degradation from the dual processors.

IV.c Secure Solution

Grid computing, which uses the Internet as the primary medium for communication between middleware and other server nodes, relies on encryption of data to secure the information being transmitted. Using the power of the dual VIA PadLock Security Engines included in the VIA VT310-DP Mini-ITX, Grid computing developers can protect data in real-time, using the military-grade AES encryption algorithms combined with the on-die quantum based random number generators.

Summary

Through the computational and power efficient technologies included in the VIA VT310-DP Mini-ITX mainboard, VIA has created an efficient, economic and secure solution for server nodes in most cluster and Grid computing servers. The combination of the ultra low power dual VIA Eden processors, with dual VIA PadLock Security Engines, onboard gigabit Ethernet and SATA RAID gives developers the right tools to create efficient and economical cluster & Grid computing server solutions. Fanless operation further empowers developers to create solutions with low noise emission and low in-field failure rates. The small form factor of the VIA VT310-DP Mini-ITX mainboard allows better utilization of physical size which has a positive impact on the implementation and operation costs of server solutions. All of which make the VIA VT310-DP Mini-ITX mainboard the server node of choice for cluster and Grid computing server solutions.

Appendix 1: VIA VT310-DP Mini-ITX Based Implementation

Figure 9 shows a 16-node cluster server in 8 x 1U units, each based on dual VIA VT310-DP Mini-ITX mainboards, thus featuring a total of 32 1GHz processors in this compact configuration.

Note the low profile of each 1U unit, with a height of just 44.45mm, made possible by the compact design and fanless operation, thanks to industry-leading physical and thermal properties of the VIA processor, core logic chipset and platform.

Figure 9: 16-Node Cluster in 8 x 1U units Based on the VIA VT310-DP Mainboard

Appendix 2: VIA VT310-DP Mini-ITX Mainboard Block Diagram