

# AMD-760™ Chipset With DDR SDRAM Memory Support

**For the ultimate computing experience on  
AMD Athlon™ Processor-based Systems**

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## **Introduction: AMD-760™ chipset supports the evolutionary DDR SDRAM memory technology**

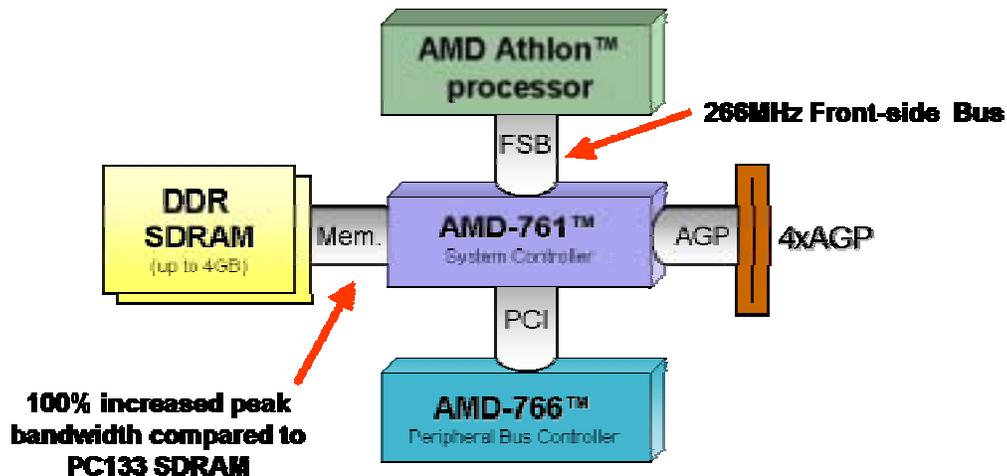
AMD continues to demonstrate its performance leadership with the introduction of the AMD-760™ chipset for AMD Athlon™ processors, supporting the new and high performing memory: Double Data Rate (DDR) Synchronous DRAM (SDRAM), commonly referred to as DDR SDRAM, PC-2100 or PC-1600. DDR SDRAM is a new memory technology that offers peak memory bandwidths up to 2.1GB/sec, enabling next generation computing on platforms ranging from notebook computers to multi-processor servers.

DDR SDRAM is a natural and evolutionary upgrade to the current industry standard memory technology, PC-133 SDRAM, and is supported by JEDEC, a non-profit standards development organization that has been advocating free and open standards for the semiconductor industry for over 40 years. DDR SDRAM is also supported by TeamDDR, a collaborative effort among DRAM manufacturers and suppliers, system developers, processor suppliers, and chipset and motherboard manufacturers to promote this evolutionary new memory technology. TeamDDR also serves the role of accelerating the market adoption of DDR SDRAM while ensuring availability, standardization, and low cost.

This white paper describes the features of the AMD-760™ chipset and its support for DDR SDRAM along with the performance benefits that enable next-generation computing for high performance desktop and workstation computers.

## **Accelerating AMD Athlon Processor Systems: The AMD-760™ Chipset**

The AMD-760™ chipset is a two chip solution, as seen in figure 1, and includes the high-performance AMD-761™ System Controller (a.k.a. Northbridge) and the advanced AMD-766 Peripheral Controller (a.k.a. Southbridge). The AMD-761™ System Controller delivers next-generation platform performance by supporting AMD Athlon processors with either a 200 MHz or 266MHz front side bus, PC-1600/PC-2100 DDR SDRAM, 4xAGP graphics, and a 33MHz PCI bus.



The AMD-761™ System Controller delivers application data to the processor at a scintillating peak rate of 2.1GB/sec's – twice that of competitive platforms – and uses large 64 byte burst transfers – also twice the size of other solutions – which provides for higher sustainable data transfer bandwidth. With such tremendous data transfer bandwidth capability, the AMD-761™ System Controller can now enable emerging applications such as visual internet computing and HDTV video streaming.

The AMD-761™ supports up to 4 Gigabytes of PC-1600/PC-2100 DDR SDRAM, providing computer manufacturers the flexibility and scalability to deliver high-performance systems from mainstream consumer and commercial desktops to high-end workstations and servers. The AMD-761™ System Controller supports Error Correcting Code (ECC) and memory scrubbing which detects and corrects fatal memory errors in systems, thereby providing IT managers with peace-of-mind computing.

The AMD-761™ System Controller supports 4xAGP graphics cards, thus enabling superior graphics performance such as higher resolution 3D images, uninterrupted soft-DVD playback, and better visual Internet computing. Furthermore, 4xAGP provides over 1.06GB/sec of peak graphics data bandwidth - twice that of today's 2xAGP technology. And since the AMD-761™ System Controller supports today's PCI cards, IT managers and system integrators save time and money when upgrading to or building systems based on the AMD Athlon processor and the AMD-760™ chipset, thus providing seamless integration and higher productivity to corporations and customers. Therefore, the AMD-761™ delivers best of class platform performance and reliability for

the corporate desktop, workstation, and server user. The AMD-761™ System Controller is available in a 2.5V, 569-pin PBGA package.

The companion to the AMD-761™ System Controller is the AMD-766 Peripheral Controller. The AMD-766 Peripheral Controller connects to the PCI bus and supports legacy PC features. It includes two high-speed enhanced Ultra-DMA 100 (100MB/sec) IDE controllers, a root USB hub for four USB devices, the new Low Pin Count (LPC) interface, an I/O Advanced Programmable Interrupt Controller (APIC), and includes support for both Advanced Configuration and Power Interface (ACPI) and Advanced Power Management (APM).

The enhanced IDE controllers support all existing Ultra-DMA 33/66 devices such as CD-ROMs, DVD-ROM, and hard drives as well as the newer high-bandwidth Ultra-DMA 100 devices for the latest hard drives. Ultra-DMA 100 devices supply over 100MB/sec – or 33% more than today's devices - of data to the system which significantly decreases the time needed to launch applications, backup large amount of data, download or copy files.

The AMD-766 Peripheral Controller's USB hub allows the user to add up to four USB devices to the system including devices such as cameras, scanners, modems, speakers, keyboard/mouse, joysticks, or portable media backup devices to the system. This capability provides the computer manufacturer with maximum flexibility when configuring a system for a specific market. With advance power management support, the AMD-766™ Peripheral Controller enables the operating system to turn off devices during long periods of inactivity to preserve power consumption and reduce noise.

## **Memory Technologies: Evolving to DDR SDRAM Memory**

Today's PC-133 SDRAM provides a little over 1 Gigabyte per second (GB/sec) of peak memory bandwidth to system components such as the processor, the graphics card, and any high-speed I/O devices (e.g. HDD) attached to the system. While this bandwidth may be sufficient for some of today's applications and users, this limited memory bandwidth will eventually reduce system performance as more sophisticated applications and faster system components become available and contend for memory resources. Furthermore, having a single memory technology such as PC-133 SDRAM,

limits flexibility and scalability for computer manufacturers and system integrators when building systems targeted to a broad array of markets. Put simply, the growing number and popularity of memory intensive applications such as digital video editing, Internet visual computing, broadband video streaming, engineering, animation and architectural design, are pushing the performance limits of the current SDRAM technology.

Combined with the continued advancements in processor frequencies, graphics card technologies (e.g. AGP 4x), faster I/O subsystems and devices; it is easy to understand why today's SDRAM technology will become a system bottleneck.

In a quest to meet the performance requirements of new and emerging high-bandwidth applications and technologies, an industry-wide effort involving JEDEC and industry leaders from over 280 manufacturers and users, helped define a new, but evolutionary, extension to the existing SDRAM memory technology. The mission was simple: create an evolutionary form of memory that would take advantage of existing manufacturing test and equipment processes and would meet the high performance and low power needs of a new generation of speed and memory hungry graphics processors, notebooks, desktops, workstations, and servers. The culmination of this effort is DDR SDRAM or PC-1600/PC-2100, which is in volume production today. DDR SDRAM provides a natural and evolutionary way of integrating the newest level of memory bandwidth into mainstream markets from notebook to multi-processor servers. As seen in Figure 1, PC-1600 provides a peak data bandwidth of 1.6 GB/sec and PC-2100 provides a peak data bandwidth of over 2.1 GB/sec – twice that of today's PC-133 SDRAM.

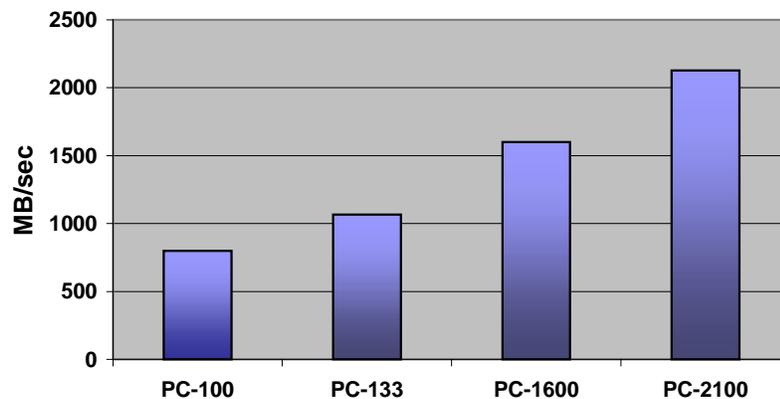


FIGURE 1: Peak data rates by memory type

DDR SDRAM is an evolutionary advancement of today's SDRAM memory technology because it uses the same architecture, package, and physical dimensions, but doubles the peak data bandwidth. Today's SDRAM memory technology can only transfer data once during the data transfer period. The data transfer period for PC-133 SDRAM is 7.5 nanoseconds (a nanosecond is 1/1,000,000,000<sup>th</sup> of a second). This is similar to printing a large document in which the pages are printed on only one side of the paper. Where as with DDR SDRAM, data is transferred twice during the same 7.5 nanosecond data transfer period. Thus, it is similar to printing the same large document, but printing on both sides of each page simultaneously, thus reducing the time to print the document by 50 percent. In other words, DDR SDRAM enables twice the peak data throughput of today's SDRAM at the same clock frequency.

Finally, DDR SDRAM devices operate at lower voltage levels (2.5V for DDR vs. 3.3V for today's SDRAM), and can be used efficiently in low power implementations such notebooks, graphics cards, or network devices. DDR SDRAM uses the same 4-bank, memory architecture and small die-size of standard SDRAM, thus eliminating SDRAM design overhead when replacing SDRAM with DDR SDRAM memory technology. Furthermore, because of this evolutionary approach to advancing SDRAM memory technology, the SDRAM module manufacturers incur no cost in tools, materials, and workflow when replacing today's SDRAM with DDR SDRAM.

## **DDR SDRAM Memory Modules: Ease of Integration**

Because DDR SDRAM is just an evolution to today's SDRAM technology, DDR SDRAM can be placed on the familiar 184-pin DIMM (dual in-line memory module). Thus, computer manufacturers, system integrators, and end-users will benefit by saving time and expense during installation of memory onto the system motherboard. Furthermore, DDR SDRAM memory module manufacturers can broadly supply memory modules because of the enormous similarities in manufacturing to that of existing SDRAM technologies including equipment, packaging, design methodology, and low-cost components.

The motherboard connector used for both SDRAM and DDR SDRAM DIMMs has a straight plug-in design, requiring a low insertion force, and is flanked by robust latch towers for module alignment and dual ejectors for easy module removal. This

connector can be used for desktop, workstation, and server computer designs. For the burgeoning small form factor computers, DDR DIMM manufacturers will be able to use a newer 200-pin Dual Small Outline DIMM (SO-DIMM) low profile connector that measures only 20mm high and only 0.65 mm long. SO-DIMMs offer convenient add-on memory expansion and upgradeability for future memory technologies.

PC-1600/PC-2100 DIMMs are available in several capacities to provide system integrators with the maximum amount of flexibility and scalability for targeting specific markets or users. PC-1600/PC-2100 DIMMs can be of either *registered* or *unbuffered* type. Registered PC-1600/PC-2100 DIMMs offer the greatest capacity per DIMM and the greatest amount of main memory for large memory configurations such as those used on high-end workstations and servers, since these systems typically execute multiple applications and often contain vast amounts of storage devices. Because register DIMMs contain registers (or data buffers) and logic on the memory module, system controllers such as the AMD-761™ System Controller, can access larger amounts of memory. Registered DIMMs are available in capacities ranging from 128MB to 1GB and more per module. The AMD-761™ System Controller can access up to 4GB of registered PC-1600/PC-2100 DIMMs.

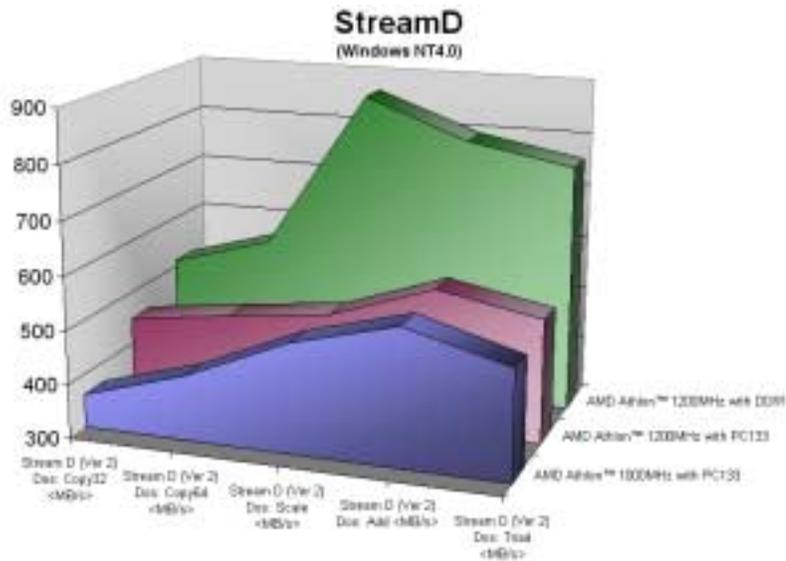
Unbuffered PC-1600/PC-2100 DIMMs offer a low-cost and scalable solution for both notebooks and desktop computers. Unbuffered PC-1600/PC-2100 DIMMs do not contain any buffers or additional logic on the memory modules, thus slightly decreasing the time to transfer data to the system controller and also reducing the cost of each module. Since there are no buffers on the memory module the AMD-761™ System Controller is able to access less memory than with registered PC-1600/PC-2100 DIMMs. The AMD-761™ System Controller can access up to 2GB of unbuffered PC-1600/PC-2100 DIMMs. Unbuffered PC-1600/PC-2100 DIMMs are available in capacities ranging from 64MB to 512MB and more per module.

Both registered and unbuffered DDR SRAM DIMMs have support for Error Correction Code (ECC), which is used by the system controller to notify the operating system of memory errors that are detected and corrected. ECC memory ensures data integrity and system stability for corporate desktop, workstation, and server environments.

## AMD-760 Platform: The Performance Advantage

The AMD-760™ chipset-based platform combines the latest in AMD Athlon processor and DDR SDRAM technologies to deliver the ultimate computing experience. This platform enables compelling system performance improvements for today’s applications ranging from commercial productivity, digital content creation, visual internet computing, CAD/CAE, to transaction-based server applications. Specifically, because these types of applications perform a significantly large number of processor-to-memory transactions, they will directly benefit from the 2.1GB/sec peak data transfer rate on both the processor’s front-side bus and system main memory.

A well-known benchmark that measure sustainable memory bandwidth and acts as a proxy for processor-to-memory transaction performance is StreamD. Figure 2 illustrates sustainable memory bandwidth possible with three systems; a 1000MHz and 1200MHz AMD Athlon™ processor on a widely available PC133 based platform and a 1200MHz AMD Athlon™ processor with a 266MHz FSB on the Gigabyte GA-7DX motherboard using the AMD-761™ System Controller installed with PC2100 DDR SDRAM.



**FIGURE 2: Sustainable memory bandwidth**

It is clearly evident that the system with DDR SDRAM memory technology offers performance improvements across all sub-systems of this benchmark. This translates into

significantly better performance on applications that perform a high number of processor-to-memory transactions compared with today's current memory technology.

The high bandwidth system topology of the AMD-760™ chipset-based platform significantly increases performance of applications such as digital video editing, high-end 3D graphics, digital content creation, CAD/CAE and many others. Listings of system and application specific benchmarks can be found on the AMD Athlon processor web page.

## Summary

Today's computing needs are wide and varied, from mission critical business applications generating billions of dollars, to educational software that can help children learn to read. Many of these applications rely on today's memory standard, SDRAM to deliver their benefits. In response to our customer's requests for a memory technology, which provide higher memory bandwidth and additional system performance at reasonable price premiums, AMD has supported the DDR SDRAM introduction into the marketplace. Its evolutionary technology leverages the current SDRAM environment to deliver increased platform performance and with only incremental price premiums.

The combination of the new AMD Athlon™ processor supporting a 266MHz FSB and DDR SDRAM support using the AMD-760™ chipset, delivers on AMD's promise to provide the ultimate computing experience for business and home customers.

## AMD Overview

AMD (NYSE: AMD) is a global supplier of integrated circuits for the personal and networked computer and communications markets. AMD produces processors, flash memories, and products for communications and networking applications. The world's second-leading supplier of Windows compatible processors, AMD has shipped more than 120 million x86 microprocessors, including more than 90 million Windows compatible CPUs. Founded in 1969 and based in Sunnyvale, California, AMD has sales and marketing offices worldwide and manufacturing facilities in Sunnyvale; Austin, Texas; Dresden, Germany; Bangkok, Thailand; Penang, Malaysia; Singapore; and Aizu-Wakamatsu, Japan. AMD had revenues of \$2.9 billion in 1999.

## Cautionary Statement

This White Paper includes forward-looking statements that are made pursuant to the safe harbor provisions of the Private Securities Litigation Reform Act of 1995. Forward-looking statements are generally preceded by words such as “expects,” “plans,” “believes,” “anticipates,” or “intends.” Investors are cautioned that all forward-looking statements in this white paper involve risks and uncertainties that could cause actual results to differ from current expectations. Forward-looking statements in this white paper about the AMD Athlon processor involve the risk that AMD will not be able to produce the processor in the volume required by customers on a timely basis; that AMD may not be successful in developing an infrastructure to support the processor; that third parties may not provide infrastructure solutions to support the processor; that the processor will not achieve customer and market acceptance; and that software applications will not be optimized for use with the processor. We urge investors to review in detail the risk and uncertainties in the company’s Securities and Exchange Commission filings, including the most recently filed Form-10K.

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## System Configuration Information

OS: Windows NT 4.0, version 4.00.1381, service pack 6a, Direct Draw X version 4.04.1381.276

Memory: 512MB (all systems) SDRAM PC133 CAS 3, PC2100 CAS 2.5

Video Card: Nvidia Quadro2 Pro (Engineering Reference Sample)

Soundcard: Creative Labs Sound Blaster Live, Model Number CT4830

Network Card: Allied Telesyn AT2700TX PCI 10/100

Hard Drive: (2) Seagate Cheetah 18GB Ultra 160 15K RPM HDD Model Number ST318451LW, RAID

Controller Card: AMI MegaRAID series 475 controller (Express500), AMI MegaRAID 40-LD Bios version 3.07, Firmware version H132 (1 x 18GB on RAID 0 with write back cache and adaptive reads, 1 x 18GB on RAID 0 with write back cache and adaptive reads)

Drivers: Videocard: Windows NT version 6.32 drivers (Nvidia Reference Driver), Soundcard: SB Live v2.1.5.0, Network Card: Allied Telesyn Card Assistant Release 1.1 – provided by Allied Telesyn