

High-end graphics conquers embedded computing applications

By Aurelius Wosylus, AMD

When talking about embedded computing we usually don't think about high-end graphics performance. And when talking about high-end graphics we don't think about embedded computing. Nevertheless, more and more embedded designs with high-end graphics for embedded applications are emerging.



■ The trend towards high-end embedded graphics has several reasons: HD-television, computer gaming products that require higher performance and the new PEG interface in combination with the trend towards greater processing performance with multi-core technologies. Moreover, with PCIe on board the internal bus is no longer a bottleneck when it comes to forwarding data from video sources to the CPU and graphics engine. Silicon vendors have also been working on smaller sized, highly integrated and more power-efficient solutions that are ideal for embedded computing applications due to lower thermal cooling requirements. These technical trends in combination with market demands have led to comparatively low-power designs with sophisticated graphics performance that are ideal for many embedded applications. Previously, developers of applications with sophisticated graphics, for example medical and industrial image processing, gaming and entertainment machines, POS/POI terminals, commercial outdoor broadcasting, public facilities and high-end residential gateways have always had a problem with graphics: if they were looking for powerful graphics with long-term availability for their embedded designs they found that such solutions simply did not exist. Standard cards for consumer gaming computers are often discontinued after just a few months, this being the typical lifecycle for standard computer boards

intended for the consumer market. These are just the beginning of the problems associated with using consumer graphics cards and motherboards: OEMs who rely on products from the mass market will face significant expenditure during the products' lifecycles: frequent driver updates, extremely high energy use (sometimes up to 150 watts) and in some cases limited MTBF due to fan failures. Additionally, the physical dimensions of consumer boards and their cooling designs often conflict with the embedded principles of compact dimensions, simplified cooling and standardized form factors. The option of designing proprietary graphics capabilities can be even more problematic since the components used could be discontinued before the finished design goes to market. At the same time, the expense and design risks involved in implementing the latest graphics chipsets are enormous. However, there is now a solution to these problems.

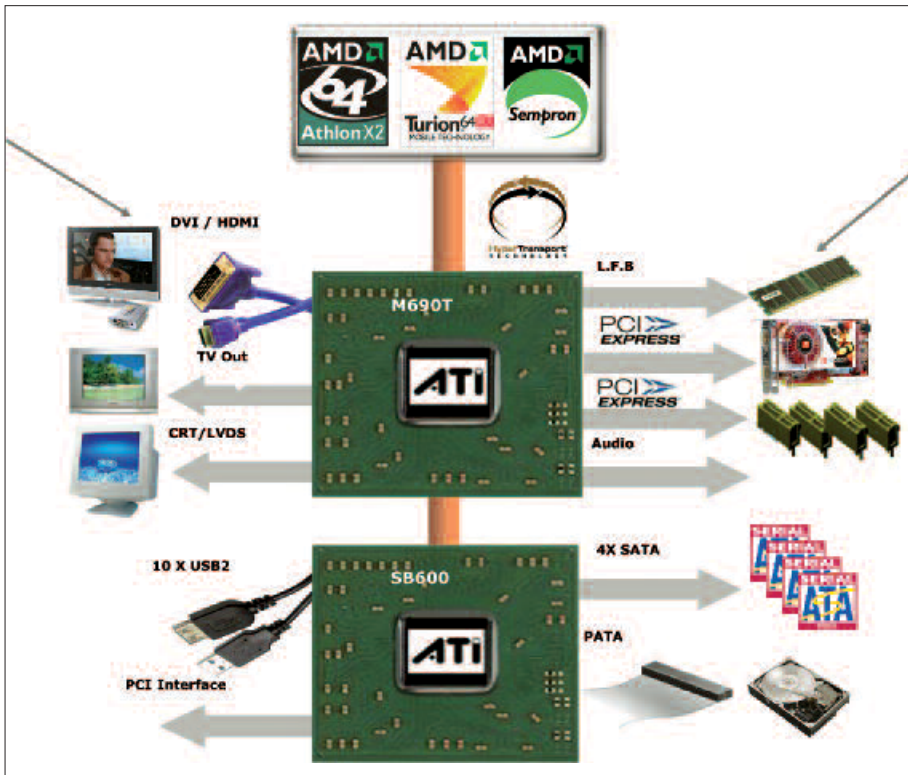
Today, high performance graphics are available on the embedded chipset and various embedded computing vendors support these technologies on their embedded motherboards. AMD processors – available in single, dual, triple and quad core variants - offer multi-core performance for life-like gaming, crystal-clear digital media and serious megatasking. Most impressive is the AMD Phenom quad-core processor to be the most advanced AMD desk-

top PC processor, it has four natively integrated processor cores that break system bandwidth barriers and turbo-charge performance. Enhanced features include AMD CoolCore™ technology, support for a split power plane motherboard design and the ability to set independent core frequencies.

The flexible infrastructure with an AM2+ socket will be compatible with the next generation AMD AM3 processors to deliver key performance gains for a future upgrade. This kind of upgradeability is an attractive proposition for applications since OEMs can change performance by simply changing the processor from quad-core over dual-core to single-core without the need to change the board.

Graphics performance is now an important component for many embedded applications. For medical and industrial imaging 2D and 3D graphics rendering and modeling are crucial. High resolution and colour depth is supported on the M690 with resolutions up to 2048x1536 @ 32bpp.

POS and POI Kiosks, as well as thin clients are demanding more and more sophisticated features- such as multi display support (especially for banking and trading exchanges), multi-media capability for short training films or advertising on terminals and last but not



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least very low power fanless operation. The M690 chipset supports two fully independent display pipelines the outputs of which can be routed via an on-chip crossbar switch to any of the physical display interfaces – CRT, TV, DVI, LVDS – thus making it a powerful solution for multi-monitor displays. The M690 includes an integrated iDCT (inverse Discrete Cosine Transfer) block for assisting with MPEG2 and MPEG4 decode – this provides hardware acceleration for videos or advertising clips which could be run on POS or thin client applications. Finally a solution based on the M690 chipset and a low power embedded Sempron or Athlon CPU can be run as a totally fanless solution. The M690 also helps to save on system costs since it uses UMA (unified memory architecture) – that is the graphics processor shares the main memory of the CPU and so does not need to have it's own local memory.

For hotel hospitality systems, advanced residential gateways and set-top boxes good multimedia support in addition to graphics features mentioned above are key. The M690 has a TV output and includes ATI Avivo technology for producing excellent quality on analog TV display.

The ATI Avivo technology consists of :

- ✓ High quality TV encoder with 10bit DAC
- ✓ gamma and colour correction
- ✓ scaling up and down of the source video for the output resolution
- ✓ de-interlacing to remove “tearing” effects

for fast moving objects
 ✓ Flicker filtering – reduces effects caused by high contrast on adjacent interlaced lines.
 For high definition display support the M690 also includes HDCP support so high definition consumer displays can be supported without any additional components. Versions of the M690 exist with and without TV output. Those with TV output include Macrovision (ver 7.1) for content protected video sources. The two versions are M690T (with TV output) and M690E (no TV out).

The two predominant APIs used today are OpenGL and Microsoft DirectX. The Radeon graphics in the M690 chipset support DirectX 9.0. OpenGL is an open standard which works with different operating systems.

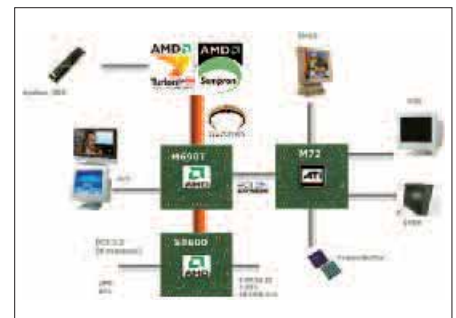
Examples of recent board introductions using this chipset are: a mini-ITX board from Fujitsu Siemens Computers, ETXexpress (a superset of COM Express) and mini ITX boards from Kontron and a COM Express board from Pinnacle Data Systems Inc.

The mini ITX board from Fujitsu-Siemens – the D2703-S - uses the AMD 690 chipset with integrated Radeon graphics and uses the CPU Socket S1 which allows the use of a range of single and dual core embedded processors all with low power profiles – for example the 1GHz Sempron 2100+ with a TDP of 8W which can be used for fanless solutions. The board is de-

signed as a workhorse for multiple industrial applications and is available with long lifetime. DVI-I display connector, LVDS interface, serial port, 4 USB 2.0 ports, dual Gigabit Ethernet, PCIe and standard PCI slots are the main I/O features. For storage there is support for SATA or ATA hard drives, together with a Compact Flash interface.

The Pinnacle Data Systems COMX-S1 COM Express module comes in the basic (Type 2) COM Express form factor (125 x 95mm). Despite the small size of this module it incorporates all the features expected for a modern embedded x86 solution. The COM Express form factor is seeing great acceptance especially for embedded applications where size is critical – examples being for advertising display panels, POI and POS kiosks, medical 3D and 4D ultrasound scanners and hotel infotainment hospitality systems. The PDSi board uses the AMD M690 chipset with integrated Radeon graphics and uses the CPU Socket S1. The I/O functionality for COM Express is routed over expansion connectors to the carrier baseboard, the PDSi board has the following I/O routed – CRT, LVDS and TV-out display signals, Gigabit Ethernet, PCI bus, PCIe x8 and three PCIe x1, SATA and IDE interfaces. PDSi can also provide a carrier board in micro ATX form factor for the COM express module.

Kontron is offering two boards based on the M690 chipset and S1 CPU socket, one is the ETX Express module and the other is a mini ITX board. Kontron also offers extended lifetime for these products. The KT690/mITX is the mini ITX board and incorporates DVI and LVDS display support, Serial ports, 4 USB 2.0 ports, dual Gigabit Ethernet, PCIe and standard PCI slots. For storage there is support for SATA or ATA hard drives. The ETX express 690 is the COM Express form factor module from Kontron. The board has the following I/O routed – CRT, LVDS display signals, Gigabit Ethernet, PCI bus, PCIe x8 and four PCIe x1, SATA and IDE interfaces. While the M690 graphics capabilities are impressive enough, embedded customers can get even more graphics capabilities by making use of the M72 (M72-CSP128) GPU.



Users can get even more graphics capabilities by making use of the M72 (M72-CSP128) GPU.

This device is a stand alone graphics processor which can be added to an M690 based system by connecting it via the PCIe bus. Adding M72 graphics brings the following major enhancements :

- ✓ greatly improved 2D and 3D graphics performance
- ✓ support for Microsoft DirectX 10 API, shader model 4.0 unified shader architecture which means that vertex and pixel shading no longer need dedicated engines – thus making better use of the available silicon.
- ✓ UVD –universal video decode –hardware based decode for high definition video content such as Blu-Ray.
- ✓ Dual high end display support
- ✓ Local frame buffer using DDR2 or GDDR3 memory
- ✓ Sophisticated anti-aliasing techniques – for removing jagged edges in images

An example of a solution based on the M72 is from Kontron with their UGM-M72 module for embedded applications requiring high performance graphics: With the launch of the UGM-M72 and the M72-MXM II embedded graphics cards the new benchmark for high-performance embedded graphics as an addition to the chipset graphics has been set new. The R600 GPU with ATI graphics is currently top of its class for high-end embedded imaging applications. For optimized energy efficiency, the current UGM-M72 and the M72 MXM II - based on the mobile edition of the R600 core - does not push the processor to its desktop limits, but it demonstrates the offer of the latest, future-proof embedded graphics solutions with long-term availability.

The UGM-M72 features the R600 GPU with a variable clock speed of 450 to 700 MHz, depending on the workload. It delivers outstanding visualization and multitasking features beyond integrated chipset graphics, combined with power saving features and long-term availability. It is designed for embedded and rugged mobile applications that call for short time to market.

High-end PEG features of the UGM-M72 and M72-MXM II include support of DirectX 10 and Shader Model to accelerate even the latest high-end 3D graphics for Windows Vista Aero and beyond. Both graphics cards presents spectacular full HD visualization with smooth surfaces, sharp images and stunning color fidelity - the result: truly realistic graphics. Fully hardware-decoded streams, up to full HD 1920x1080p resolution, will be supported by up to 512MB / 128 bit / 500-800 MHz GDDR3. The first available UGM-M72 variants are equipped with 256 MB / 64 bit GDDR3. With not more than 25 watt power dissipation, UGM-M72 is equipped with hardware-managed dynamic power modes and integrated Powerplay 7.0 power management technology. These features offer outstanding performance-per-watt ratios for embedded applications and exceptional battery life for mobile rugged applications.

What's next?

The AMD RS780 family of chipsets with integrated graphics is the latest chipset which has recently been launched in the PC market. This product can be seen as a combination of the M690 chipset with the additional graphics and video decode features of the M72. In addition the RS780 boasts the following new features :

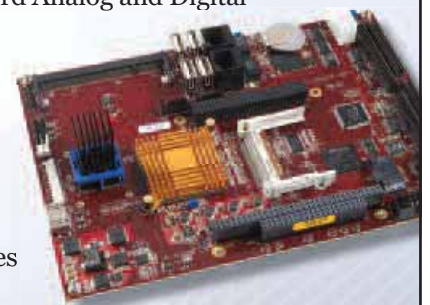
- ✓ High-end DX10 graphics for 2 displays in parallel
- ✓ Full hardware support for high definition video decode, including Blu-Ray decode
- ✓ HyperTransport 3.0 support for significant data throughput increase between CPU and chipset
- ✓ Support for PCIe 2.0 which again gives significant improvements in throughput
- ✓ First integrated chipset with support for the new Display Port interface standard on chip.

Every computing store offers motherboards at attractive prices but the configurations they offer are only short-term available. They are designed for consumer and office PCs that do not rely on identical configurations. On the other hand there are embedded motherboards that are available in the same configuration for periods of five years or more. Innovative OEMs who constantly integrate the latest performance features into solutions that require highest graphic performance such as 4D ultrasound devices and professional gaming applications will see a new performance level to grow in. These high-end graphic boards are also ideal for the latest generation of POS and POI applications with high innovation rates such as automatic check-in systems at airports, railway stations and bus stations as well as toll collection terminals, automatic cash machines and other kiosk applications. Due to economies of scale, these motherboards offer a cost-effective solution for such applications. The first examples were displayed at Embedded World 2008.

Stream processing utilizes the Graphics Processor Unit as a non graphics processor hence the name GPGPU – General Purpose Graphics Processing Unit. The GPU is ideal for data processing which requires parallel or repetitive processing of data – in contrast the main CPU which processes data in a sequential manner. Typical applications which benefit from stream computing are those with a high level of parallelism, perform a large number of arithmetic operations on small amounts of data or use iterative procedures – which is similar to the mode of operation of modern DSPs. Such applications include image processing, handwriting recognition, facial recognition and other scientific applications. For such operations the GPU can offer 100's of GFLOPs of performance. In order to ease the development of such applications an API is being developed called Compute-Abstraction-Layer (CAL). ■

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