Designing electronic slot machine systems with optimal performance, power consumption and reliability – it all starts with the processing platform.
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Electronic slot machines provide an important revenue stream for most gambling facilities, offering a unique combination of entertainment and wagering enticement that appeals to the masses. Even as slot machine payouts have risen through the years, the sheer volume of play typically yields a majority contribution to the bottom line of any casino. Yet despite the importance of these machines to the revenue stream, many gaming operators don’t put adequate thought into the embedded hardware that goes into these systems, or the associated ramifications for their business. The truth is that what’s under the hood of these machines matters quite a bit, sometimes in ways one wouldn’t expect.

The first thing that any successful electronic slot machine must deliver on is entertainment. The game’s content will be the most important factor in a machine’s ability to stimulate players. However, while enjoyable gameplay is important to keep players engaged longer, eye-catching graphics are what draw players to a machine in the first place. Today’s consumers are surrounded by high-definition multimedia in their daily lives and expect no less from their casino gaming experiences. High-end electronic slot machines therefore need high-performance components to power today’s immersive, 3D graphics-intensive games.

The system’s graphics processing unit (GPU) is the engine that makes this possible. Every gaming system with a display has some kind of GPU embedded within. Machines with low to moderately complex graphics may use integrated graphics units, where the GPU is combined with the central processing unit (CPU) on a single processor. Higher-end machines will typically use a “discrete” GPU, where the GPU is a separate processor on its own, driving greater overall system performance. GPUs and complementary, high-performance display technologies are key to maintaining the visual edge that distinguishes successful electronic slot machines. It is estimated that these machines will account for more than 2.5 million GPUs shipped in 2014.

Designing for high reliability

The second critical feature of an electronic slot machine is reliability. Any casino operator can tell you that a down machine equals lost revenue. Floor space is precious, and an operator can’t afford to leave any corner of it sitting idle. Common points of failure for gaming machines (and many other types of computer equipment) are mechanical devices like hard drives that store game data, and fans that keep electronic components like CPUs and GPUs cool. By nature, mechanical devices include moving parts that eventually wear out. Leading equipment manufacturers have helped solve these problems by replacing rotating hard drives with solid-state media built from memory chips. They also utilize larger, high-reliability fans with long life spans to help avoid failures, though additional care must be taken to thwart the ever-present dust and debris which can quickly clog intake filters, fans and cooling components. Choosing an equipment vendor involves understanding their design choices and how these choices affect system reliability.

As obvious as the reliability concern may seem, some equipment vendors continue to try to trim costs by using off-the-shelf hardware designed for personal computers (PCs). This practice is more common with GPU-based PC graphics cards than any other component type. The problem is that PCs typically have a very different set of reliability requirements than embedded applications like electronic slot machines. PC technology turns over quickly, and the average PC is designed to last for about three to four years. Also, it is generally assumed that...
the average PC is only operating for some small percentage of the day, sometimes only six to eight hours. Doing the math you can see how operating such a device in a casino gaming system 24 hours a day, seven days a week would quickly consume its intended life cycle.

Fans are a particular weakness of PC graphics cards, which most often use very small, high-speed fans because they must cool the GPU within a relatively confined space. Their high speed increases noise and accelerates mechanical wear while their small size allows them to clog more easily. The cost-sensitive nature of the PC market also puts pressure on manufacturers to use lower-cost components, particularly capacitors, which can further reduce reliability. When considering the lost revenue of a downed slot machine on a casino floor and the cost of the impending service call, the total cost of one failure can far outweigh any savings achieved with low-cost graphics cards.

High performance at low power

GPU vendors like AMD have addressed many of these problems by offering specialized products specifically for embedded markets like digital gaming. AMD has leveraged its 28-year history of GPU design for PCs and console gaming devices to create embedded GPUs that are especially well-suited for electronic gaming machines. By digging into their technical characteristics, one can start to understand their value. The first big difference is power consumption. Embedded discrete GPUs tend to fall into the 25-35 watt power range, while mainstream graphics cards for desktop PCs are typically in the 30-75 watt range. Since power consumed by electronic devices is converted to heat, operating at lower power levels has several benefits. Fans can either be eliminated altogether or run at low speeds to improve reliability and reduce noise.

With reduced air-flow requirements inside the cabinet, equipment is less likely to become clogged with dust and debris. Lower power consumption also means less electricity is consumed, and there is less heat to remove from the gaming floor via air conditioning. Each of these benefits adds to the cumulative cost savings over the life of the system. They may seem small individually, but savings may be multiplied by hundreds of units in a large-scale deployment.

Integration is important

Another significant benefit of AMD embedded GPUs is higher levels of integration. To understand how this is relevant, one must consider how the circuit boards that house GPUs are designed. A typical discrete GPU is packaged as a single device that is soldered to a printed circuit board. GPUs require ample memory to do their work, so four to eight additional memory chips are soldered to the circuit board as well. GPU memory interfaces are comprised of over 150 signals, and routing them all between the GPU and memory chips can take a lot of board space.

To help conserve space on the board, AMD created multichip modules (MCMs) that contain the GPU and memory chips on the same device package. The required circuit board space to implement the MCM is nearly half that of traditional GPUs. This higher level of integration simplifies designing a system with a discrete GPU. The smaller footprint makes it easier to integrate the GPU onto the mainboard with the

![AMD embedded GPU multichip modules integrate graphics memory chips on the package to simplify design and reduce space.](image)
system’s CPU and eliminate the separate graphics card altogether. Many gaming hardware providers utilize AMD’s embedded GPUs in exactly this way. They benefit by providing smaller form factors that are easier to design, install and service.

Built to last

The fact that PC hardware evolves quickly adds another detrimental attribute to consumer graphics cards. Typical production life is only about 18 months, meaning hardware vendors may have to qualify replacements multiple times over the life of a gaming machine design. Even casino operators may feel the pinch if existing units need replacement or if they need to order more a year down the road. Cases where hardware changes require recertification of the product represent large cost implications to the hardware vendor, which are indirectly passed on to operators. Providers like AMD offer embedded GPUs with longevity commitments of up to 10 years. They understand that continued availability of product is critical for embedded systems within electronic slot machines. This commitment helps ensure a stable supply to meet current and future product demand and reduce long-term costs.

Gaming hardware vendors and purchasers must understand the implications of the hardware that is implemented in their gaming machines. After all, this equipment represents a significant investment in their business that can directly impact overall revenue. Cutting corners is a gamble unworthy of the risk.

About the author

Ben Boehman is a senior member of technical staff in AMD’s Embedded Solutions Group and is responsible for technical marketing in the digital gaming hardware segment. Mr. Boehman holds a B.S. in Electrical Engineering Technology from Purdue University and has more than 12 years of experience in embedded computer system design.

About AMD

AMD (NYSE: AMD) designs and integrates technology that powers millions of intelligent devices, including personal computers, tablets, game consoles and cloud servers that define the new era of surround computing. AMD solutions enable people everywhere to realize the full potential of their favorite devices and applications to push the boundaries of what is possible.