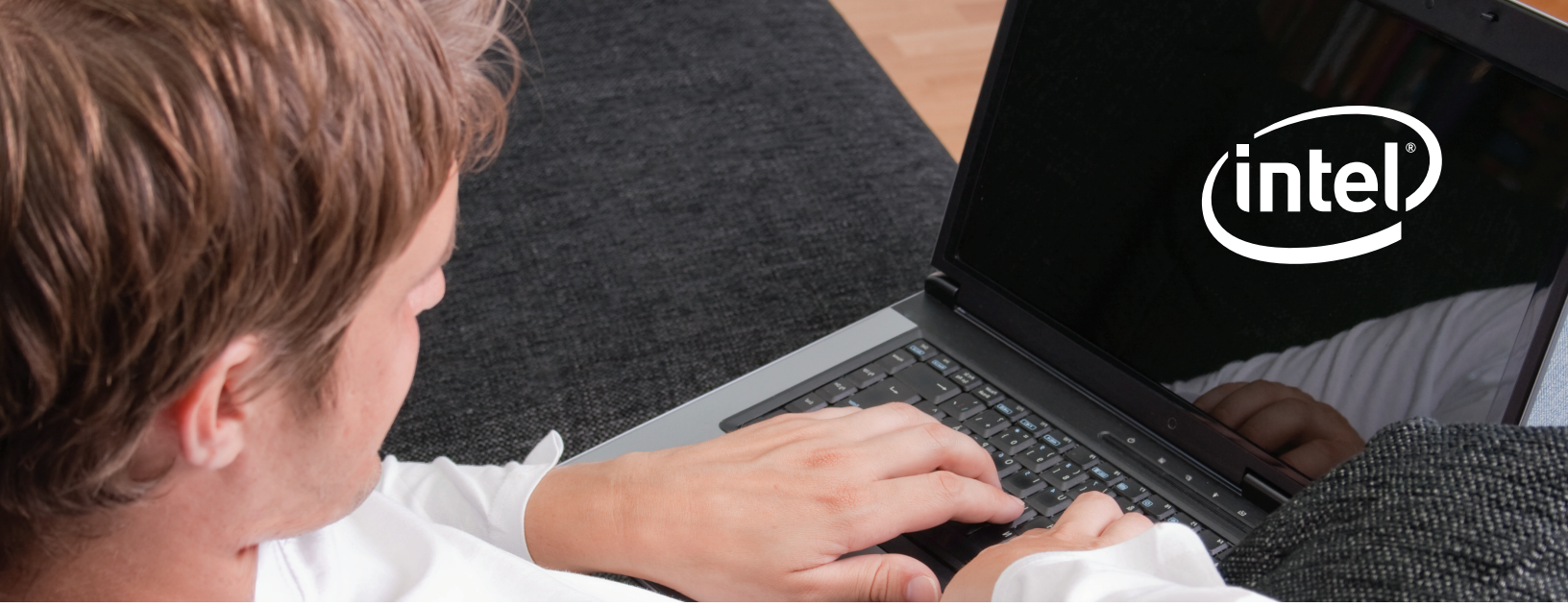


Solution Brief

Intel® Media Sofware Development Kit 3.0

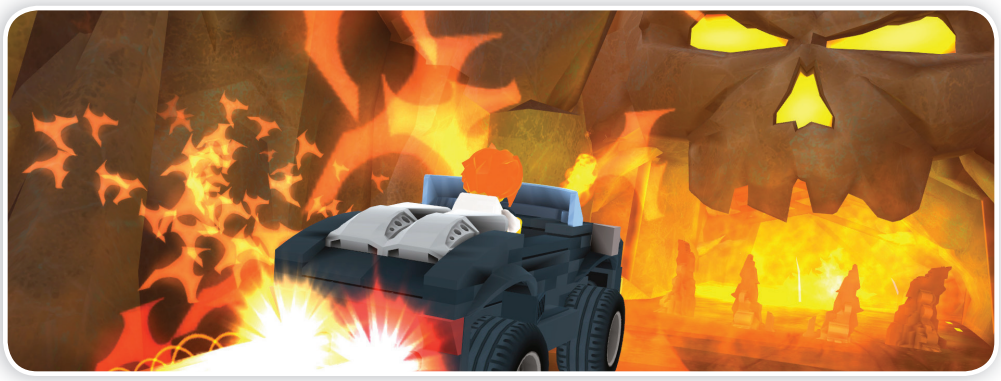
Intel® Graphics Performance Analyzers Version 3.0:

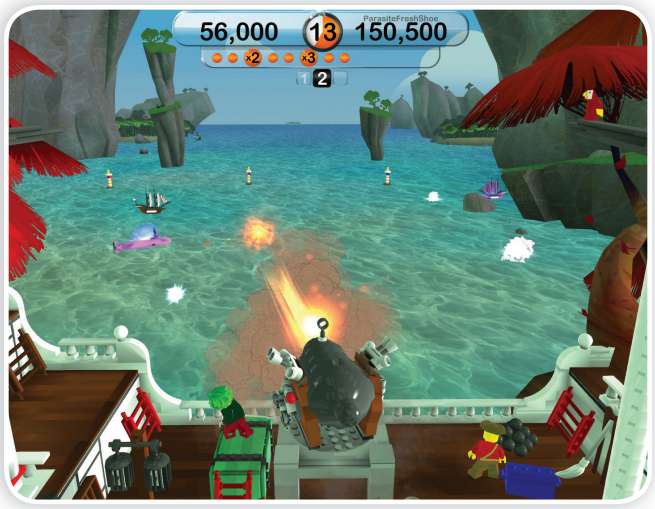
The Optimization and Collaboration Tool Set for Game Development Teams

Never before has the bar been set as high for graphics app developers as it has been today. Consumers expect ever-evolving graphics, ultra-fast responsiveness, and regular title release cycles to keep their favorite content experiences fresh and new. At the same time, developers must address a constantly increasing number of gameplay platforms. The result: serious pressure on production timelines. Facing these sorts of challenges, how can game publishers efficiently and rigorously validate the quality and performance of their content across numerous platforms *before* release? Developers at NetDevil, Gazillion Entertainment, and LEGO Corporation got ahead of this problem in their work on the recently released title *LEGO* Universe* by arming themselves with version 3.0 of the Intel® Graphics Performance Analyzers (Intel® GPA).

"With each version of [Intel®] GPA, the ease of use has improved, and that is fantastic."

— Lynn Taylor
Compatibility Lead,
Gazillion Entertainment



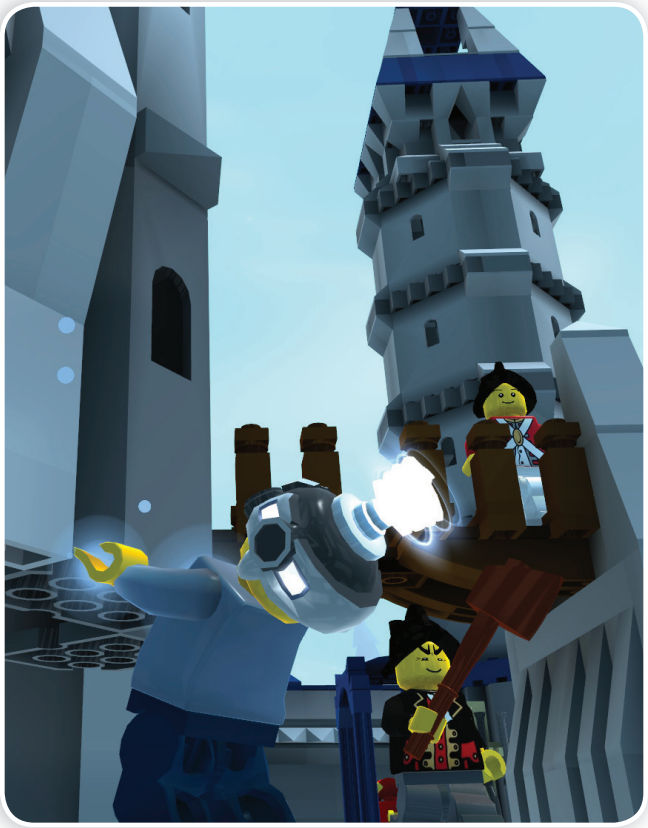


Intel GPA is a suite of development tools that offers comprehensive performance-analysis capabilities. Engineers can dynamically focus on specific sections of code and see precise statistics for the percentages of time a GPU is active, busy, or stalled, along with statistics for overall CPU and GPU utilization. Intel GPA exposes information about shader behavior, allowing for in-tool editing of HSL and assembly code without the need to re-compile the game. It also provides context through exposing the number of vertex shader threads and geometry shader threads executed. Intel GPA is useful in reporting the exact causes of GPU backend stalls, including percentages of total stall time allocated according to each stall circumstance.

One huge bonus of Intel GPA v3.0 is its support for 64-bit game analysis, which allows early, incremental performance testing for games that don't fit in a 32-bit address space. This is often the case in the initial stages of development when it isn't practical to remove debug code, symbol tables, and other memory-intensive assets. Another sophisticated capability of Intel GPA v3.0 can be found in its game-engine performance-analysis infrastructure. Intel GPA provides developers an API that allows instrumentation of game engines with TRACE code. Developers can monitor a game engine compiled with TRACE code using the Intel GPA Platform View tool and can accumulate context-specific performance data, pinpointing bottlenecks and rapidly identifying optimization candidates.

These tools have been a key strategic advantage for NetDevil, based in Louisville, Colorado, and its parent company, game publisher Gazillion Entertainment, in the development of their *LEGO Universe* title. The game is an MMO aimed at 8-to-12-year olds who typically play on mainstream systems, which represent a significant growth segment through the upcoming years. Erik Urdang, NetDevil's chief technical director, talked about the strategic importance of Intel GPA in his development cycle: "The focus at NetDevil is always on trying to achieve as low a min-spec as we possibly can get. Even if we have to trade away a little visual appeal, when we can double the number of kids who have immediate access to our games, that's a big win for us. The tool that we use more than anything else is Intel GPA. We have found a number of big opportunities for optimization as a result of the metrics we get from it. It's just been extremely helpful to us."

"Here are a few concrete examples that come immediately to mind. LEGO Corporation, our collaborator on the *LEGO Universe* game, is very particular about the depiction of their intellectual property. They want the game elements kids construct and the parts of the game environment composed of LEGO to look just like real LEGO Bricks. For us to accomplish this, shaders have to be exactly right. Individual bricks have to look like ABS plastic with the right kind of polish, they must have the little round cylinders on top of the bricks, and so forth. To get them to look right we have to have a pretty high poly model, which includes not just the structure of the top of the brick but also the underside of the brick. At our highest resolution, a single stud on top of a LEGO brick is a dodecagon, with twelve triangles on top and twelve faces, each of which is two triangles. That's a total of 36 triangles for one stud on top of one brick. Drawing bricks can be pretty expensive! We have some algorithms that we use to throw away hidden surfaces to get a lower poly model, and thus a better frame rate; we have all sorts of shader tricks, and we do ambient occlusion to get nicer shaded models. Even so, we can't have bricks everywhere. It just wouldn't provide a good play experience on min-spec systems."



Urdang described how NetDevil makes choices to create an optimal, visually rich user experience on mainstream hardware, given the demands of rendering a universe comprised largely of LEGO bricks. "We pick scenes where we feel there is the potential for performance degradation and run exhaustive [Intel] GPA passes over it. We accumulate a lot of data and can see important trends. Recently one of my engineers used [Intel] GPA to discover that in a certain scene, a smoke effect was consuming 14.2 percent of the scene budget. We disabled a small amount of the smoke and got a jump in FPS of 14 percent. In another analysis, we looked for the top four culprits in a scene that we felt might be underperforming. [Intel] GPA told us that 21.9 percent of our render time was being consumed by drawing some LEGO brick wall sections and by the way we were handling terrain. [Intel] GPA has just been a huge help for finding things like that quickly. It has allowed us to reduce iteration time dramatically."

Lynn Taylor is Urdang's collaborator at Gazillion Entertainment. Compatibility lead and15-year game industry veteran, Taylor is a virtuosic user of Intel GPA tools. "I've used [Intel] GPA since version 1.0," said Taylor. "Gazillion has three studios working independently on game titles, NetDevil currently being the most active of these. We have projects under development that run on the Unreal Engine*, the Unity Engine,* and one that is entirely Flash*-based. It really varies how I use Intel GPA, based on the project. I run it on all applications and across a virtually unbounded range of platforms, from latest and greatest to oldest and slowest."

"Compatibility testing a game across this spectrum of platforms demands patience and a lot of troubleshooting. Remember that at the low end of our audience, we can't actually run [Intel] GPA on their same systems. However, we are able to use [Intel] GPA to proxy those systems. We rigorously examine performance on more powerful computers, where slight drops in performance can predict big bottlenecks for typical *LEGO Universe* kids' hardware."

Taylor has accumulated mountains of [Intel] GPA data, which she organizes in many-tabbed Microsoft Excel* spreadsheets, developing empirical evidence used to improve game design and development workflow by establishing min-spec best practices. "I utilize [Intel] GPA extensively as far as looking at the graphics and layers of art. I create spreadsheets that show frame rates in each area of a game so we can correlate drops in FPS with code design or art layering. [Intel] GPA will decisively say whether a particular aggregation of artwork will play well for our min-spec audience. Then I can work with our artists, saying 'Do we need to do it this way? Can we optimize in this fashion?' For me, working with artists and game developers at our three studios, Intel GPA has been a collaboration and tutoring tool as well as a software engineering support tool. With each version of [Intel] GPA, the ease of use has improved, and that is fantastic."

NetDevil, Gazillion, and LEGO stand to benefit tremendously from the 2nd Generation Intel® Core™ processors. Is Taylor excited about screaming-fast rendering performance on consumer-priced hardware? "Absolutely. Those things are the future of our products" said Taylor, who participates in the early experience program for the 2nd Generation Intel Core processor technology. "I make sure that I always have the latest and greatest hardware in my lab. Long ago, I worked on a game released just before the advanced [Intel] Pentium processor started shipping in consumer systems. When that hardware came out, you couldn't play the game on it, because it moved too fast! Because of that experience, I make sure I stay ahead of hardware trends."

Probably the wisest course to take where the 2nd Generation Intel Core processor is concerned. With relatively low price points and features such as embedded GPU, shared cache, and improved parallelism, the 2nd Generation Intel Core processor family will endow consumer-targeted systems with graphics capability that was once the exclusive province of high-dollar gaming hardware.

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