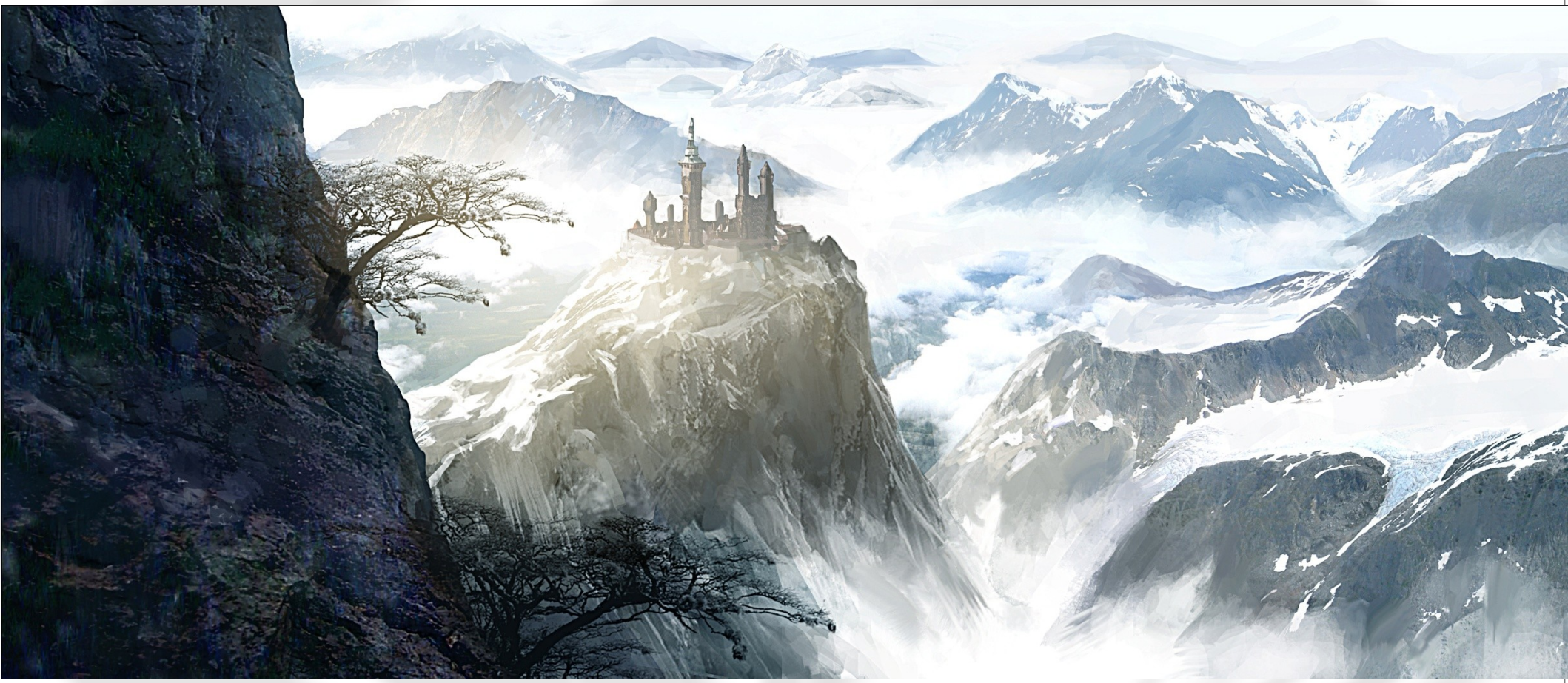


Delivering Demand-Based Worlds with Intel® SSD

GDC 2011

The Who

Intel - no introduction required.

Digital Extremes - In addition to be great developers of AAA games, they are also the authors of the Evolution Engine which we used to build the demo.

Iron Galaxy - Founded in 2008, a spin-off of Midway Chicago. We do a lot of technical outsourcing in addition to “regular” game development (XBLA/PSN). We worked closely with Streamline Studios to deliver this demo.

The What

Previously, Intel has been limited to autopsy-style investigation into SSD performance using already released titles. And while this has been useful...

They needed more meaningful data.

1 Screenshot above taken from http://intelssdgaming.com/main.php

The What: SSD

Intel has been limited in what they could ascertain about SSD performance without being able to get into a game's source code and try different things out.

Q: Why does Game A show vast performance improvements (faster loads, no hitching) when using a SSD while Game B only shows marginal improvement?

A: Who knows!

This project's goal is give Intel the access they require to actual game code, so they can perform deeper, more meaningful experiments on the benefits SSD confers to games.

The What: Sandy Bridge

On the Sandy Bridge side of things...Intel already knows the chipset's capabilities. They wanted us to utilize many of the very high-resolution assets built from a previous project and push the boundaries of Sandy Bridge to show everyone else what it is capable of.

Like the SSD team, they use games already available in the marketplace to demonstrate Sandy Bridge's capabilities, and while this is intuitive it has its limits.

The Why

Intel: Believe this has been covered…

Digital Extremes: Glen Miner (Lead Architect on the Evolution Engine) did some R&D on the benefits of SSD to the development team at DE for the 2010 IDF. DE wanted to use SSD to test the serialization speeds within their engine, as he felt like the engine “sipping through a straw.” (http://www.intel.com/references/pdfs/digitalextremes.pdf)

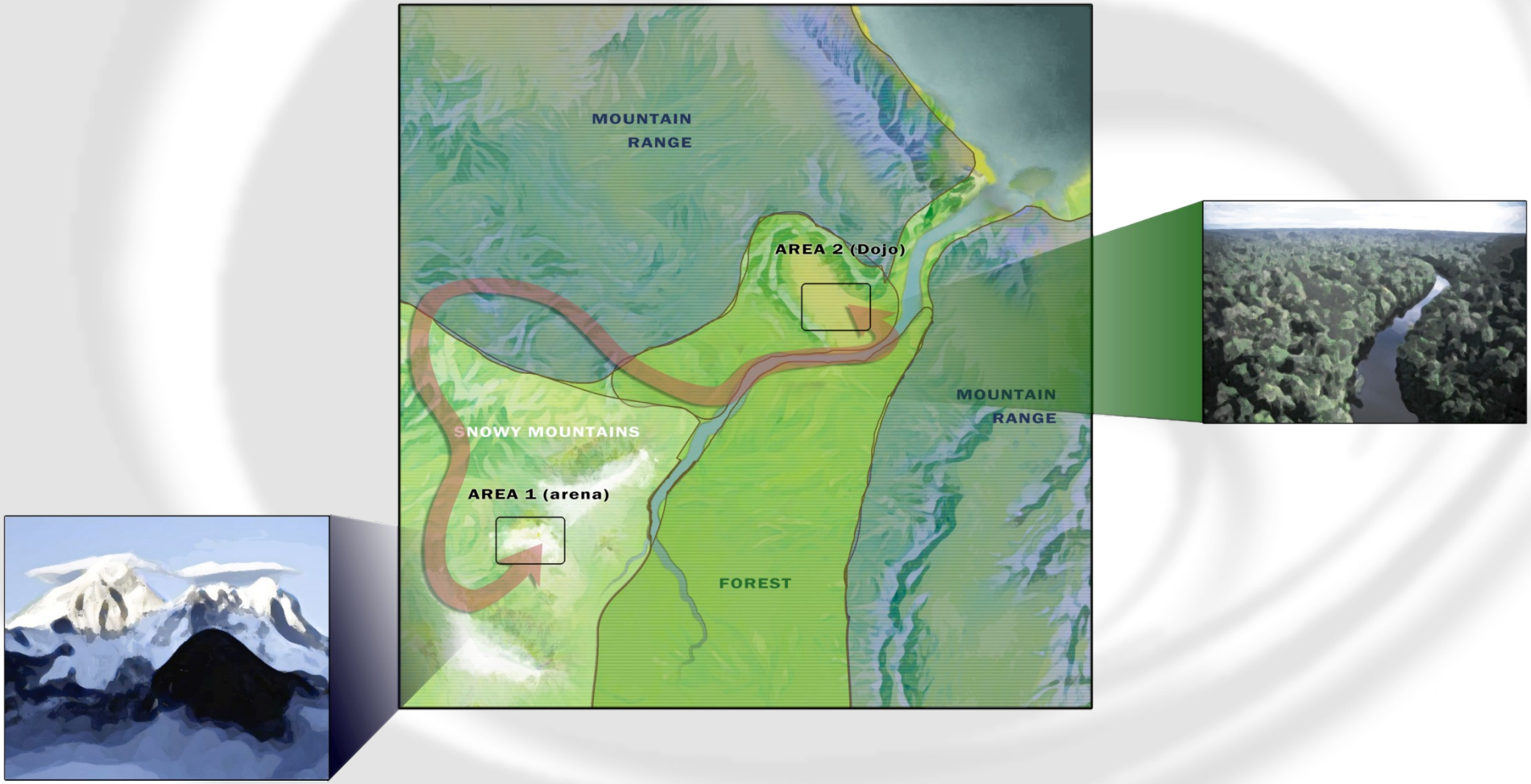
Iron Galaxy: Have been curious for some time about Evolution, and as primarily console developers we wanted to see what the near future of laptops (SSD & Sandy Bridge) meant to that as a platform.

Demo Goals

- Design a demo that maximizes streaming data from the SSD/HDD.
- Game must work with both SSD/HDD.
- Demo must be graphically compelling.

Demo Design

Create a large pseudo open world, featuring distinct looks across different regions of the world. Allow the player to traverse from one end to the other seamlessly. Blend highly detailed, high resolution assets with newly created art to create one complete game world.



Demo Design

We initially believed that streaming textures of the highly varied terrain would be a good demonstration of what SSD was capable of.

More on this later…but turns out streaming these assets off of SSD isn't even a drop in the performance bucket.

Testing Methodology

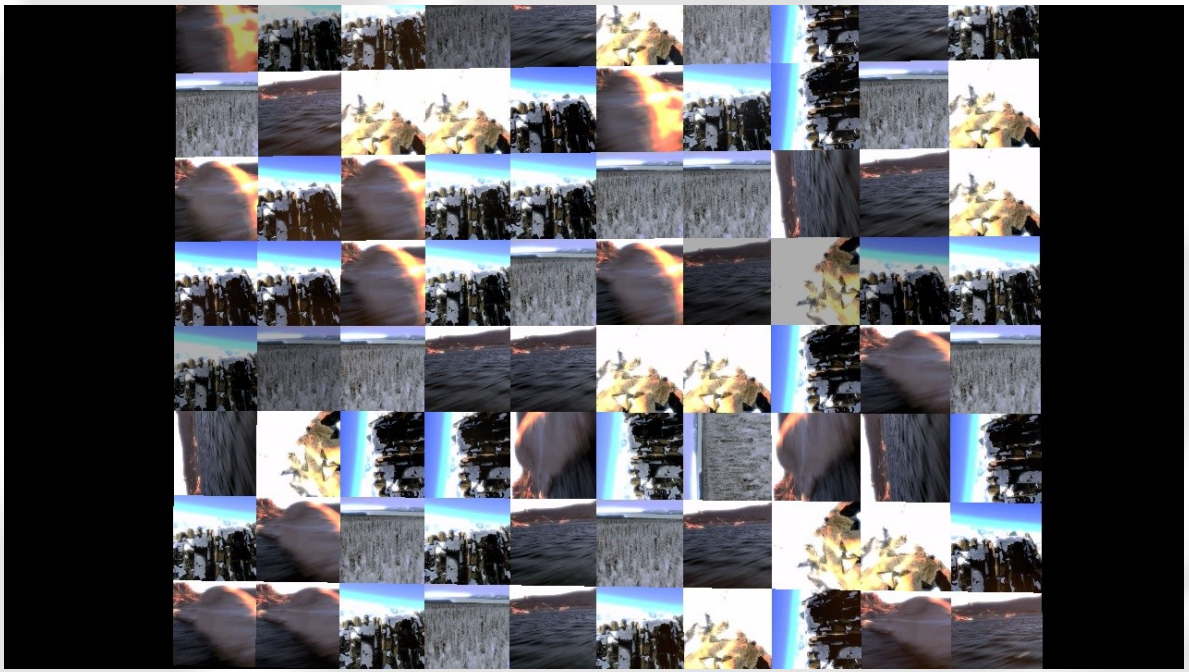
Focus on Texture Streaming and Video Playback.

We focused on creating a demo around the capabilities of the Evolution Engine, as such we concentrated on taking advantage of sub-systems unencumbered with data serialization bottlenecks. This allowed us to throw as much data as possible at these systems.

We can visit other systems (mesh streaming, animation streaming, etc.) in future work.

Demo #1: Tech R&D

While determining what was capable on SSD we did some quick and dirty tech demos to get an idea of what was possible. Think of this as the “control” group.

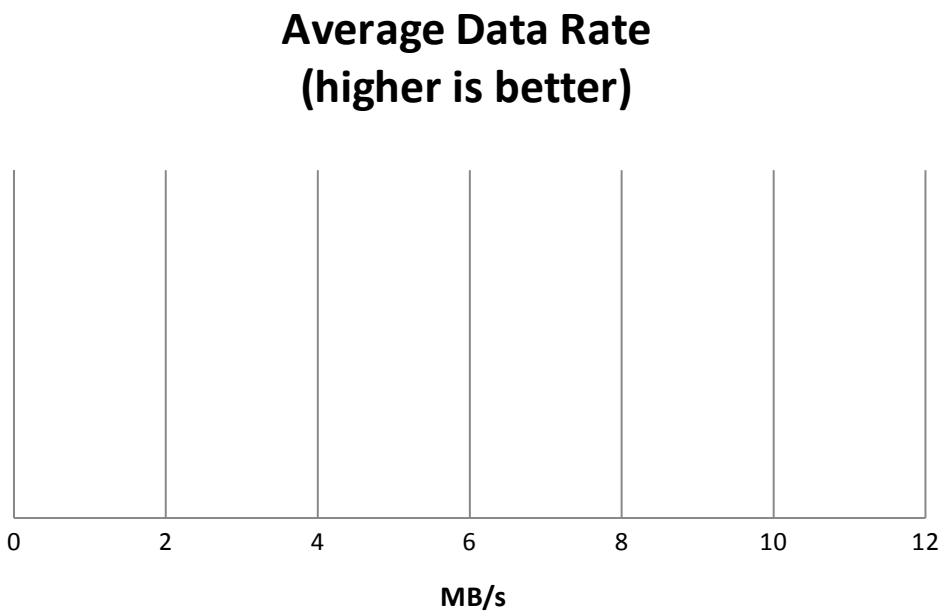


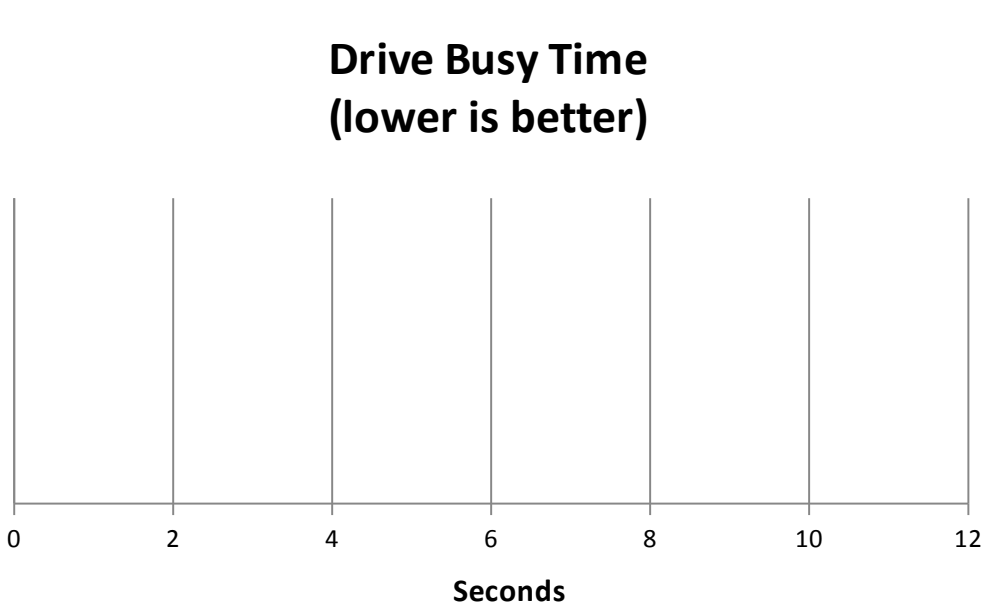
Demo #1 Findings

100 videos: 240 x 240 resolution streaming independently

Bink is rad!

The following stats are taken over an 85 second test:





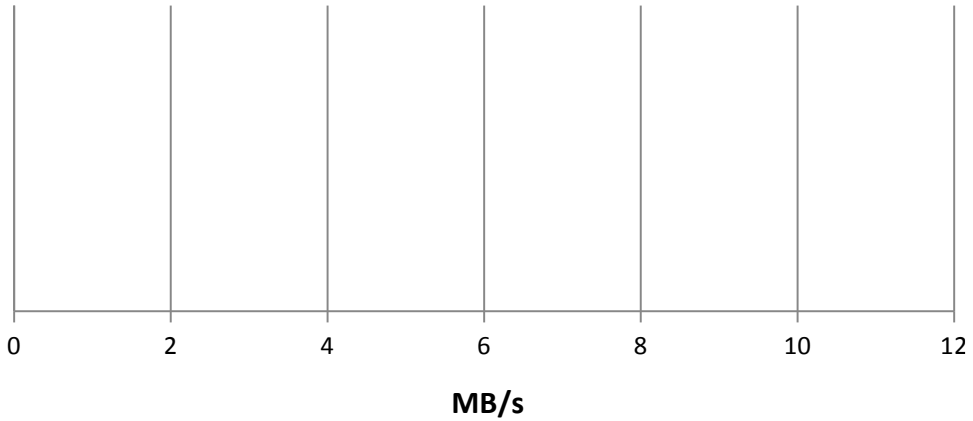
Demo #2: World Streaming

Start off in a Arena environment.
Transition to world fly through.
Start off in snow-covered peaks, end up in arid valleys.
Transition into Dojo environment.

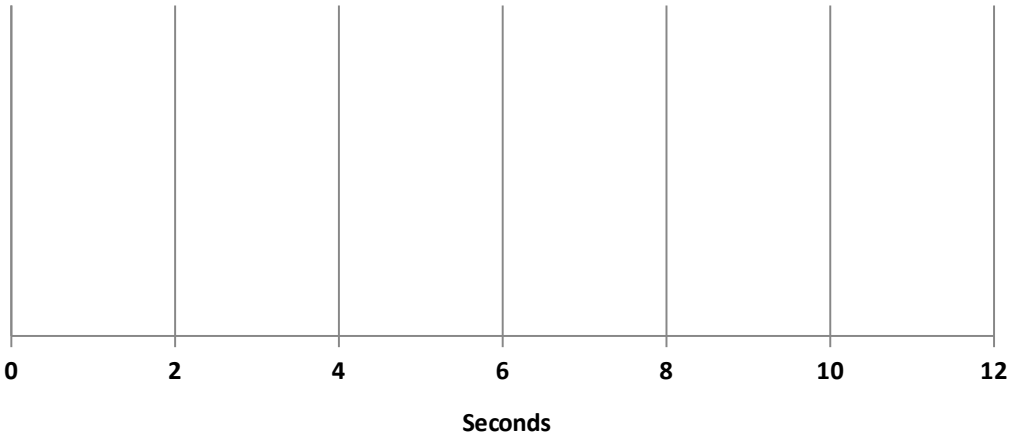
Demo #2 Findings

These stats were taken over a 150 second “playthrough:”

Average Data Rate
(higher is better)



Drive Busy Time
(lower is better)



Demo #2 Findings Continued

Focusing just on the terrain fly through that binds the two static areas together:

The terrain is made of large chunks of static meshes stitched together, and each static mesh is textured with eleven 2048x2048 textures (five color, five normal, and one blend texture).

188.8 MB of textures read from SSD @ 225 MB/s

This means that for the duration of the fly through the SSD was only in use for 0.75s.

This means that streaming textures/mip maps off of SSD is effectively free. No amount of throttling the size of the texture pool had much of an effect on the visual quality on SSD. On HDD mip maps pop into view during the fly through.

Engine Modifications

Had to make some trivial changes to the engine for this phase of the demo:

Did some tweaks to the size of the texture pool.
Integrated a new version Bink and give it more threads.
Had to work around the mandatory loading screen.

Future work will be more interesting from an engineering perspective, as we will need to worry more about built-in serialization bottlenecks associated with more “complicated” data (meshes, animations, physics assets, etc.)

PC Configuration

- Intel® Core™ i7-2600k Processor (8M Cache, 3.40 GHz) with Intel HD Graphics 3000

- 4GB Dual Channel DDR3-1333 (non-ECC, 2 x 2GB)

- Microsoft* Windows 7 Ultimate 64-bit

- Intel® SSD 510 Series (250GB) vs. Western Digital 7200 RPM Scorpio Black HDD (320GB)

One of the best HDDs out there, a separate physical drive from the OS

Pre-release GPA tool extension to measure bandwidth right off the SATA drives.

Why Should You Care About This?

Need to think about SSD & Sandy Bridge as the new “mainstream” PC platform. Will be in every laptop on earth soon.

Advantage in the Marketplace.

Benefits for content creators (iteration time).

Overall benefits to your Engine.

New types of games will be possible because of this.

Call to Action

1. Get your developers SSDs ASAP.
2. Remove bottlenecks in streaming engine
3. Call to API to profile storage performance
4. Double your iterations and try new features!
5. Burn your DX8 reference books.

What's Next?

Further work possible.

Streaming actual geometry JIT (not just LODs).

Re-working texture streaming to minimize memory costs.

Using movies in new and creative (non-novel) ways in your game.

How to Detect when an SSD is Installed?

I/O Performance Tool Usage

Options:

-c Enable file system caching

-q <q depth> Count of simultaneous outstanding I/O

-s <io_size> Size in bytes of each I/O

-n <io_count> Count of I/Os to issue

-f <file_name> File to read/write

-r Randomize I/O

Questions?

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President/CEO Iron Galaxy

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Twitter: JosephJBroni

Quote From Fractiv.Com

“Our previous company, Offset Software, was purchased by Intel in 2008. Our labor of love was Project Offset and the game engine that went with it. As many of our fans already know, Project Offset was cancelled. The graphics hardware it was being designed for did not ship and our game was a casualty of this.

The IP and Engine are property of Intel so its future is out of our hands. We have tried working with Intel to obtain the rights and there are some good people there who have made some effort to help us, but without success.

We would like to thank all those who supported us and the project. We learned some good lessons along the way and met some incredibly talented people who we are fortunate enough to call our friends”

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