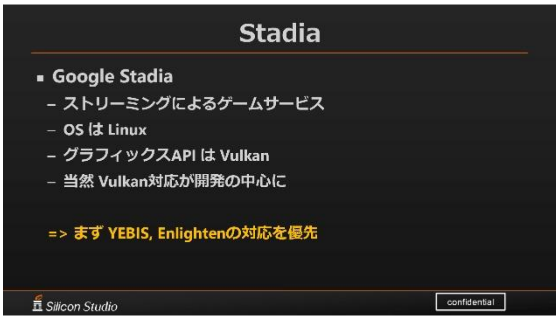
[GTMF 2019] 4K is Soon to be Global Standard - How Middleware to support “Stadia,” a view of Silicon Studio

On July 12, 2019, a free entry event “Game Tools ＆ Middleware Forum 2019 (GTMF)” was held at UDX GALLERY NEXT THEATER in Akihabara, Tokyo, and the event brought together solutions related to development and operation of apps and games. This article reports the summary of the lecture session, “The status of Silicon Studio’s middleware products to support Google Stadia” by Mr. Toshiaki Tsuji, Manager of Middleware Development Dept. at Silicon Studio.

Silicon Studio has been providing a lot of middleware products such as post processing effects middleware “YEBIS,” Global Illumination “Enlighten,” rendering engine “Mizuchi” and game engine “OROCHI.” The main theme of this lecture session was how to support Stadia with such middleware products.

Stadia is Google's new cloud-based gaming platform which is scheduled to be released in

2019 (service schedule in Japan has not been announced). Stadia uses Linux based OS, graphics API to be used for development of games is Vulkan, therefore, Silicon Studio’s top priority to support “Vulkan” was two products, “YEBIS” and “Enlighten” to begin with.



Stadia

- Google Stadia
  - ストリーミングによるゲームサービス
  - OS は Linux
  - グラフィックスAPI は Vulkan
  - 当然 Vulkan対応が開発の中心に

=> まず YEBIS, Enlightenの対応を優先

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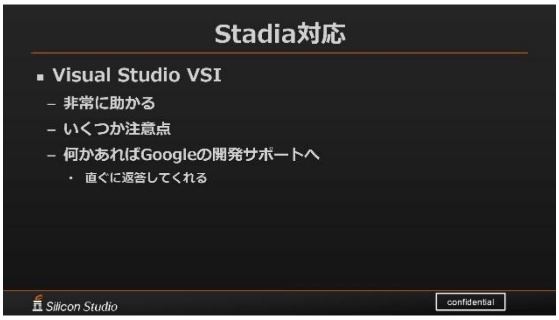

Stadia対応

- Visual Studio VSI
  - 非常に助かる
  - いくつか注意点
  - 何かあればGoogleの開発サポートへ
    - 直ぐに返答してくれる

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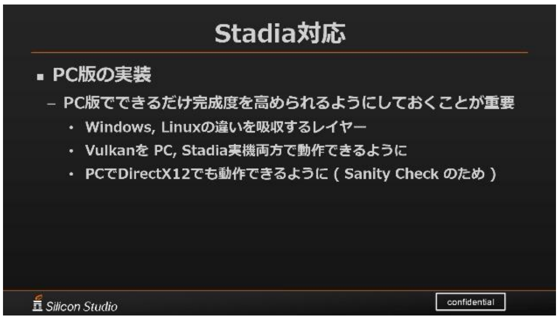
In order to support Stadia, development environment is Visual Studio VSI. Although its usability is very good, the framework is not mature enough and they had some problems, including “Visual Studio VSI was not recognized after being installed” or “debugging was not possible." Every time such problem occurred, they solved the problem through communication with the Stadia development support team.

Mr. Tsuji added, “The Stadia support team was very kind and we believe such problems will be solved in accordance with the progress of SDK in the future.” Introducing his view, he said, “At present, it is preferable to proceed with developments on PCs as much as possible, and when the product is at the final stage of development, complete the work in the development environment of Stadia. To do this, it is necessary to prepare for Vulcan to be operated on both PCs and Stadia environment.”



Stadia対応

- PC版の実装
  - PC版でできるだけ完成度を高められるようにしておくことが重要
    - Windows, Linuxの違いを吸収するレイヤー
    - Vulkanを PC, Stadia実機両方で動作できるように
    - PCでDirectX12でも動作できるように (Sanity Check のため)

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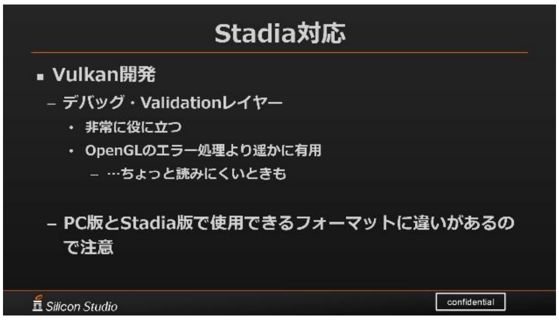

Stadia対応

- Vulkan開発
  - デバッグ・Validationレイヤー
    - 非常に役に立つ
    - OpenGLのエラー処理より遥かに有用
      - …ちょっと読みにくいときも
  - PC版とStadia版で使用できるフォーマットに違いがあるので注意

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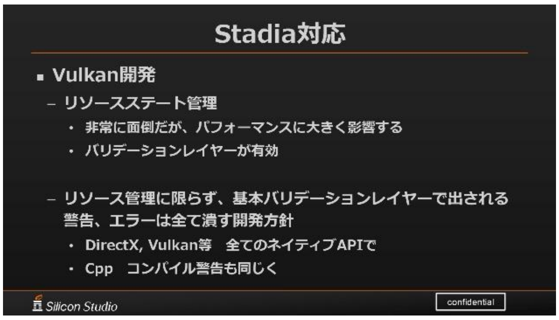

Stadia対応

- Vulkan開発
  - リソースステート管理
    - 非常に面倒だが、パフォーマンスに大きく影響する
    - バリデーションレイヤーが有効
  - リソース管理に限らず、基本バリデーションレイヤーで出される警告、エラーは全て潰す開発方針
    - DirectX, Vulkan等　全てのネイティブAPIで
    - Cpp　コンパイル警告も同じく

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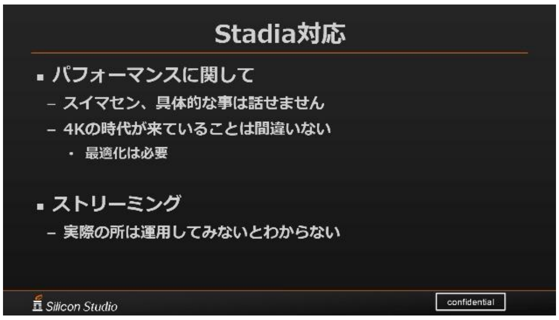

Stadia対応

- パフォーマンスに関して
  - スイマセン、具体的な事は話せません
  - 4Kの時代が来ていることは間違いない
    - 最適化は必要
- ストリーミング
  - 実際の所は運用してみないとわからない

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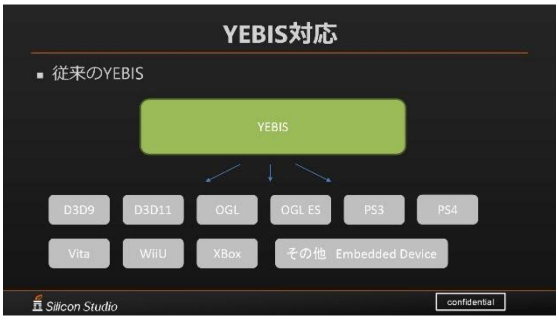
While he could not disclose specific performance of Stadia in details, he assured that we were already in the age where 4K was to be set standard. He added, “It does not mean that 4K and 60 FPS can be achieved automatically, and appropriate optimization is necessary. In some cases, there may be a need for checkerboard rendering." In addition, because there is a possibility of block-noise when distributing video by streaming such as Stadia, an issue of whether it is necessary to create pictures assuming potential noises was also discussed.

Next, he talked about their experience of “YEBIS” supporting Stadia. “YEBIS” is equipped with GHI (Graphics Hardware Interface) to absorb differences in various kinds of graphics APIs; that is one of strengths of YEBIS which makes it possible to be used in a wide variety of platforms.



YEBIS対応

- 従来のYEBIS

YEBIS

D3D9　D3D11　OGL　OGL ES　PS3　PS4

Vita　WiiU　XBox　その他　Embedded Device

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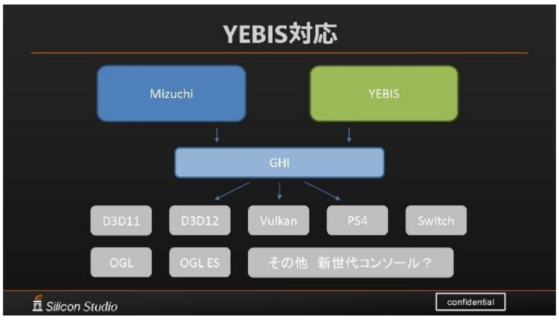

YEBIS対応

Mizuchi　YEBIS

GHI

D3D11　D3D12　Vulkan　PS4　Switch

OGL　OGL ES　その他　新世代コンソール？

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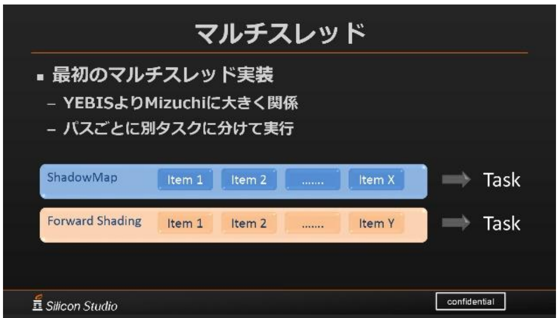
Subsequently, in September 2014 at the time of “Mizuchi” official release, they started integration with graphics abstraction layer of Mizuchi. Accordingly, support for DirectX9, Wii U, PlayStation 3 and PlayStation Vita was terminated to newly support Vulkan, PlayStation 4, Nintendo Switch as well as other new generation consoles including Stadia.

In order to support Stadia and Vulkan, firstly, extensive refactoring was performed. By converting shaders written in HLSL to a form which is easily compiled in SPIR-V, such complied data is transferred to Vulkan API.

As an element that is greatly relevant to "Mizuchi," multi-threading was also mentioned. In the beginning, they assigned one task to each path; however, a large variation in the number of commands for drawing for each path resulted in a difference in load distribution, and they found efficient scaling was not possible.

When they tried again by dividing each drawing path into dozens, it became fairly easier to scale. However, this method presented an issue that the number of tasks could be too large. In the current implementation they achieved through trial and error, they call each drawing path RenderBatch and collection is made by single task to set up a cost. And then, by assigning them to individual threads in accordance with the cost, they succeeded in solving imbalanced load distribution problem. Mr. Tsuji said that they would keep moving forward toward optimization while examining a possibility for 8K beyond 4K and necessity of checkerboard rendering as things progressed.



マルチスレッド

- 最初のマルチスレッド実装
  - YEBISよりMizuchiに大きく関係
  - パスごとに別タスクに分けて実行

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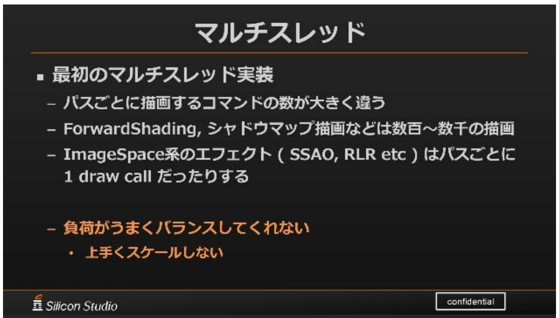

マルチスレッド

- 最初のマルチスレッド実装
  - パスごとに描画するコマンドの数が大きく違う
  - ForwardShading, シャドウマップ描画などは数百～数千の描画
  - ImageSpace系のエフェクト (SSAO, RLR etc) はパスごとに 1 draw call だったりする
  - 負荷がうまくバランスしてくれない
    - 上手くスケールしない

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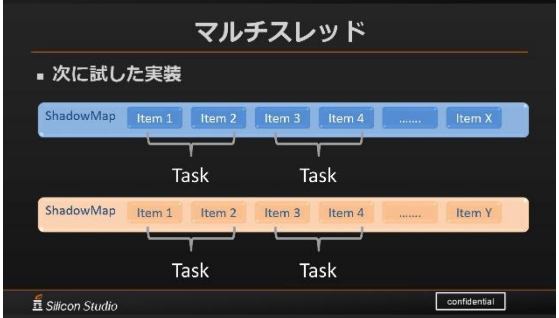

マルチスレッド

- 次に試した実装

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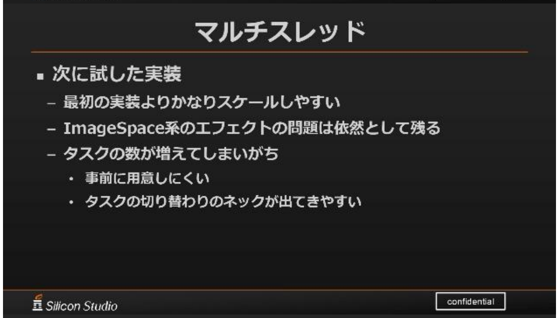

マルチスレッド

- 次に試した実装
  - 最初の実装よりかなりスケールしやすい
  - ImageSpace系のエフェクトの問題は依然として残る
  - タスクの数が増えてしまいがち
    - 事前に用意しにくい
    - タスクの切り替わりのネックが出てきやすい

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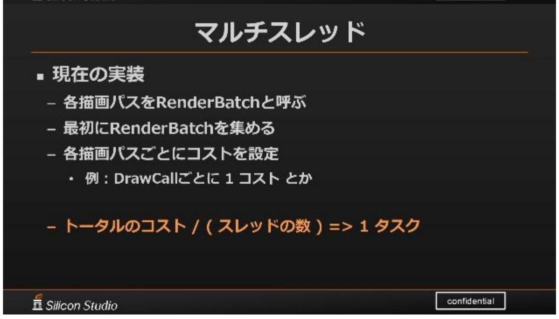

マルチスレッド

- 現在の実装
  - 各描画パスをRenderBatchと呼ぶ
  - 最初にRenderBatchを集める
  - 各描画パスごとにコストを設定
    - 例：DrawCallごとに 1 コスト とか
  - トータルのコスト / (スレッドの数) => 1 タスク

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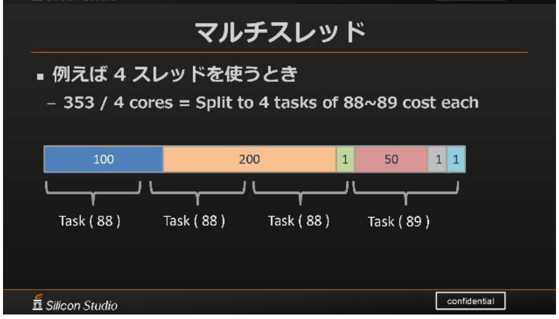

マルチスレッド

- 例えば 4 スレッドを使うとき
  - 353 / 4 cores = Split to 4 tasks of 88~89 cost each

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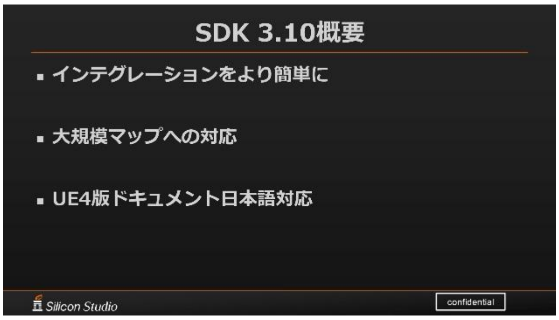
Following the topic of Stadia support, he went on to talk about new SDK of “Enlighten.”

SDK has been released up to 3.09 and currently SDK 3.10 is under development. Support for “Visual Studio 2017 (and subsequent versions)” has been completed, and Japanese language is supported for documents of Unreal Engine version 4. In addition, support for large maps, which was, according to Mr. Tsuji, one of weaknesses of “Enlighten” has been improved. He said that handling of Enlighten would be easier than before from multiple points of view.



SDK 3.10概要

- インテグレーションをより簡単に
- 大規模マップへの対応
- UE4版ドキュメント日本語対応

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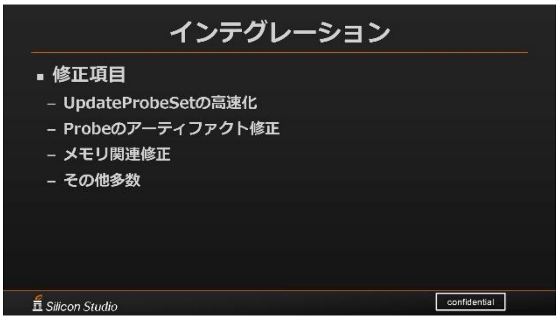

インテグレーション

- 修正項目
  - UpdateProbeSetの高速化
  - Probeのアーティファクト修正
  - メモリ関連修正
  - その他多数

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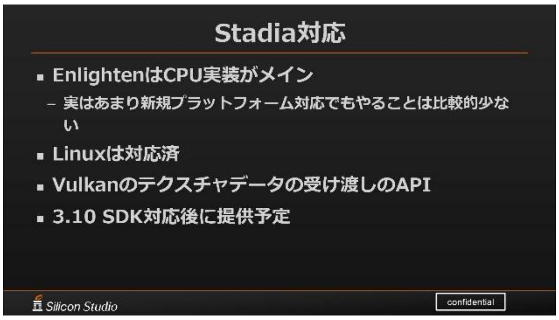
He also mentioned supporting Stadia with “Enlighten.” Because “Enlighten” operates mainly on CPU and its support for Linux has been completed, he considered that there were relatively fewer things to be done to support Stadia. SDK 3.10 would be released in near future and they would start working on support, but it would not take long time, he noted.

As a subsequent schedule of “Enlighten,” the first thing mentioned was reinforcement of support system. Currently an engineer sometimes has to handle both development and support, but they will increase engineers to dedicate to support so that roles are thoroughly separated. Regarding the major update, which is currently under consideration, he revealed several features including higher-speed processing, use of real-time ray tracing, and enhancement of Light Probes.



Stadia対応

- EnlightenはCPU実装がメイン
  - 実はあまり新規プラットフォーム対応でもやることは比較的少ない
- Linuxは対応済
- Vulkanのテクスチャデータの受け渡しのAPI
- 3.10 SDK対応後に提供予定

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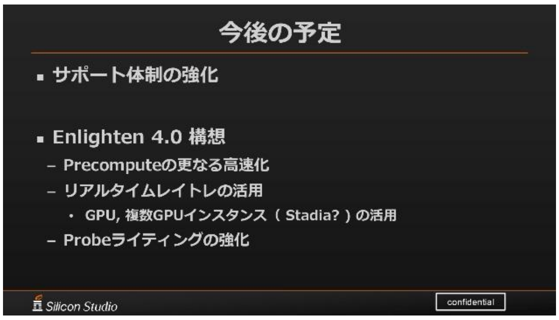

今後の予定

- サポート体制の強化
- Enlighten 4.0 構想
  - Precomputeの更なる高速化
  - リアルタイムレイトレの活用
    - GPU, 複数GPUインスタンス（Stadia?）の活用
  - Probeライティングの強化

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At the end of his presentation, he mentioned a roadmap of “Enlighten.” On top of pursuing and researching more realistic expression techniques combining machine learning and rendering and pursuing procedural expressions such as nature and weather, he revealed the company’s new direction to actively expand into non-game industries. He said that needs for “Enlighten” was increasing in industries including automotive, construction and video production industries, and in collaboration with other companies, they were searching for new workflow to improve video production efficiency.

Stadia対応
PC版の実装
PC版でできるだけ完成度を高められるようにしておくことが重要
Windows, Linuxの違いを吸収するレイヤー
Vulkanを PC, Stadia実機両方で動作できるように
PCでDirectX12でも動作できるように (Sanity Check のため)
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