

GPU TECHNOLOGY
CONFERENCE

Profiling and Debugging Tools for High-performance Android Applications

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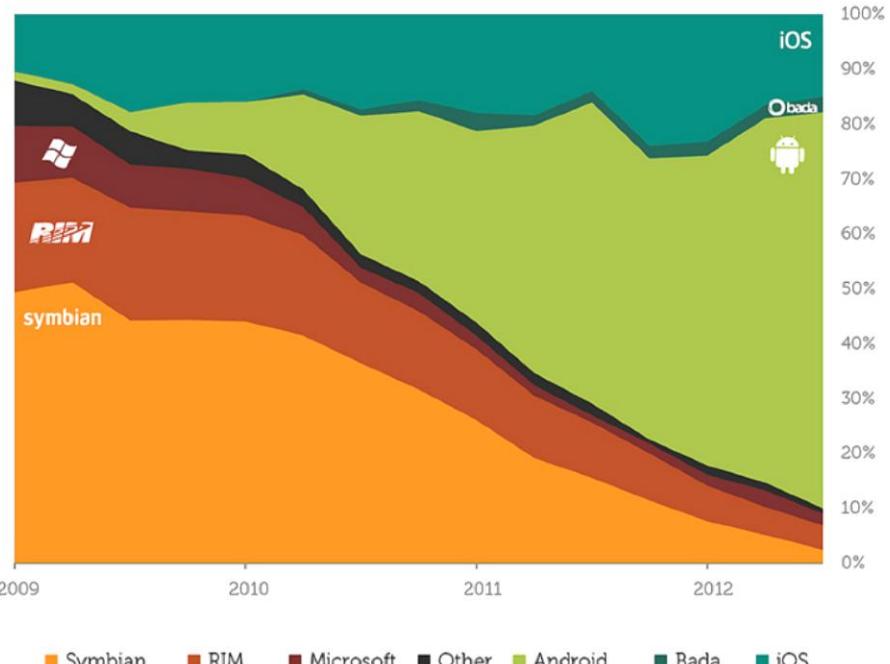
Android By The Numbers

1.3M Android activations per day

750M Android devices worldwide

1.68B in Google Play Revenue (2012)

Android activations predicted to double in 2013



Source: VisionMobile estimates, IDC, Canalys, Gartner, OS vendors

Source: Developer Economics 2013 | www.DeveloperEconomics.com | January 2013
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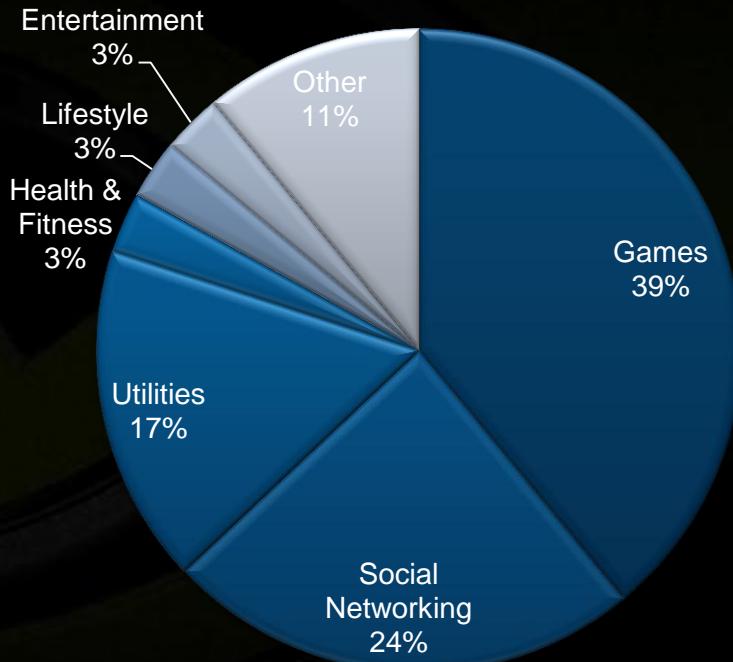
Sources: Eric Schmidt, Andy Rubin, IHS iSuppli forecast



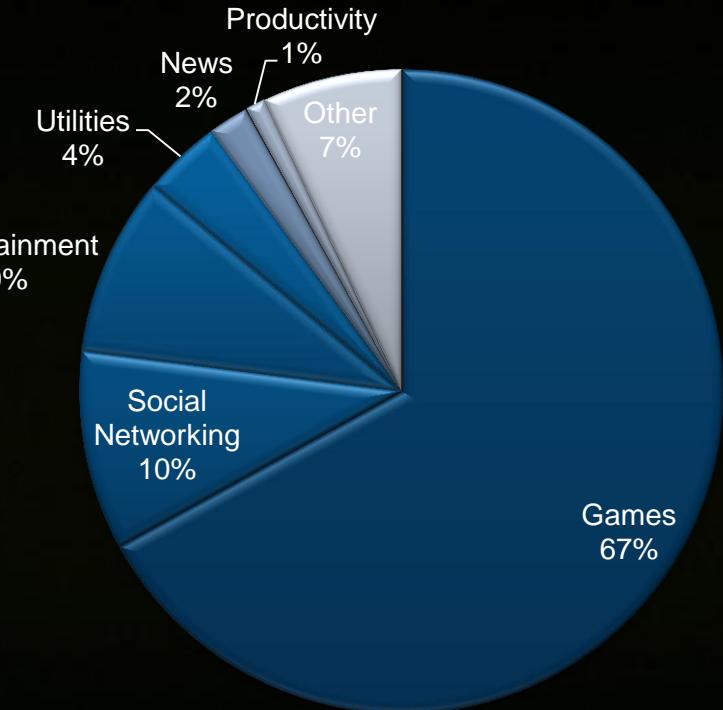
Android

App Categories

Smartphones



Tablets



Android



Native Development Kit (NDK)

Native	Code languages, such as C / C++
Java	Not required — <i>Implement your application using NativeActivity</i>
Tools	To generate and embed native code libraries
System	Headers and libraries for managed resources
No Silver Bullet	It is NOT a silver-bullet for performance issues — <i>you can still shoot yourself in the foot</i>
Not Standalone	It does NOT replace the Android SDK
Not 4 Standard	It is NOT meant for standard Android applications — <i>image processing, physics, AR, facial recognition</i>
No Alternative	It is NOT for alternative programming languages — <i>chicken, etc</i>

Android

Why use the Android NDK?



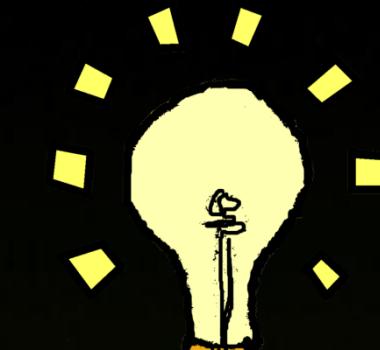
Cross-Platform



Code Reuse



NEON / Vector (vfp)



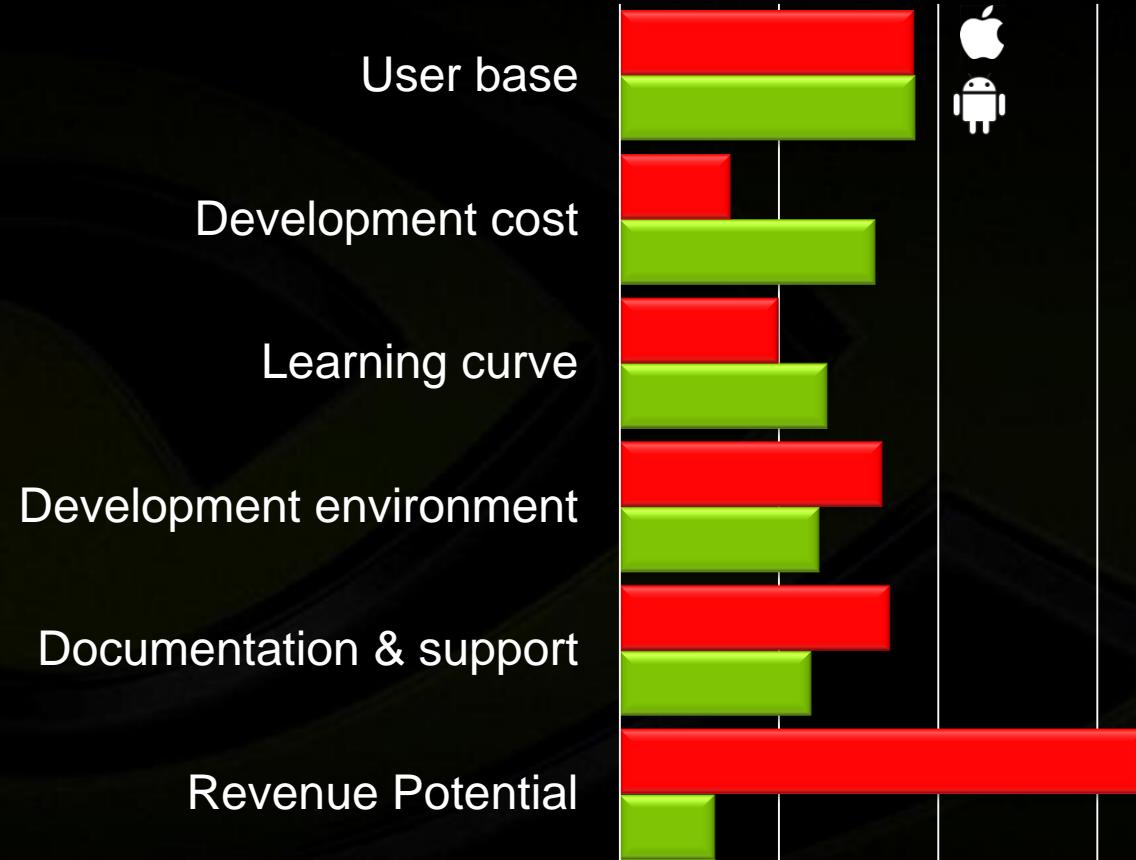
Perf / Watt



High-performance
CPU-intensive

Android

Developer Perceptions ~~Misconceptions~~



Setup and Configuration



Native Debugging



Eclipse

Tegra Android Development Pack



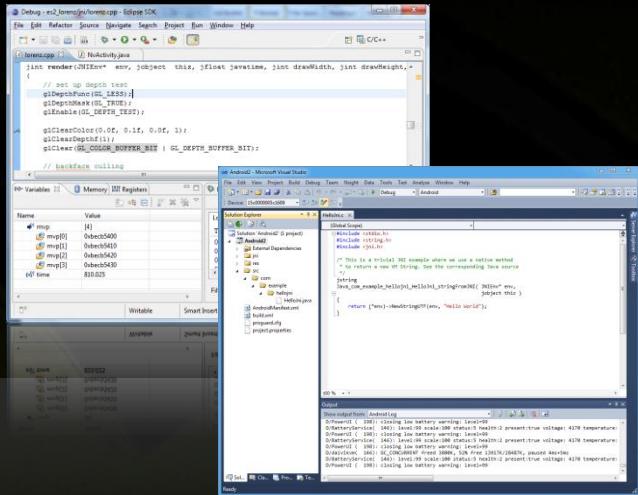
- **GET STARTED** in minutes NOT hours
- **INSTALS** all tools required for Tegra Android
- **CPU DEBUGGING** with Nsight Tegra
- **GPU DEBUGGING** with PerfHUD ES
- **OPTIMIZE** applications with Tegra Profiler
- **REFERENCE** docs, samples & tutorials
- **OPTIMIZED** for Tegra Android development
- **FLASHES** Tegra DevKit with OS Image
- **CONFIGURED** for debugging and profiling
- **INCLUDES** Kernel symbols and DS-5 support

<http://developer.nvidia.com/develop4tegra>



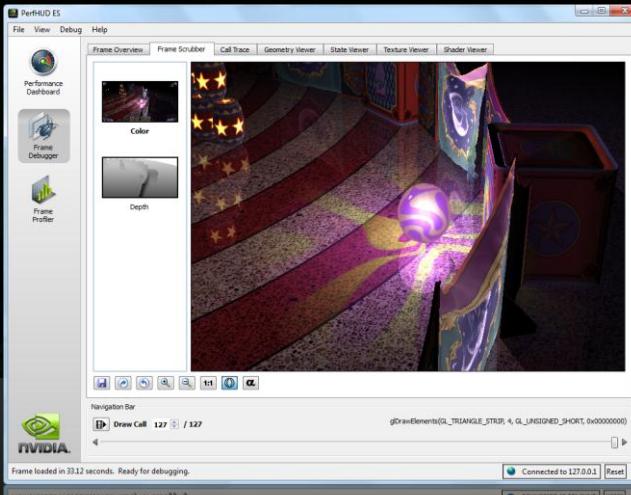
Tegra Developer Tools

Native Android Development Tools



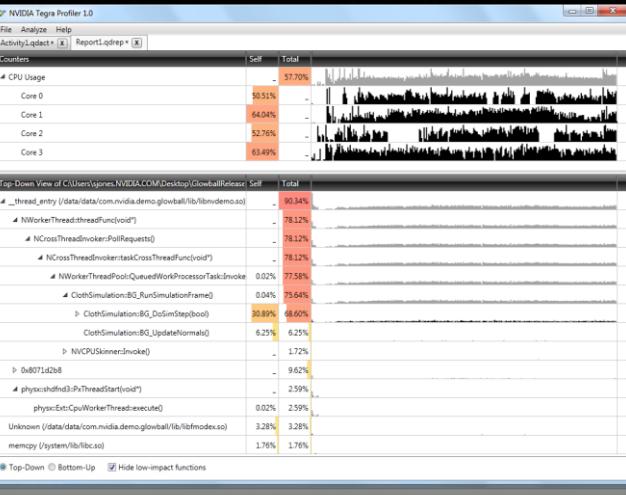
Nsight Tegra

Visual Studio and Eclipse integrations
Full Android build management
Native Android CPU debugging
Breakpoints in both Java and Native



PerfHUD ES

Examine and debug OpenGL ES frames
Automated bottleneck analysis
Edit shaders at runtime



Tegra Profiler

Maximize multi-core CPU utilization
Quickly identify CPU “hot spots”
Identify thread contention issues

<http://developer.nvidia.com/develop4tegra>



“The most powerful solution for Android game development”

“... as much time as it took to get a console game engine to honour the Android lifecycle, it would have taken twice that without NVIDIA’s developer tools for Android.” -- *TickTock Games*

“PerfHUD ES is by far my favourite thing about Android development. It’s helped us make substantial improvements to the rendering performance of our game.” -- *Fireproof Studios*

“...I expect in some parallel universe there’s another version of me building Android games without NVIDIA’s Nsight Tegra debugger, and he sure looks pissed off! ” -- *Strawdog Studios*



A Goatee
In old Science Fiction series that's the whole difference between good and evil.



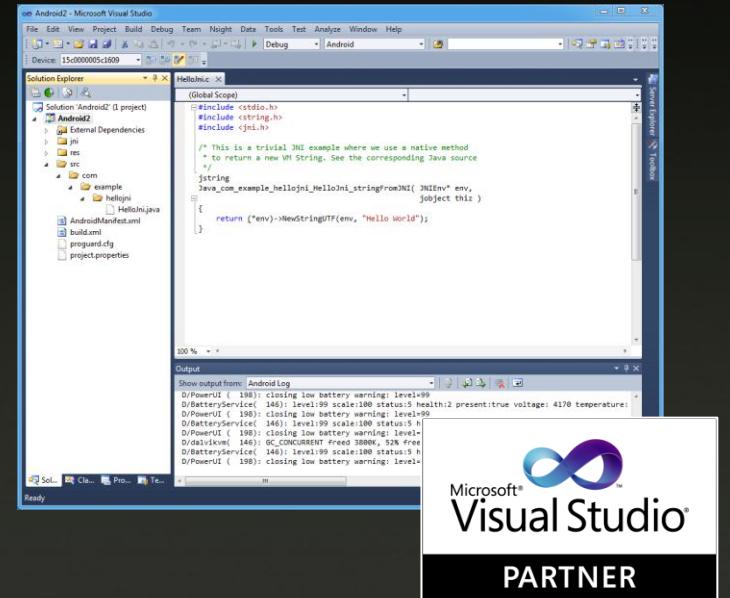
Tegra Developer Tools

Nsight Tegra, Visual Studio Edition



Key Benefits

- Visual Studio integrated Android development
- INCREASED build and runtime performance
- Multi-core native Tegra Android GDB DEBUGGING
- Seamlessly debug Java and native C/C++ code
- Manage and build Tegra Android applications
- Familiar environment for Tegra Android development
- Android specific features integrated into Visual Studio (like LOGCAT)



<http://developer.nvidia.com/develop4tegra>



Nsight Tegra, Visual Studio Edition



Build native Android projects in Visual Studio using vs-android, ndk-build or makefiles.

Android GDB debugging in Visual Studio

The screenshot shows the Microsoft Visual Studio IDE with the Nsight Tegra extension. The main window displays the Disassembly view of a C++ file, NVDebugRender.cpp. The Locals window at the bottom shows variables like `this`, `m_triangles`, `m_lines`, `m_lineCount`, `m_triangleCount`, `m_shownTooManyL`, and `m_shownTooManyT`. The Call Stack window shows the current stack frames. A green callout bubble points to the Locals window with the text "Use the familiar Visual Studio Locals, Watches, Memory and Breakpoints windows.". Another green callout bubble points to the Disassembly window with the text "Set breakpoints in both Java and Native (C/C++)".

<http://developer.nvidia.com/NsightTegra>



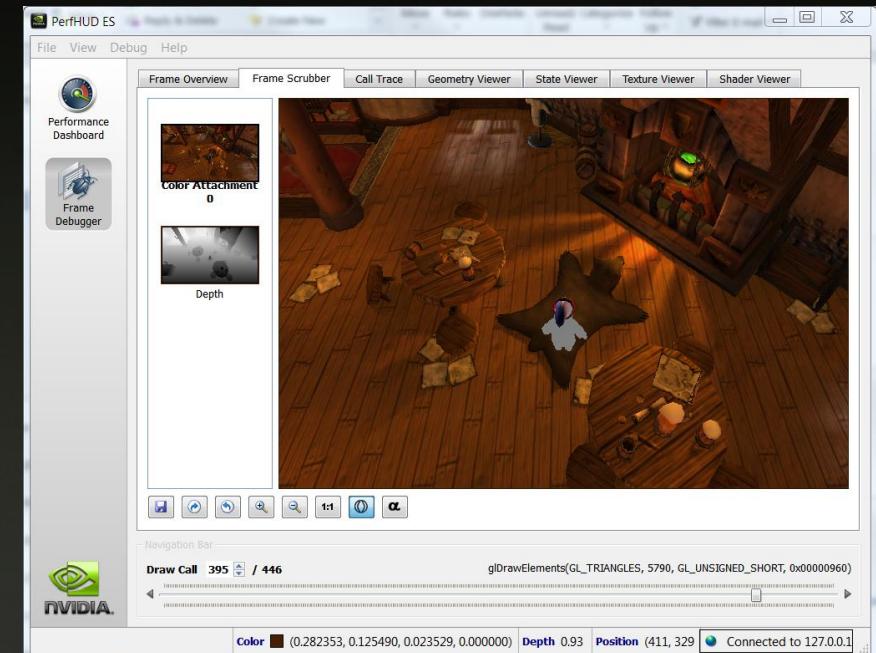
Tegra Developer Tools

PerfHUD ES



Key Benefits

- Examine OpenGL ES frames to reveal rendering problems
- Debug OpenGL ES API calls, parameters, return values and errors
- Execute directed tests to identify rendering bottlenecks
- Edit and apply shaders dynamically at runtime
- Monitor CPU and GPU utilization

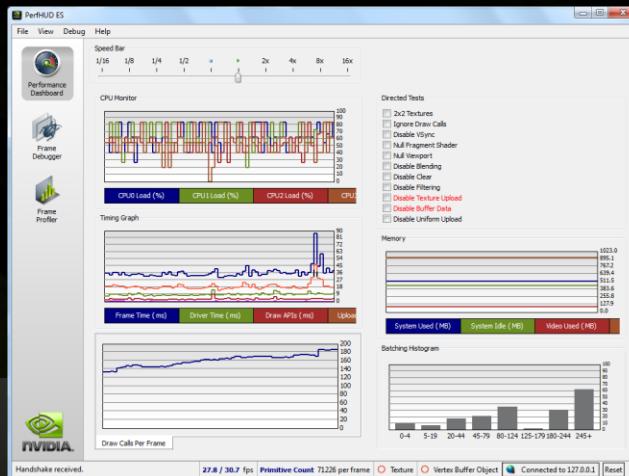


<http://developer.nvidia.com/phes>



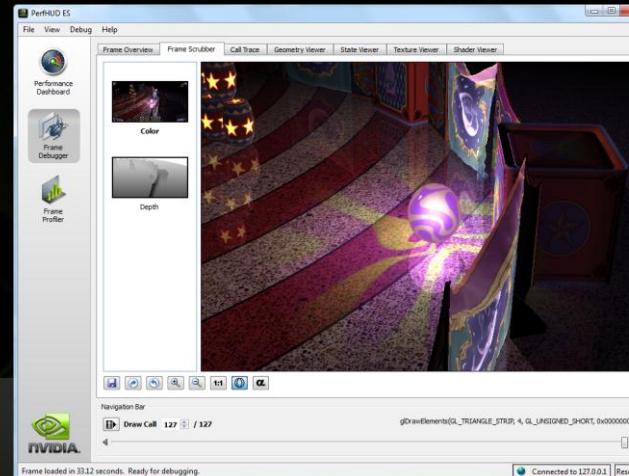
PerfHUD ES for Android

OpenGL ES Graphics Debugging and Profiling



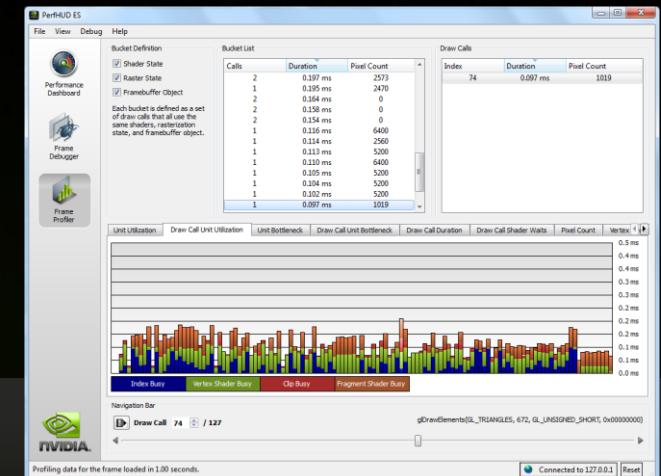
Performance Dashboard

Graph pertinent frame statistics in real-time
Directed tests help identify performance issues
Monitor memory usage and draw call efficiency



Frame Debugger

See the current frame draw call by draw call
Scrub through all of the draw calls in a frame
Examine all aspects of the rendered frame, including API calls, errors, geometry, textures, shaders and pipeline state



Frame Profiler

“Bucket” draw calls that share common render state
Examine in-depth profiling data for each draw call in the frame
Examine “buckets” and draw calls by cost

<http://developer.nvidia.com/phes>



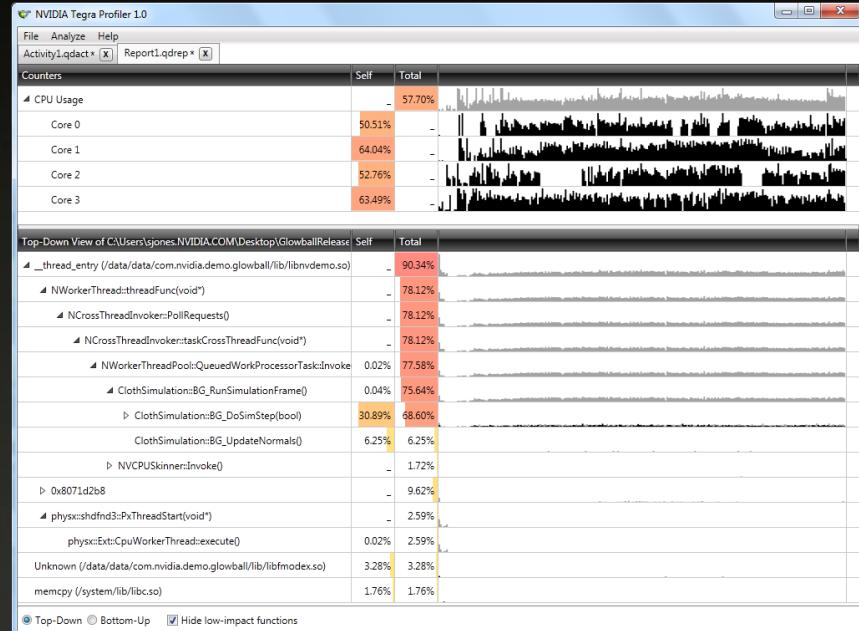
Tegra Developer Tools

Tegra Profiler (Windows only)



Key Benefits:

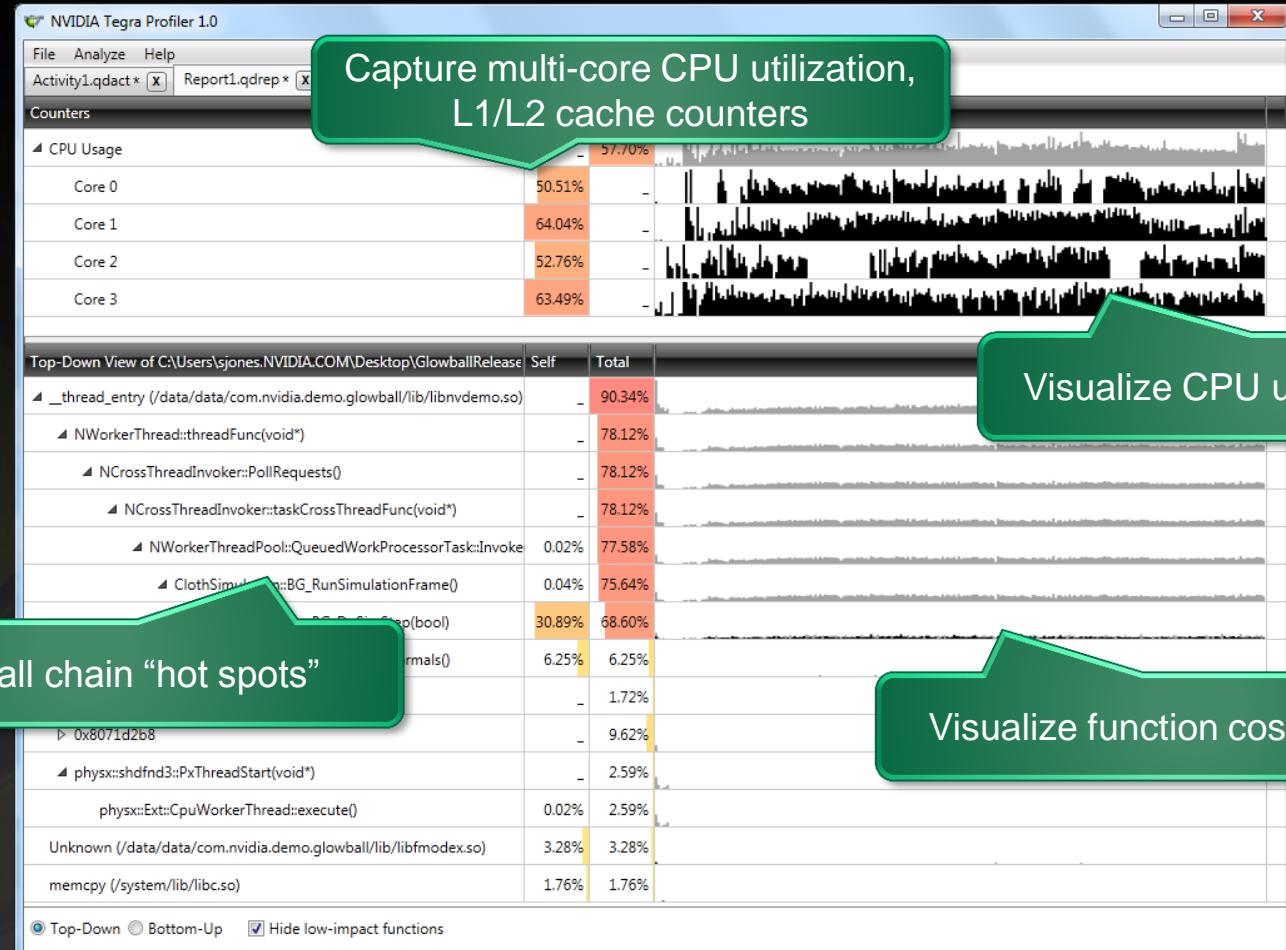
- Maximize multi-core CPU utilization
- Quickly find CPU hot spots and cache issues
- Easily deploy applications for profiling
- Visualize CPU thread state
- Display OpenGL ES frame boundaries
- Instrument source with custom annotations



<http://developer.nvidia.com/develop4tegra>



Tegra Profiler for Android



<http://developer.nvidia.com/tegra-profiler>

Tegra Developer Tools Supported Devices



	Nsight Tegra, Visual Studio Edition	PerfHUD ES	Tegra Profiler
ASUS Transformer (TF201 / TF300T / TF700T)	✓	✓	✗
HTC One X / One X+	✓	✓	✗
ASUS Nexus 7	✓	✓	✓
NVIDIA SHIELD	✓	✓	✓
Ouya	✓	✓	✓
NVIDIA Cardhu (DevKit)	✓	✓	✓
NVIDIA Dalmore (DevKit)	✓	✓	✓
NVIDIA Pluto (DevKit)	✓	✓	✓

Tegra Developer Tools System Requirements



	Host Platform	Device	Device OS	Requires	Cost (\$)
Nsight Tegra, Visual Studio Edition	Win7	Tegra only <i>(non-Tegra devices supported on a limited basis)</i>	Android 4.0+ (ICS)	Visual Studio 2010 <i>(Visual Studio Express not supported)</i>	\$0*
PerfHUD ES	Win7, OSX, Ubuntu Linux	Tegra only	Android 4.0+ (ICS)	---	\$0*
Tegra Profiler	Win7	Tegra DevKits <i>(Cardhu, Dalmore, Pluto, Shield)</i>	Android 4.0+ (ICS)	---	\$0*
NVIDIA Debug Manager (NVDM)	Win7, OSX, Ubuntu Linux	All Android Devices <i>(QA limited on non-Tegra devices)</i>	Android 4.0+ (ICS)	Eclipse	\$0*
Tegra Android Development Pack (TADP)	Win7, OSX, Ubuntu Linux	Tegra only	N/A	---	\$0*

*Requires Tegra Registered Developer Program Membership



Tegra Developer Tools

What's coming?



Nsight Tegra, Visual Studio Edition

- Super-fast apk/file deployment and sync
- Logcat filtering (ala Eclipse)
- Visual Studio 2012
- Windows 8 support

Tegra Profiler

- Host support for OSX and Ubuntu Linux

Need Help?

The Tegra Registered Developer Program:

<http://developer.nvidia.com/develop4tegra>

Support Forums: <http://devtalk.nvidia.com>

Support Email: devtools-support@nvidia.com

