

The logo for the GPU Technology Conference is located in the top-left corner. It consists of a green rectangular box containing the text "GPU TECHNOLOGY CONFERENCE" in white, sans-serif font. The background of the entire slide is a vibrant, abstract digital landscape with glowing lines and patterns in shades of blue, green, and purple, suggesting a high-tech or data-driven environment.

GPU TECHNOLOGY
CONFERENCE

Profiling and Debugging Tools for High-performance Android Applications

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(sjones@nvidia.com)

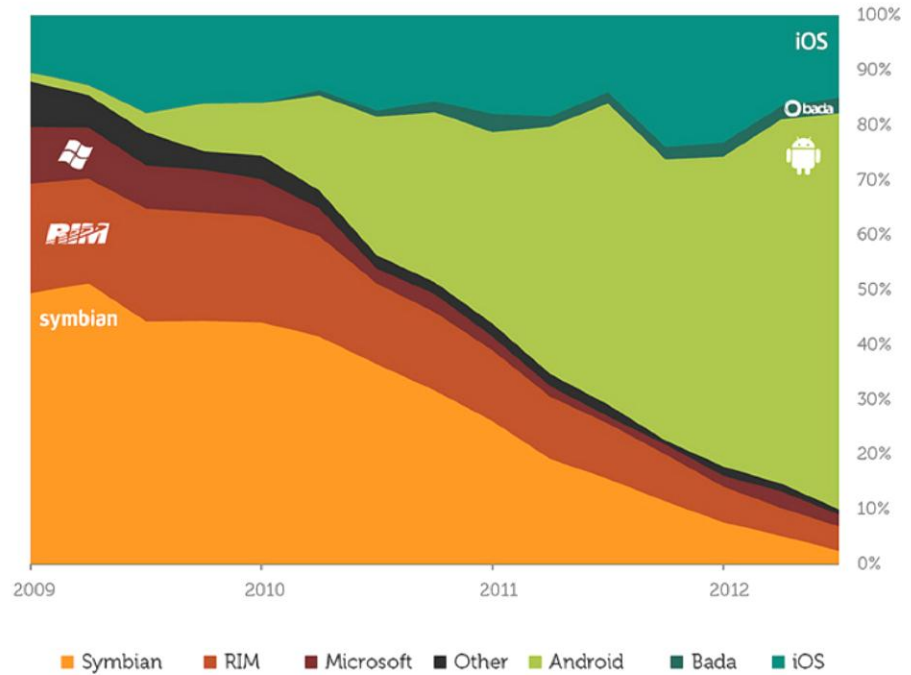
Android By The Numbers

1.3M Android activations per day

Android activations predicted to double in 2013

750M Android devices worldwide

1.68B in Google Play Revenue (2012)



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

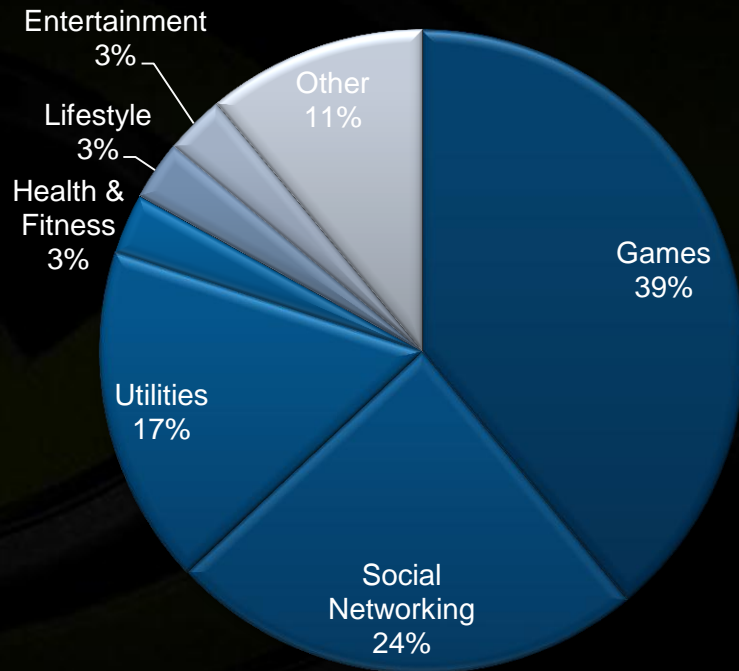
Source: Developer Economics 2013 | www.DeveloperEconomics.com | January 2013
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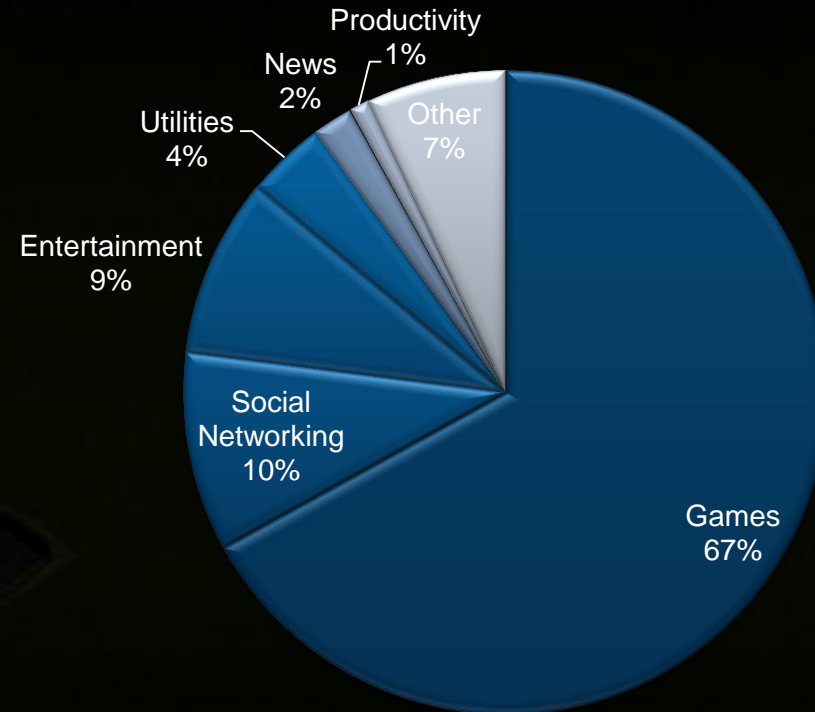
Android

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



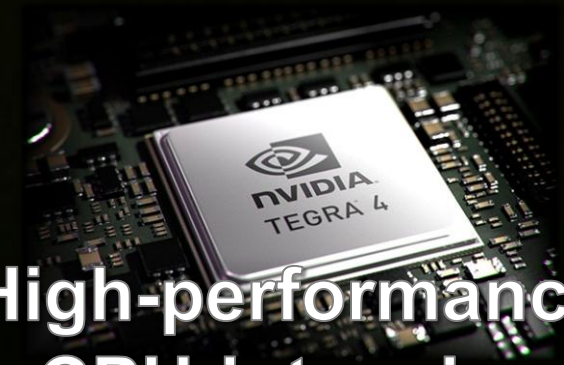
NEON / Vector (vfp)



Code Reuse



Perf / Watt



High-performance
CPU-intensive

Android

Developer Perceptions ~~Perceptions~~ Misconceptions




Setup and Configuration



Debugging



Tegra Android Development Pack



- **GET STARTED** in minutes NOT hours
- **INSTALLS** 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

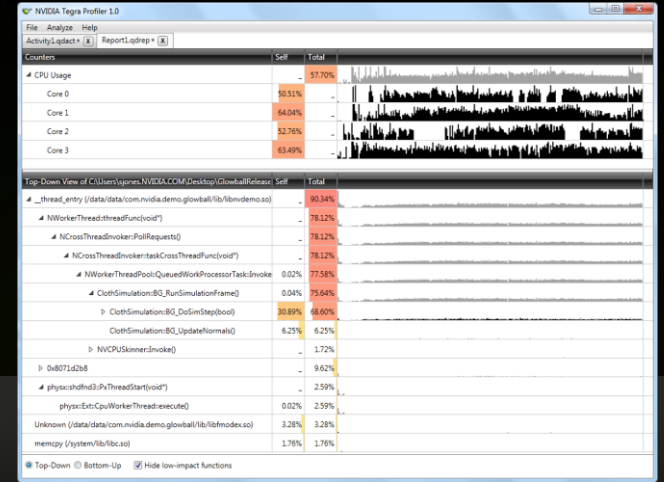
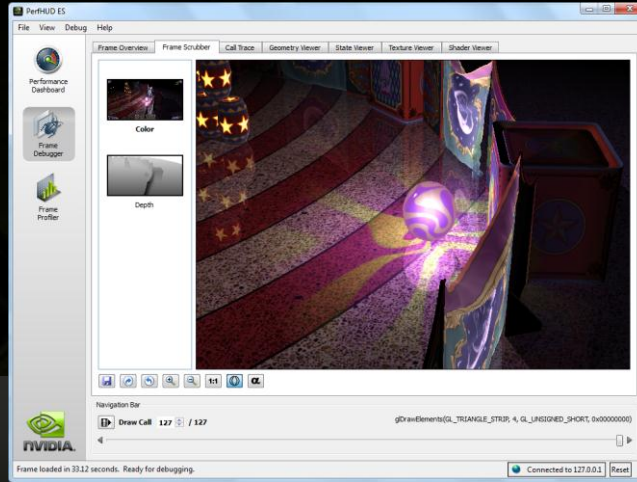
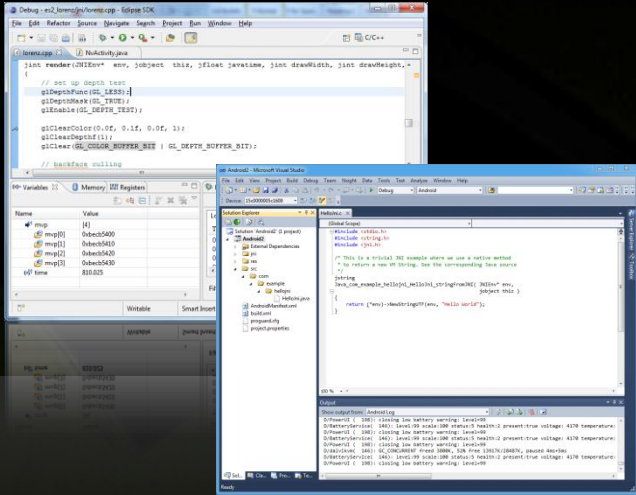
- **OPTIMIZED** for Tegra Android development
- **FLASHES** Tegra DevKit with OS Image
- **CONFIGURED** for debugging and profiling
- **INCLUDES** Kernel symbols and DS-5 support

<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

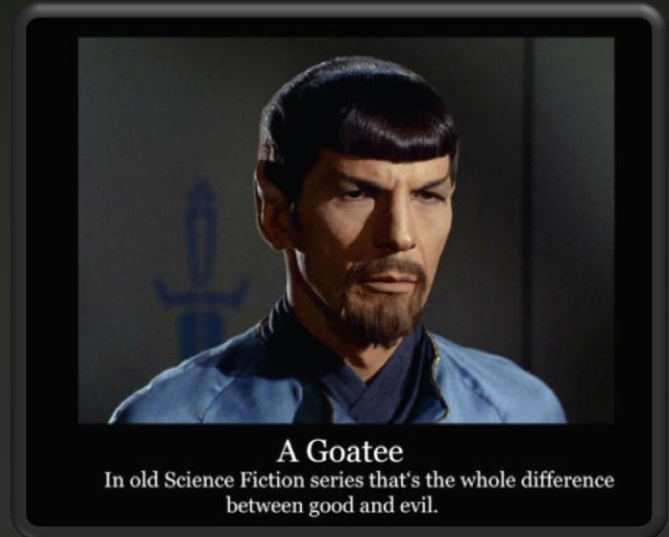
<http://developer.nvidia.com/develop4tegra>

“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





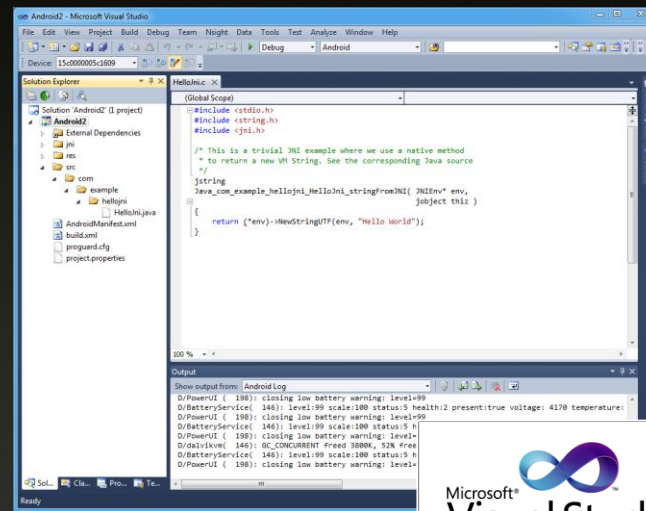
Tegra Developer Tools



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

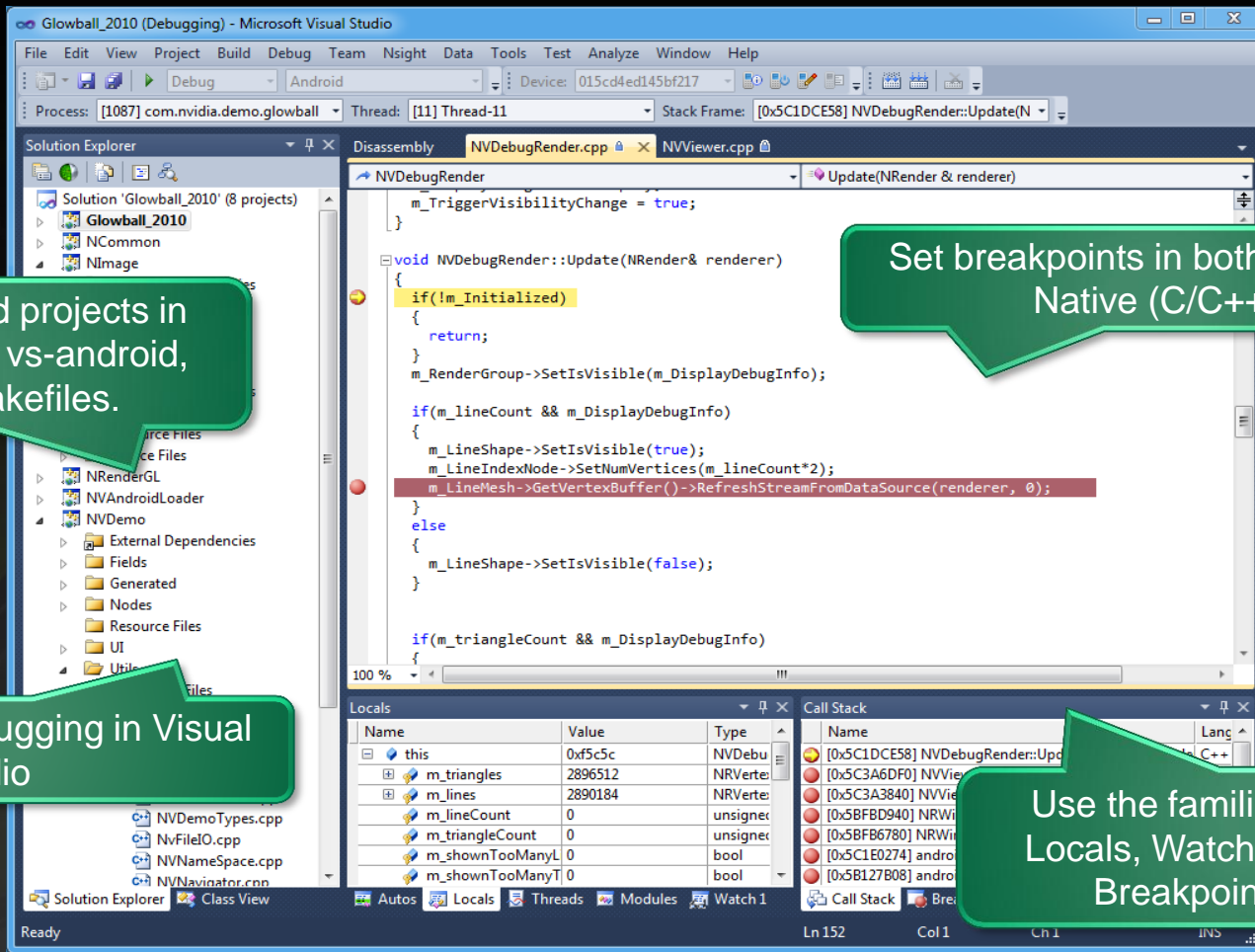


Build native Android projects in Visual Studio using vs-android, ndk-build or makefiles.

Android GDB debugging in Visual Studio

Set breakpoints in both Java and Native (C/C++)

Use the familiar Visual Studio Locals, Watches, Memory and Breakpoints windows.



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



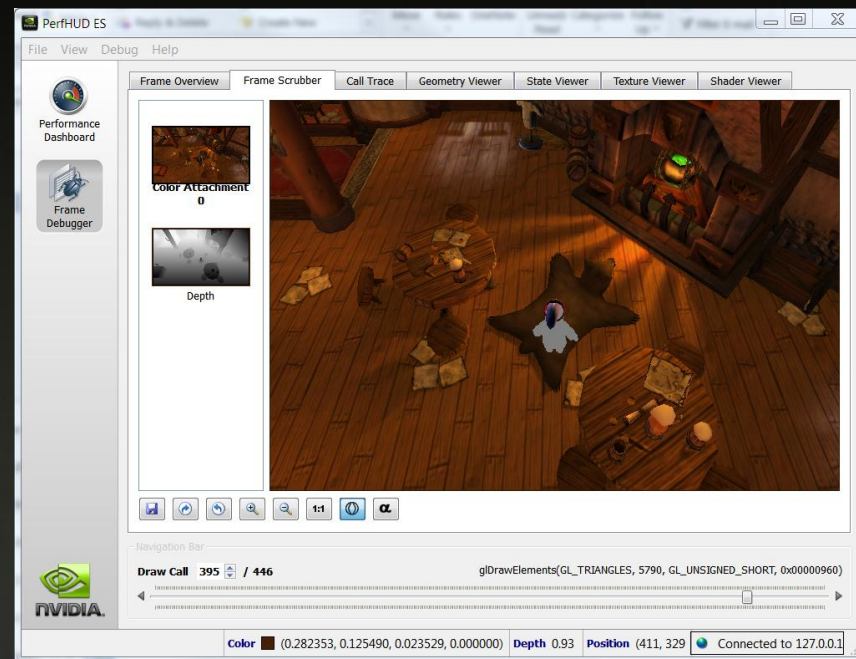
Tegra Developer Tools



PerfHUD ES

Key Benefits

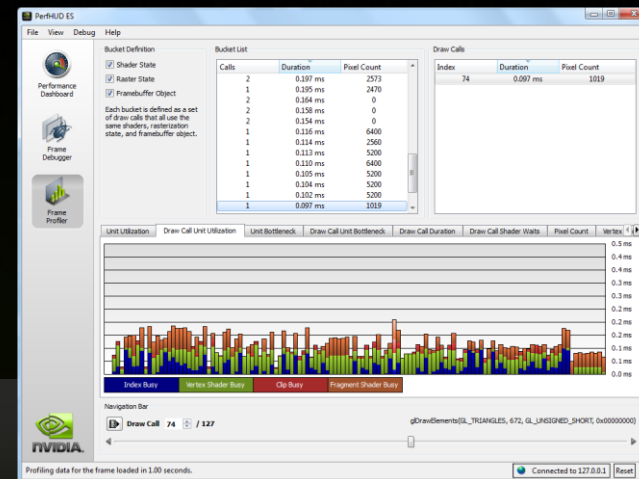
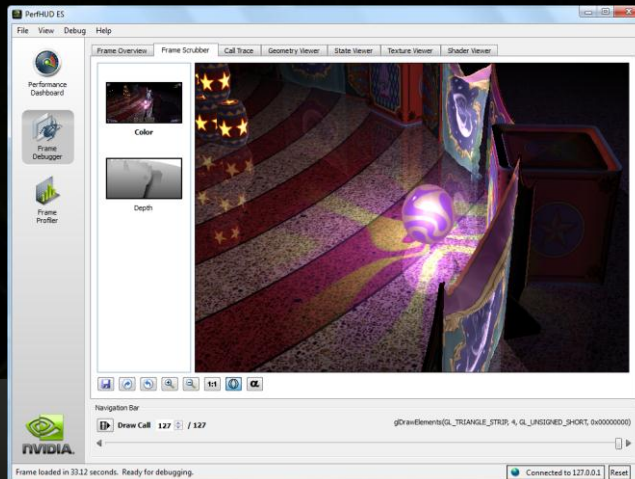
- Examine OpenGL ES frames to reveal rendering problems
- Debug OpenGL ES API calls, parameters, return values and errors
- Execute directed tests to identify rendering bottlenecks
- Edit and apply shaders dynamically at runtime
- Monitor CPU and GPU utilization



<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>



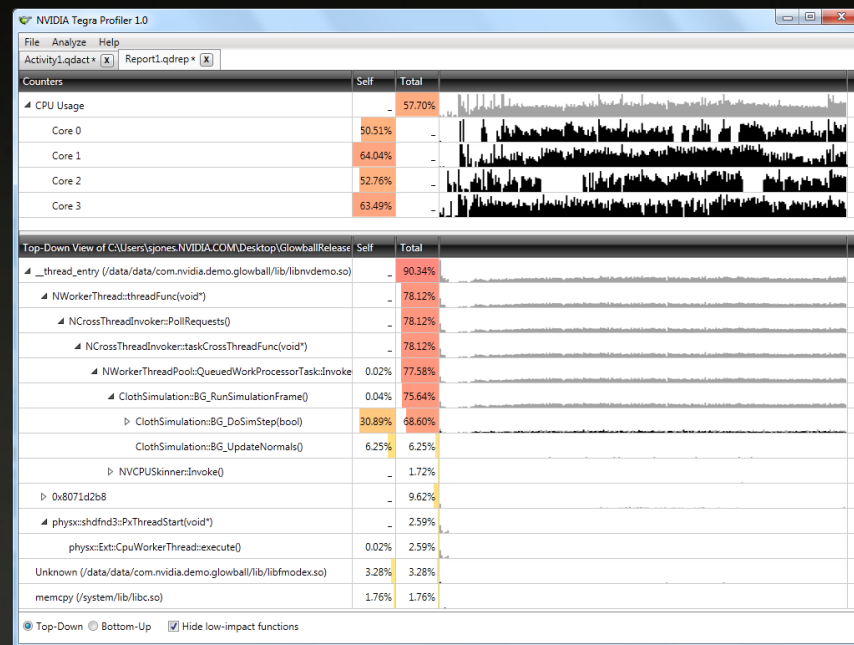
Tegra Developer Tools



Tegra Profiler (Windows only)

Key Benefits:

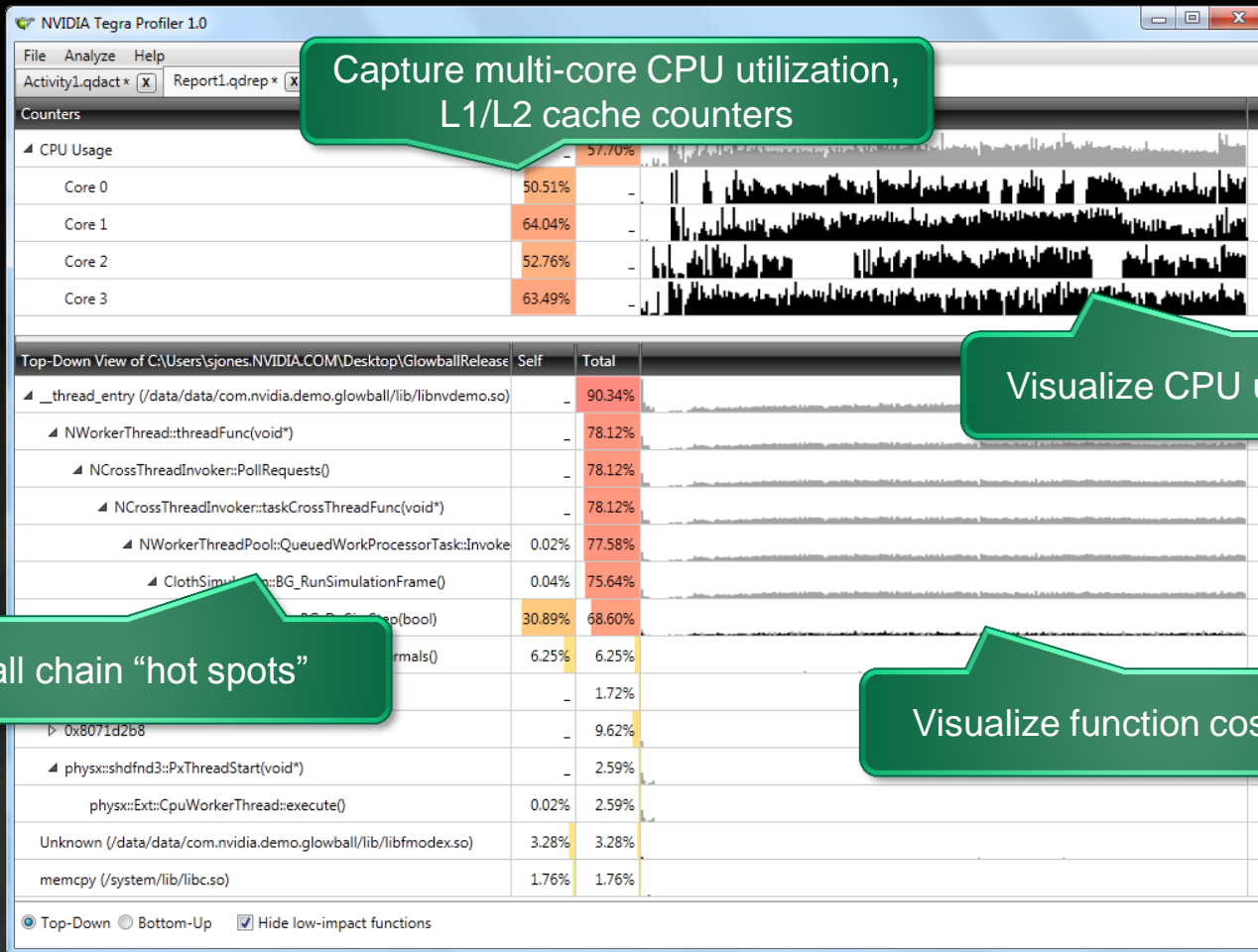
- Maximize multi-core CPU utilization
- Quickly find CPU hot spots and cache issues
- Easily deploy applications for profiling
- Visualize CPU thread state
- Display OpenGL ES frame boundaries
- Instrument source with custom annotations



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



Tegra Profiler for Android



Capture multi-core CPU utilization, L1/L2 cache counters

Visualize CPU utilization over time

Identify call chain "hot spots"

Visualize function cost over time

<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

