Profiling and Debugging Tools for High-performance Android Applications

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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)

Sources: Eric Schmidt, Andy Rubin, IHS iSuppli forecast
Android App Categories

**Smartphones**
- Games: 39%
- Social Networking: 24%
- Utilities: 17%
- Health & Fitness: 3%
- Lifestyle: 3%
- Entertainment: 3%
- Other: 11%

**Tablets**
- Games: 67%
- Social Networking: 10%
- Entertainment: 9%
- Utilities: 4%
- News: 2%
- Productivity: 1%
- Other: 7%
Native Development Kit (NDK)

Native
- Code languages, such as C / C++

Java
- Not required
  - Implement your application using NativeActivity

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
  - you can still shoot yourself in the foot

Not Standalone
- It does NOT replace the Android SDK

Not 4 Standard
- It is NOT meant for standard Android applications
  - image processing, physics, AR, facial recognition

No Alternative
- It is NOT for alternative programming languages
  - chicken, etc
Why use the Android NDK?

- Cross-Platform
- Code Reuse
- NEON / Vector (vfp)
- Perf / Watt
- High-performance CPU-intensive
Developer Perceptions

Android

User base
Development cost
Learning curve
Development environment
Documentation & support
Revenue Potential

Percent of developers that believe one platform is better than the other. Source: Developer Economic 2013 | www.DeveloperEconomic.com | January 2013
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

- Identify call chain "hot spots"
- Capture multi-core CPU utilization, L1/L2 cache counters
- Visualize CPU utilization over time
- Visualize function cost over time

http://developer.nvidia.com/tegra-profiler
# Tegra Developer Tools Supported Devices

<table>
<thead>
<tr>
<th></th>
<th>Nsight Tegra, Visual Studio Edition</th>
<th>PerfHUD ES</th>
<th>Tegra Profiler</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASUS Transformer (TF201 / TF300T / TF700T)</td>
<td>✓</td>
<td>✓</td>
<td>×</td>
</tr>
<tr>
<td>HTC One X / One X+</td>
<td>✓</td>
<td>✓</td>
<td>×</td>
</tr>
<tr>
<td>ASUS Nexus 7</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>NVIDIA SHIELD</td>
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<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Ouya</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>NVIDIA Cardhu (DevKit)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>NVIDIA Dalmore (DevKit)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>NVIDIA Pluto (DevKit)</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
# Tegra Developer Tools System Requirements

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

*Requires Tegra Registered Developer Program Membership
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