Intel Android 소개 및 Application 최적화

이진용 차장
Application Engineer
SSG/DRD/APAC

Rich Portfolio of Android* and Windows* Mobile Devices

New Tablets From $99-~$499+

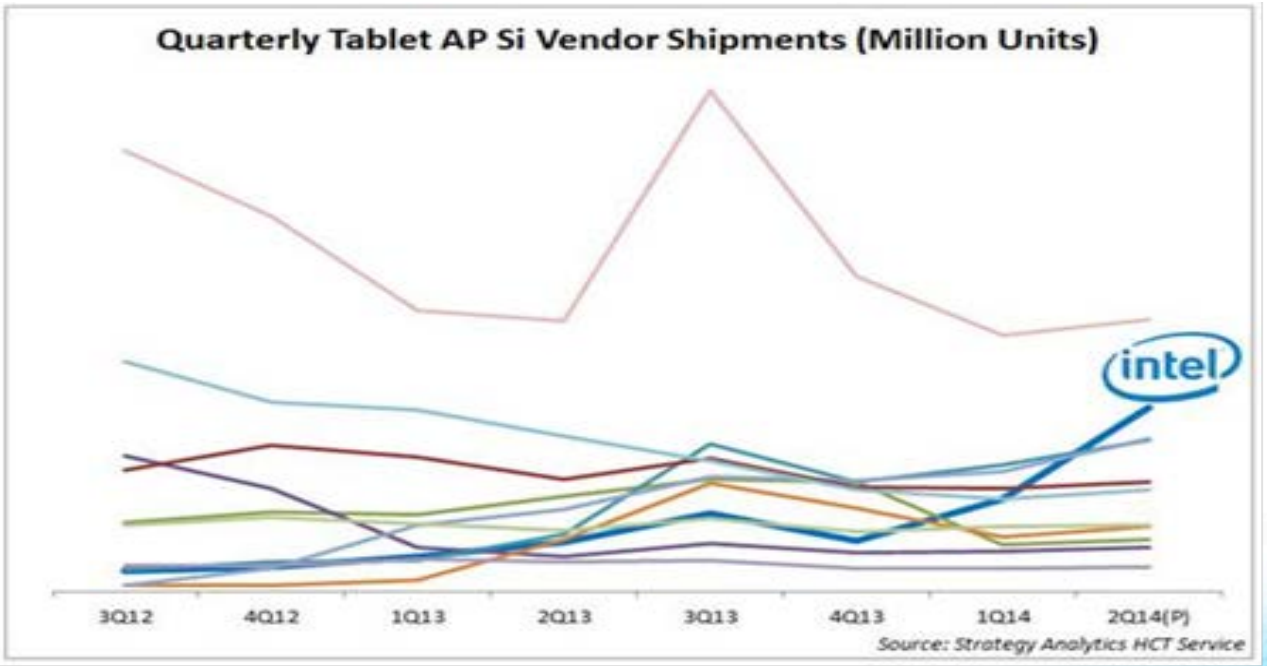
Over 200 Designs Available globally

Nexus Player + x86

- Intel Atom is powering the only Android TV device on the market

Bay Trail Devices

- 46 million Intel based tablets shipped in 2014
- As of Q2'14, Intel took #2 position in tablet AP MSS with 15%, behind only to Apple



Tablet, Phablet & Smartphone Platforms

Intel® Atom™ x7 Processor

Z8700 Series

(Cherry Trail)

Performance

Intel® Atom™ x5 Processor

Z8500 & Z8300 Series

(Cherry Trail)

Mainstream

Intel® Atom™ x3 Processor

C3000 Series

(SoFIA LTE, SoFIA 3G-R, SoFIA 3G)

Entry/Value

A portfolio of scalable Intel Atom SoC products from Entry/Value through Performance

Intel® Atom™ x3 Processors offers complete solutions for the low-cost segment

SOFIA 3G – C3130

Intel® Atom™ processor with Dual-core, 64-bit and Low Power 3G Modem

SOFIA 3G-R* - C3230RK

Intel® Atom™ processor with Quad-core, 64-bit and Low Power 3G Modem

SOFIA LTE – C3445

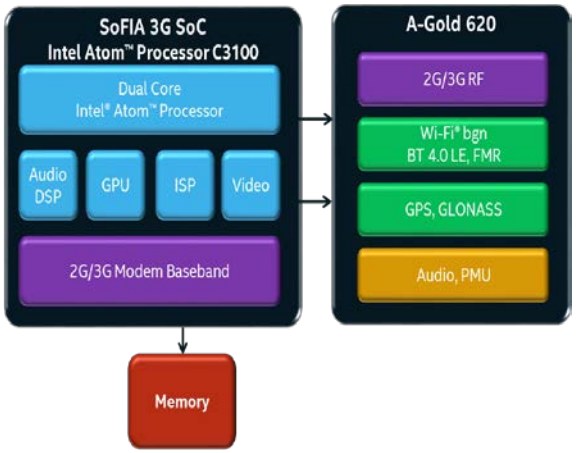
Intel® Atom™ processor with Quad-core, 64-bit and World LTE Modem

Powered By Intel Platform Capabilities & Solutions

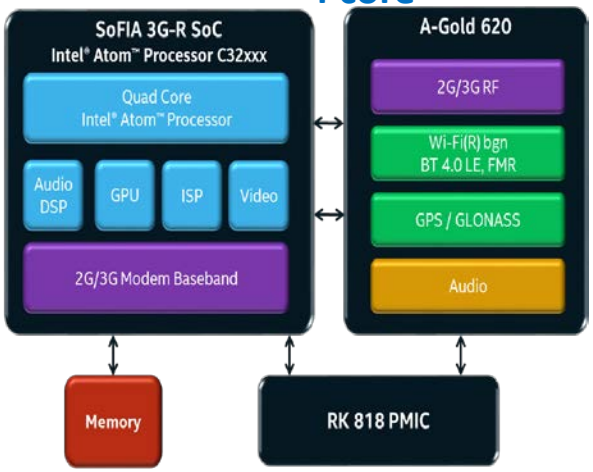
*Partnership with Rockchip. Other names and brands may be claimed as the property of others

SoFIA Family of Products for Affordable Segment

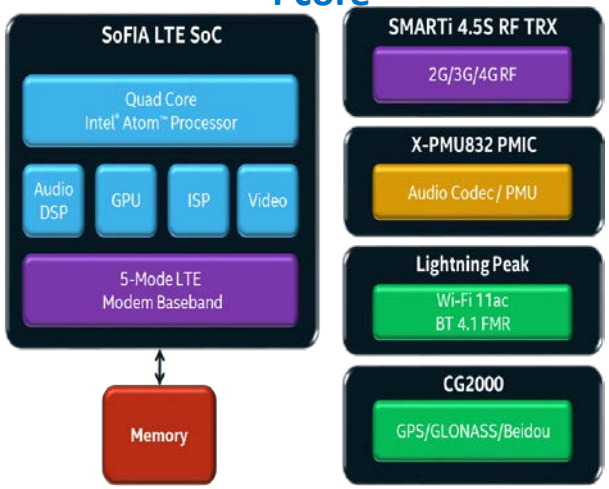
SoFIA 3G
2 core



SoFIA 3G-R
4 core



SoFIA LTE
4 core



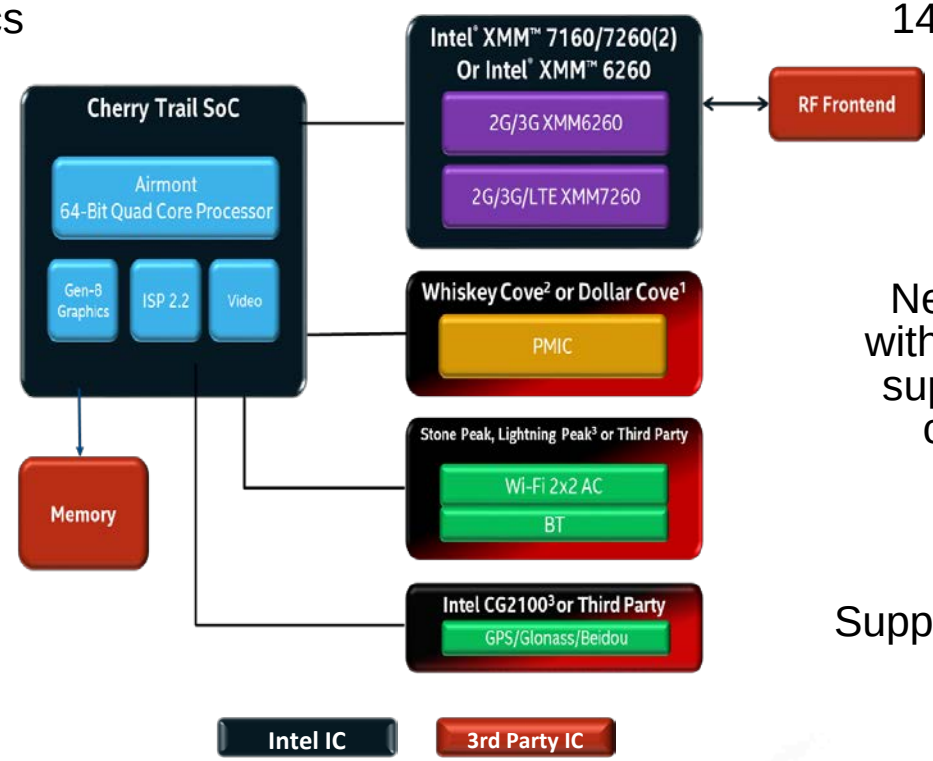
	SoFIA 3G	SoFIA 3G-R	SoFIA LTE
CPU*	Intel® Atom™ DC 1.0 GHz 64-bit	Intel® Atom™ QC 1.1 GHz 64-bit	Intel® Atom™ QC 1.4 GHz 64-bit
Graphics	Mali* 400 MP2	Mali 450 MP4	Mali T720 MP2
Modem	GSM/GPRS/EDGE, HSPA+ 21/5.8, DSDS, DvP	GSM/GPRS/EDGE, HSPA+ 21/5.8, DSDS, DvP	GSM/GPRS/EDGE DC-HSPA+ 42/11, TD-SCDMA FDD/TDD LTE Cat4
Memory	LPDDR2 1x32	LPDDR2/3 1x32 DDR3/DDR3L 2x16	LPDDR2/3 1x32
Storage	eMMC 4.41	eMMC 4.51 NAND 8b with up to 60b ECC	eMMC 4.51
SKU Plan	C3130	C3230-RK C3200-RK (Wi-Fi only)	C3445 C3405 (Wi-Fi only)

Cherry Trail Platform Overview

World class 64-bit CPU and Intel® Gen 8-LP graphics

Broad BOM & SPP coverage with support for a wide range of form factors

Support for Windows* and Android* operating systems



Intel's first SOC on 14nm, featuring next generation micro architecture

Next-generation LTE with Intel® XMM 726x supporting Cat-6 and carrier aggregation

Support for Intel® Wi-Fi with Pro WiDi for Business

New user experiences with Intel® RealSense™ Technology³, wireless charging¹, wireless docking³, and low power sensing & context SDK

1 Cherrytrail mid/ value SKU
2 Cherrytrail mid/ performance SKU
3 Cherry Trail HR'15
*Other names and brands may be claimed as the property of others

Enabling The Software Ecosystem

"Unity is used by half of all mobile game developers, ..." said David Helgason, CEO, Unity Technologies. "We are proud to be working with Intel to ensure that Unity provides the smoothest and highest performing experience possible on Intel platforms."

Removing Developer Roadblocks

Unity*

- Most used mobile game dev tool worldwide
- x86 / Android no add'l cost for all developers
- Covers all Intel platforms for Android

Marmalade*

- Cross platform game dev tool used by EA, Activision, Square Enix and others
- x86 / Android support included today at no add'l cost

Epic* Unreal

- One of the leading game engine for AAA titles and leading mobile games such as Infinity Blade* and UberStrike*
- Pre-release with x86 available from Intel today
- Broad release expected within a quarter

Adobe* AIR & Flash

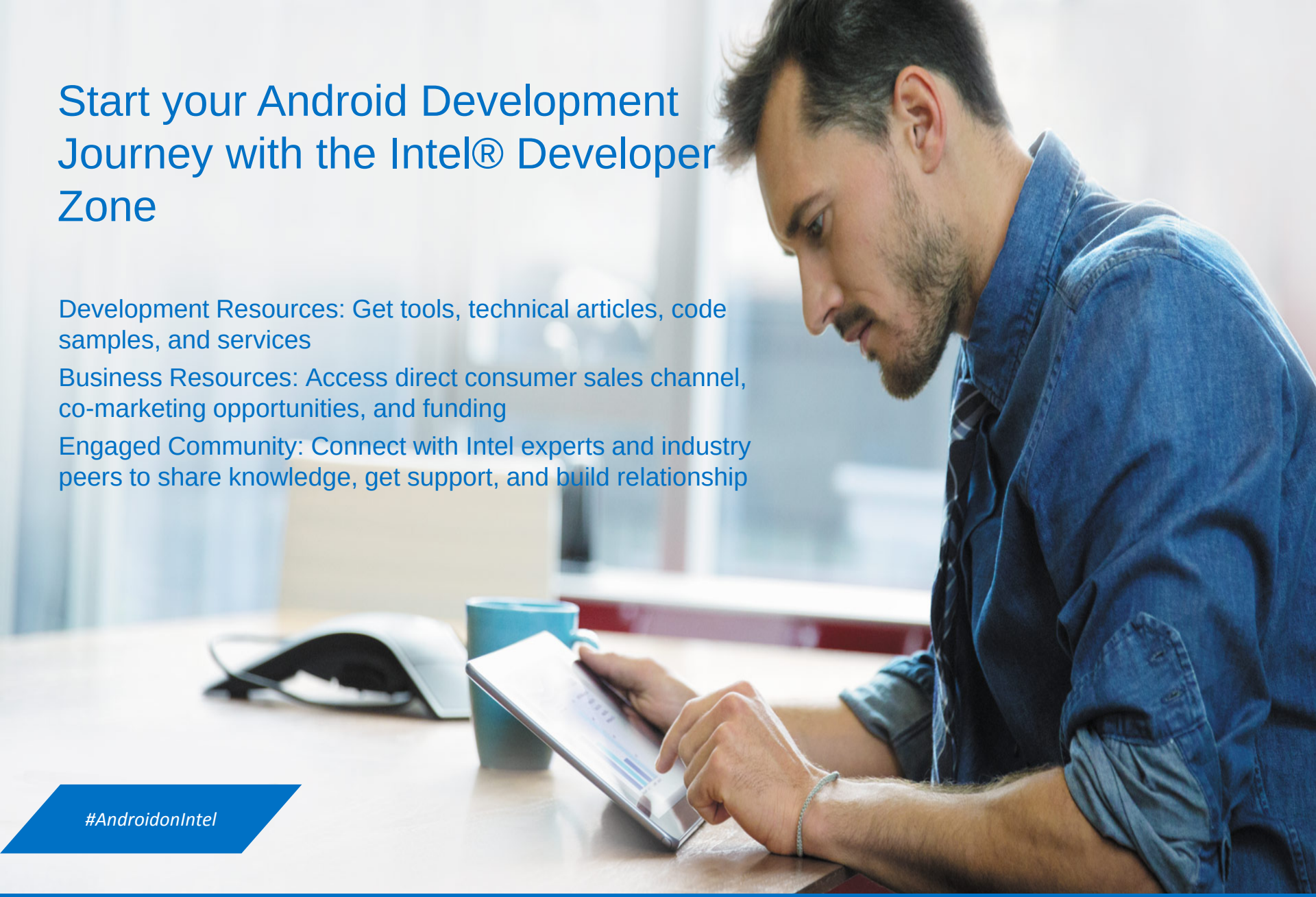
- AIR for x86 / Android announced in April
- AIR captive and native runtimes supported
- Flash Player 11.1 supported on x86/Kit Kat

List of Game Engines Supporting x86 Platform(Not Exhaustive)

- Unreal Engine
- Unity
- Project Anarchy by Havok
- Marmalade
- App Game Kit
- Cocos2d
- Libgdx
- Linderdaum Engine

More and more game engines are now supporting x86

Start your Android Development Journey with the Intel® Developer Zone



Development Resources: Get tools, technical articles, code samples, and services

Business Resources: Access direct consumer sales channel, co-marketing opportunities, and funding

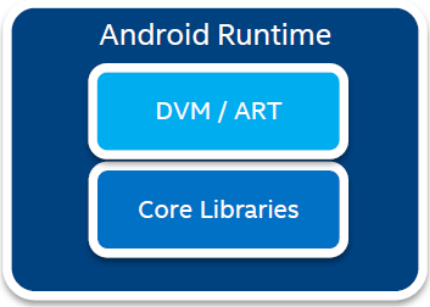
Engaged Community: Connect with Intel experts and industry peers to share knowledge, get support, and build relationship

#AndroidonIntel

Development Options for Android

Android* SDK apps

- These will just work well. We're optimizing the Runtimes for Intel® platforms.



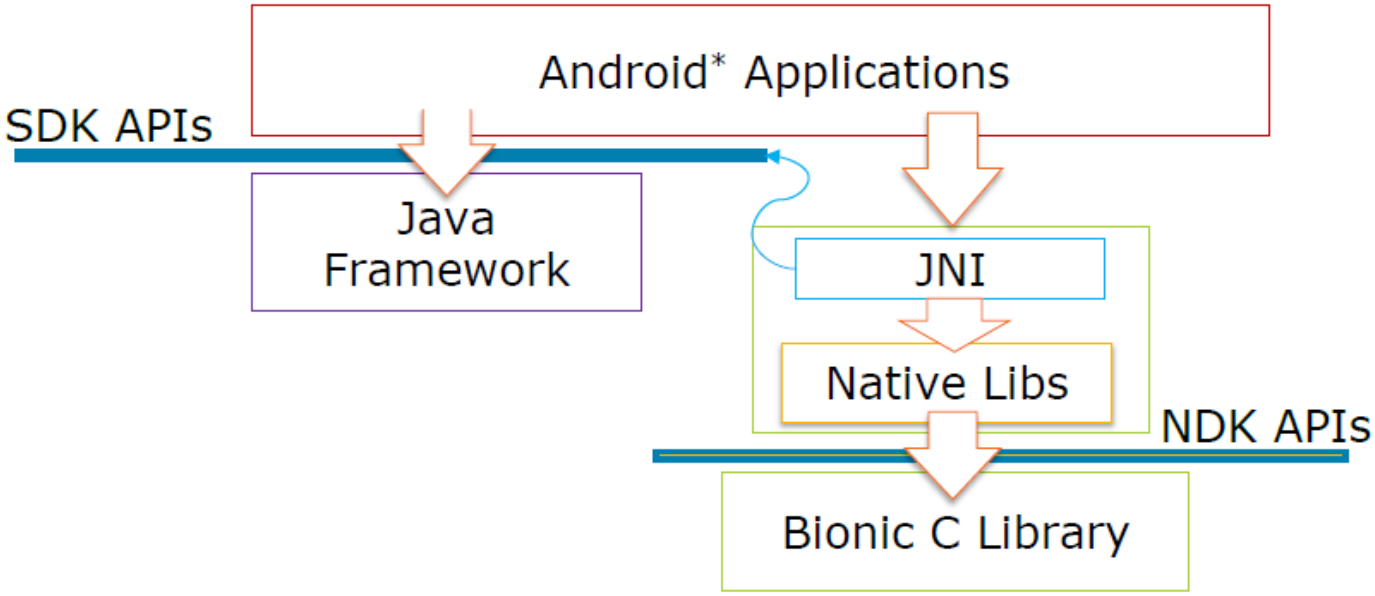
Android* NDK apps

- Most will run without any recompilation on consumer platforms.
- Android NDK provides an x86 toolchain since 2011
- A simple recompile using the Android NDK yields the best performance
- If there is specific processor dependent code, porting may be necessary

NDK Application Development

APP_ABI := all
or APP_ABI := x86

through jni



Packaging APKs for Multiple CPU architectures

Tow options:

- One package for all (“fat binary”)
  - Embed native libraries for each architecture in one APK
  - Easiest and preferred way to go
- Multiple APKs
  - One APK per architecture
  - If you have good reasons to do so (i.e., your fat binary APK would be larger than 50MB)

Fat Binaries

By default, an APK contains libraries for every supported ABIs.

The application will be filtered during installation (after download)

GCC flags

```
ifeq ($(TARGET_ARCH_ABI), x86)
LOCAL_CFLAGS += -O3 –ffast-math –mtune=atom –msse3 –mfpmath=sse
else
LOCAL_CFLAGS += ...
```

To optimize for Intel Silvermont Microarchitecture (not available with current NDK r9 standard toolschains) :

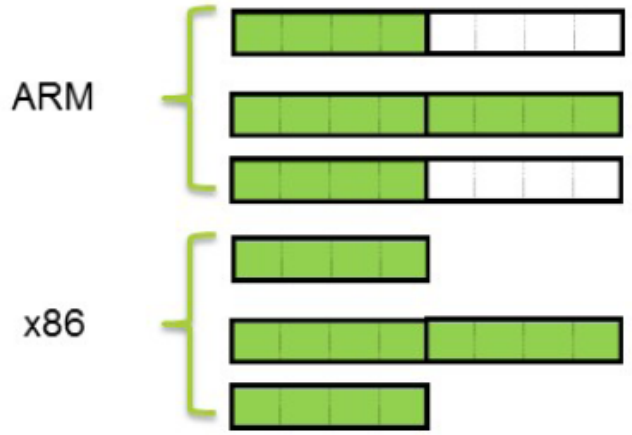
```
LOCAL_CFLAGS += -O3 –ffast-math –mtune=slm –msse4.2 –mfpmath=sse
```

- ffast-math influence round-off of fp arithmetic and so breaks strict IEEE compliance
- The other optimization are totally safe
- Add –ftree-vectorizer-verbose to get a vectorization report

Memory Alignment

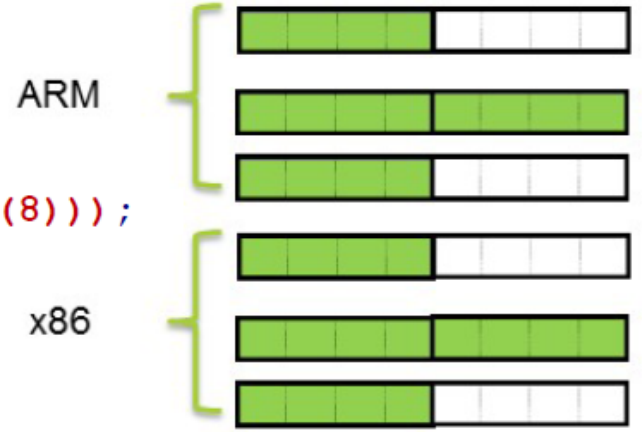
By default

```
struct TestStruct {
  int mVar1;
  long long mVar2;
  int mVar3;
};
```

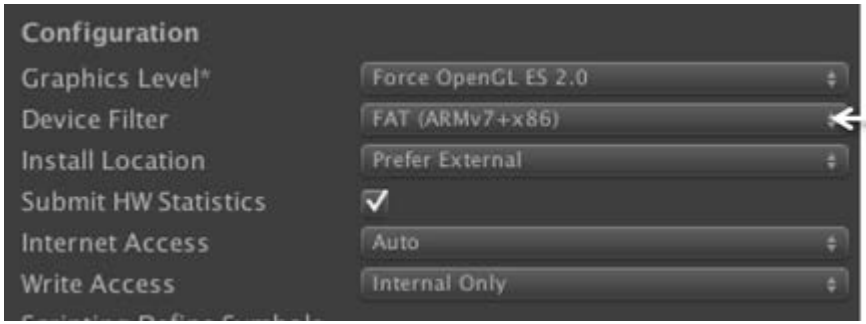


Easy fix

```
struct TestStruct {
  int mVar1;
  long long mVar2 __attribute__ ((aligned(8)));
  int mVar3;
};
```



How to build Unity games for Android x86



- Under Player Setting ..
  - Device Filter determines which .so files get packaged
  - FAT(ARMv7 + x86) is the default
  - You can select just ARMv7 or x86
  - You will needed to create two separate APKs
  - You can upload both to Google Play

Fat binary does not double APK size

Binary Type	Angry Bots APK Size
x86 or ARM	24.5 MB
FAT (x86 and ARM)	31.5 MB

Targeting the correct hardware is important

- Angry Bots on an Android x86 device:

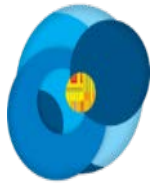
	Non-native x86	Native x86	Diff
FPS	35	46	31%
CPU Load Per Frame	0.71%	0.48%	48%
Power Per Frame	28 mA / Frame	19 mA / Frame	46%
Execution time	6.9 seconds	4.3 seconds	61.2%

Intel Tools for Any App, Device, and User

As a developer, I care about:		...in these environments:	Developer Solution:
	Writing an app once and deploying across many App stores, regardless of OS, device, or architecture.	▪ HTML5 ▪ Cross-OS ▪ Cross-platform ▪ Intel® Architecture ▪ ARM*	Intel® XDK HTML5 Cross-platform Development Tools
	Making my Android* and Microsoft Windows* apps stand out by delivering native performance that runs on ARM* and runs best on Intel® Architecture-based devices.	▪ C++/Java* ▪ Intel® Architecture ▪ ARM*	Intel® INDE Intel® Integrated Native Developer Experience (Beta Version)
	Creating system software including firmware, OS, driver, middleware, and applications for dedicated devices	▪ C/C++ ▪ Intel® Architecture	Intel® System Studio

Cross-platform meets native performance

Intel® INDE 2015



Intel INDE is a suite of tools that let you write fast C++ code that targets multiple operating systems and multiple architectures, and speeds your time to market.

Developer Needs

Cross-OS, Cross-Architecture

- C++/Java* tools and libraries for Android* and Windows* development, supporting ARM* and Intel® architecture.

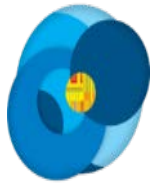
More Performance, Less Time

- Code native applications, expose underlying architecture, and deliver higher performance, responsive apps.

IDE Choice

- Freedom to integrate into your preferred IDE: Visual Studio*, Eclipse*, or Android Studio*.
- **Download: intel.com/software/inde**

Integrated suite of tools for X-OS and X-Arch development



Develop Native Apps on Preferred Host OSs and IDEs	Utilize Consistent Tools and Libraries on Intel® Architecture and ARM*	Deploy on Multiple Device Operating Systems and Architectures

Improve productivity at every step along the development chain

Visual Studio

ANDROID studio

eclipse

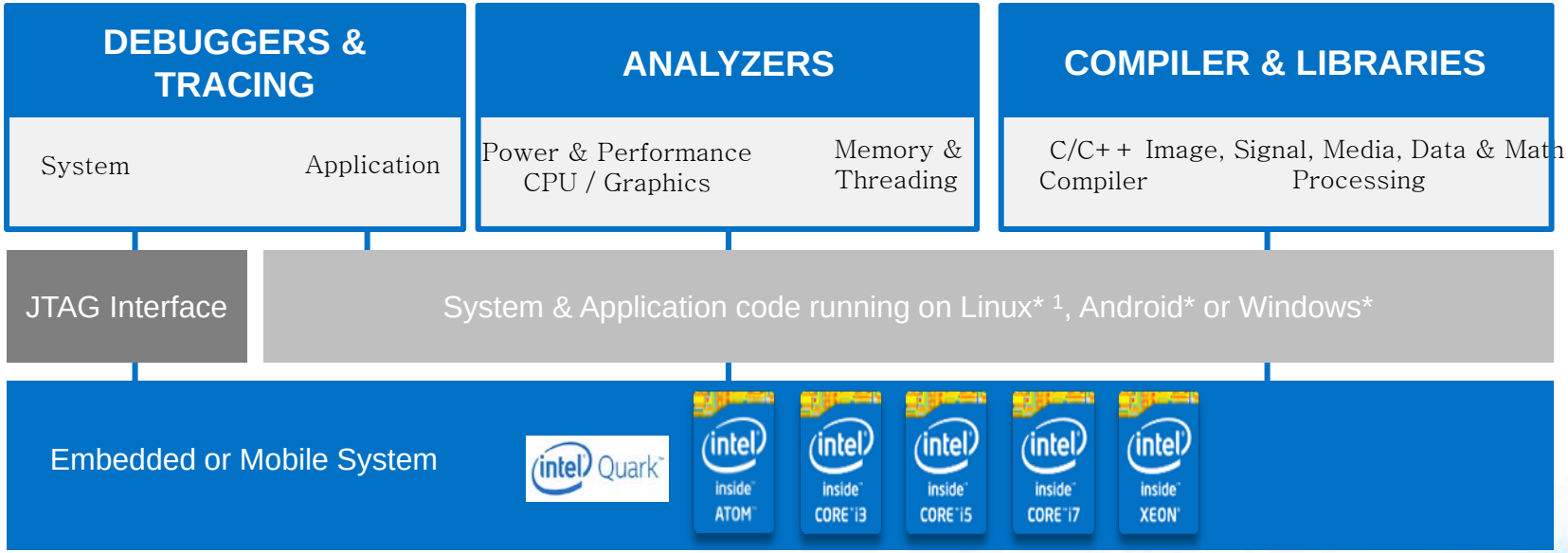
Intel® INDE – Feature Details

	OS Host	OS Target	Feature	Starter Edition Free	Professional Edition $299	Ultimate Edition $799
Getting Started			IDE Integration for Android*†	X	X	X
Build			Context Sensing SDK†	X	X	X
			OpenCL™ Code Builder	X	X	X
			Media RAW Accelerator for Windows*	X	X	X
			Media for Mobile†	X	X	X
			Media SDK for Windows*	X	X	X
			Audio for Windows*		X	X
			Intel® Threading Building Blocks			X
			Intel® Integrated Performance Primitives			X
			Intel® C++ Compilers			X
Analyze/Debug			Intel® HAXM	X	X	X
			System Analyzer‡	X	X	X
			Graphics Frame Analyzer	X	X	X
			Graphics Frame Debugger‡		X	X
			Platform Analyzer		X	X
			Debugger Extension for VS-Android		X	X

†JAVA / ARM support
‡Limited ARM support

Intel® System Studio 2015 Overview

Deep system-wide insight into power, performance, and reliability that helps accelerate time to market of Intel Architecture-based mobile and embedded systems and embedded applications



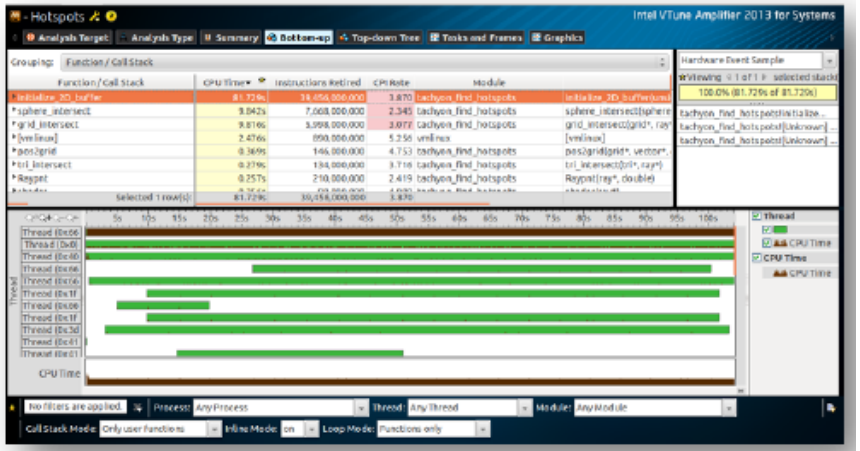
[1] Linux*, Embedded Linux, Wind River* Linux*, Yocto Project*, Tizen*

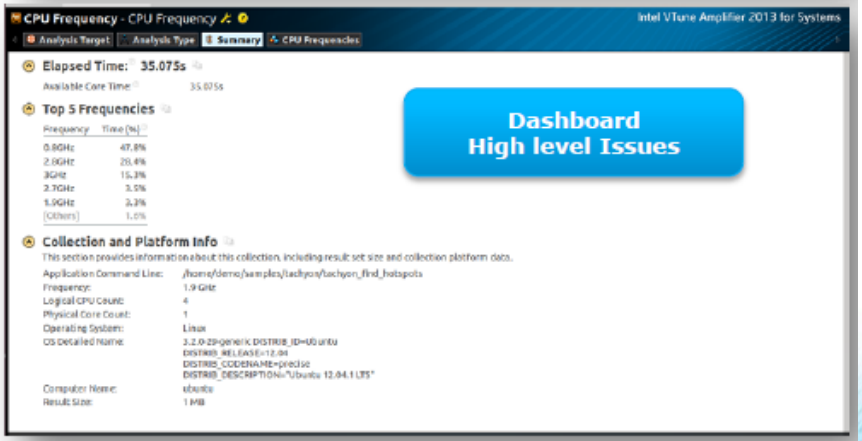
Learn more at: http://intel.ly/system-studio

Intel VTune Amplifier for Android

Performance profiler – Analyzes CPU Performance using PMU

- Event-based sampling for tuning platform performance
- Analyzes hardware events and call stacks
- Identifies Intel® Architecture bottlenecks
  - Cache Misses
  - Branch Mispredictions
  - Important CPU Metrics
- Provides statistical call counts for better data for in-lining decisions
- Powerful filtering to quickly identify cause of performance issues
- Drill-down to the Source Code





Advanced profiling to boost performance

Intel® VTune™ Amplifier for Android* Deep Insights - Boost Power Efficiency and Performance

Remote Data Collection

adb (typically over usb)

Intel® VTune™ Amplifier running on a host system
Performance Collector (amplxe-runss.py)

- Collects performance data on target device
- Automatically copies data to host system

Target Android Smartphone or Tablet

Power Collectors (SoCWatch or WuWatch)

- Collects power data on target device
- Manually copy results to host system

Low overhead sampling
No hardware instrumentation required
View results in source or assembly

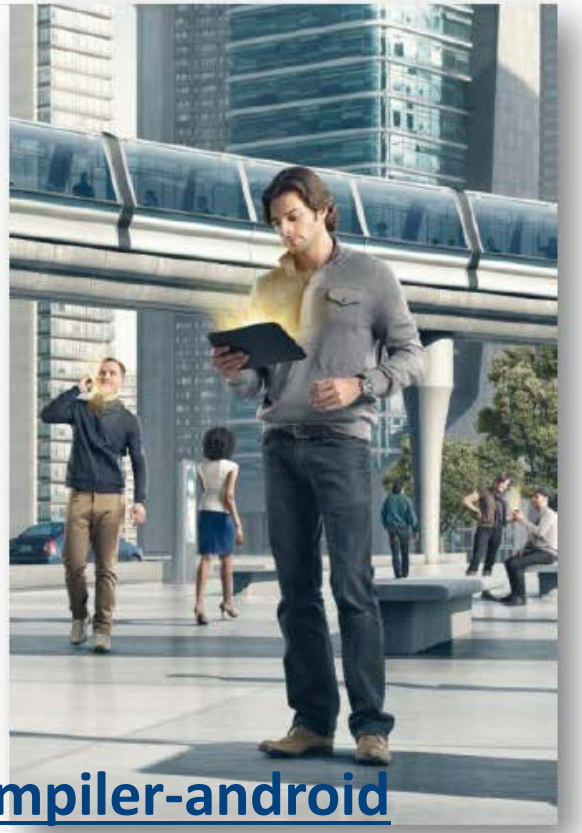
Intel C++ Compiler for Android
Optimized System and Application Performance

High Performance

- Boosts performance with a single recompile
- Binary and source compatible with GNU* GCC compiler
- Intel® Cilk™ Plus - task and data parallelism
- Standards support

Optimization

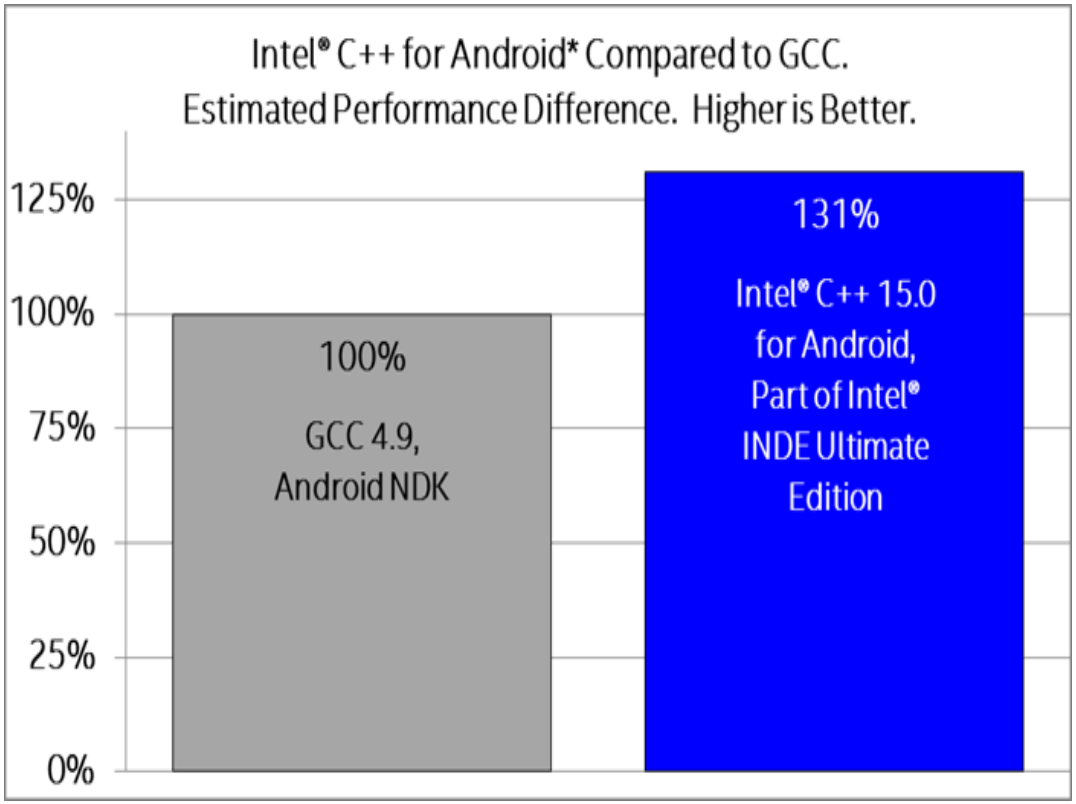
- Intel® Atom™ - optimized common libc/libm functions
- Intel Silvermont microarchitecture support
- Vectorization for loops - SIMD
- Interprocedural optimization (IPO)
- Profile guided optimization (PGO)



http://software.intel.com/en-us/c-compiler-android

High performance. GNU compatibility. Standard support.

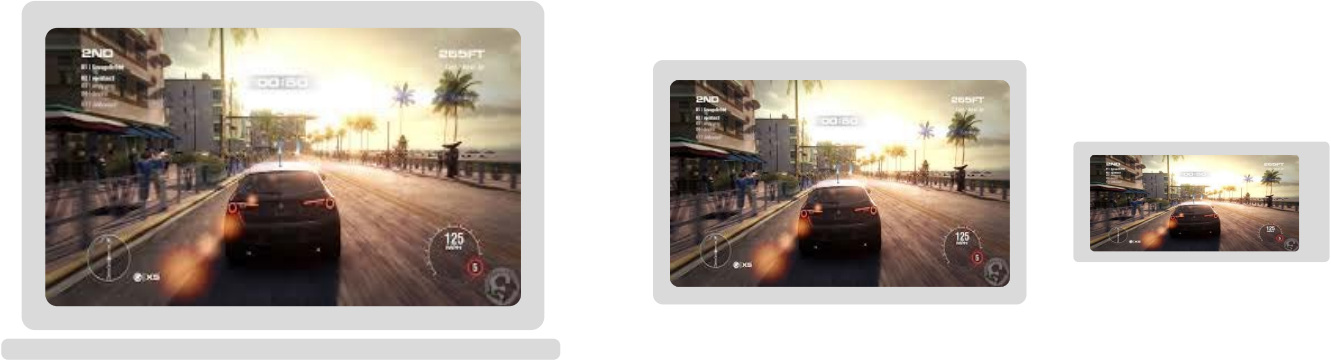
Improve Performance with Optimized C++ Compiler



- Seamlessly integrated within Eclipse* and Visual Studio*
- Automatically selects Intel compiler for x86 targets
- Compatible with GCC

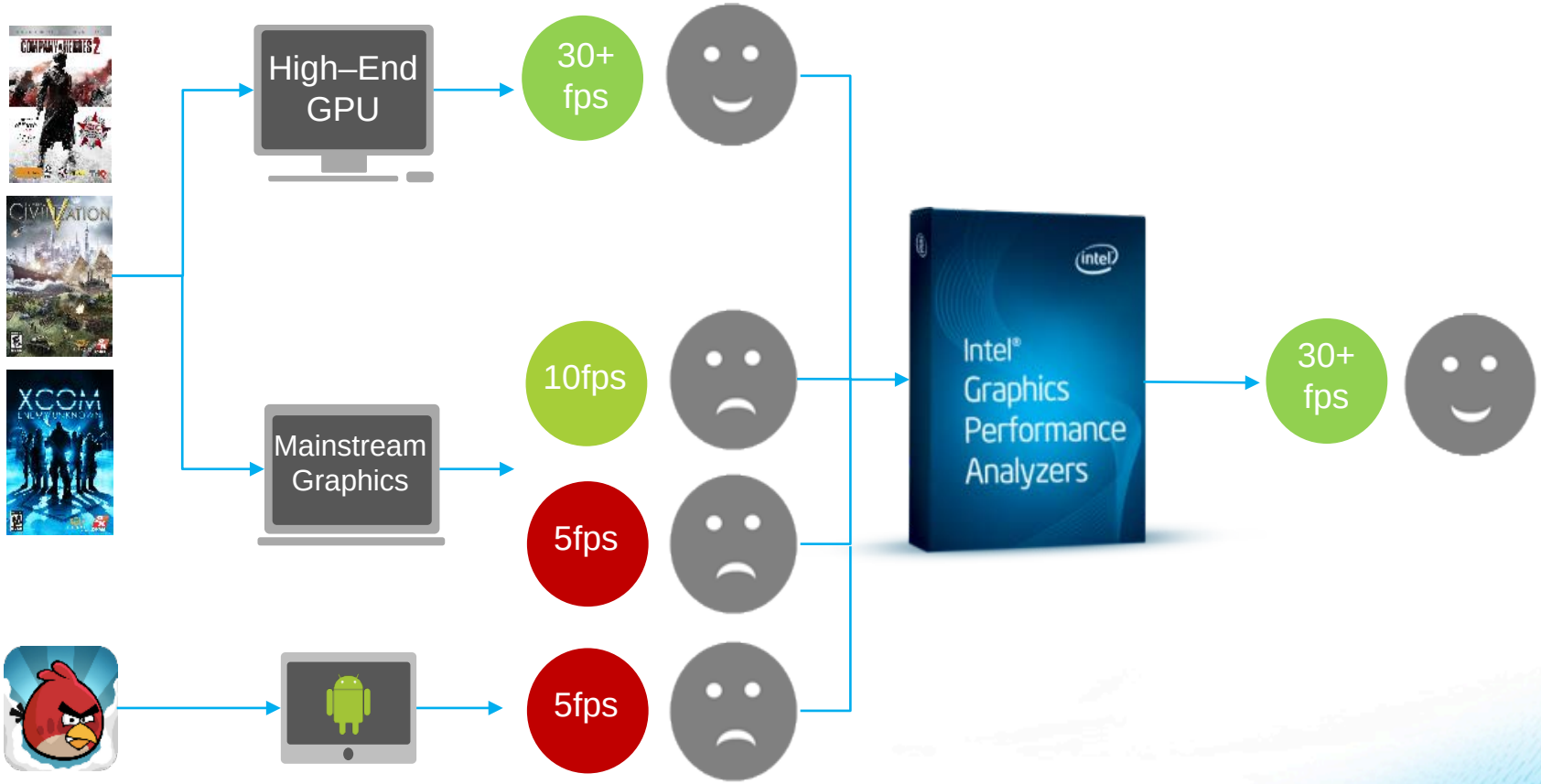
Intel® C++ 15.0 in Intel® INDE Ultimate Edition delivers about 30% more performance for Android apps estimated using SPECint_base2006 rate
Configuration details found here: https://software.intel.com/intel-c-compilers-inde

Intel Graphics Performance Analyzers (Intel GPA)

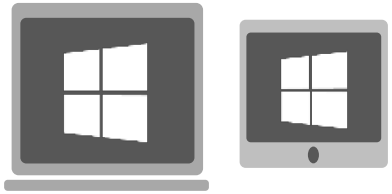


PC Windows* gaming	Mobile gaming (Windows, Android*)

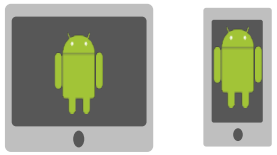
Intel GPA is the app to optimize your games!



For Windows and Android games!



Windows Gaming



Android Gaming

OS support

- Win 7, Win 8.1 64bit

DirectX

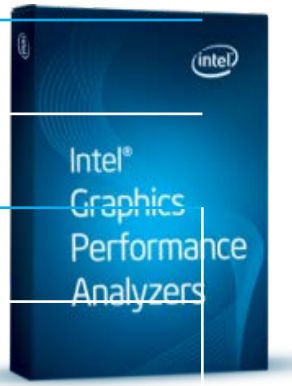
- DX 9.x, 10.x, 11.x

Hardware

- DirectX 9-compatible GPU or newer

Extra

- HTML5 in browsers
- Windows UI apps



Host OS

- Windows, Linux, MacOS X front-end

Android OS

- 4.x

Hardware

- Intel ™ Atom, ARM

OpenGL ES

- 1.x, 2.x, 3.x

Intel® GPA: Four Major Analysis Tools

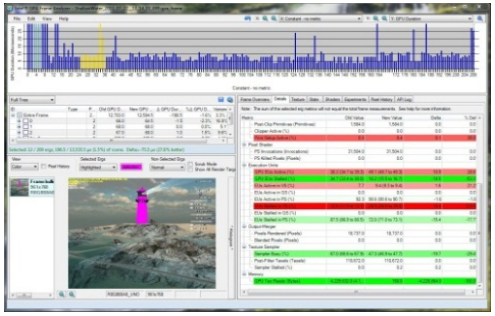
A suite of tools for analysis of graphics and media workloads

System Analyzer

- System Analyzer Heads Up Display (HUD) & Stand-Alone Modes
- Real-time, in-game analysis with graphical metrics displays and state overrides

Heads-Up Display

Stand-Alone Display

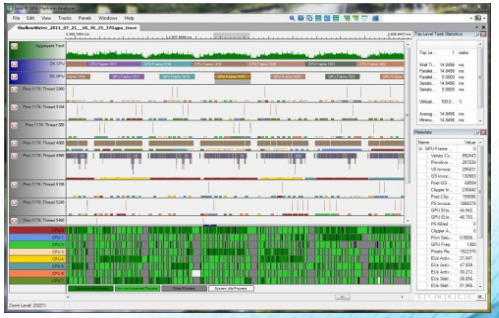


Frame Analyzer

Deep frame performance analysis down to draw call level, including shaders, textures, D3D states, pixel history, and textures.

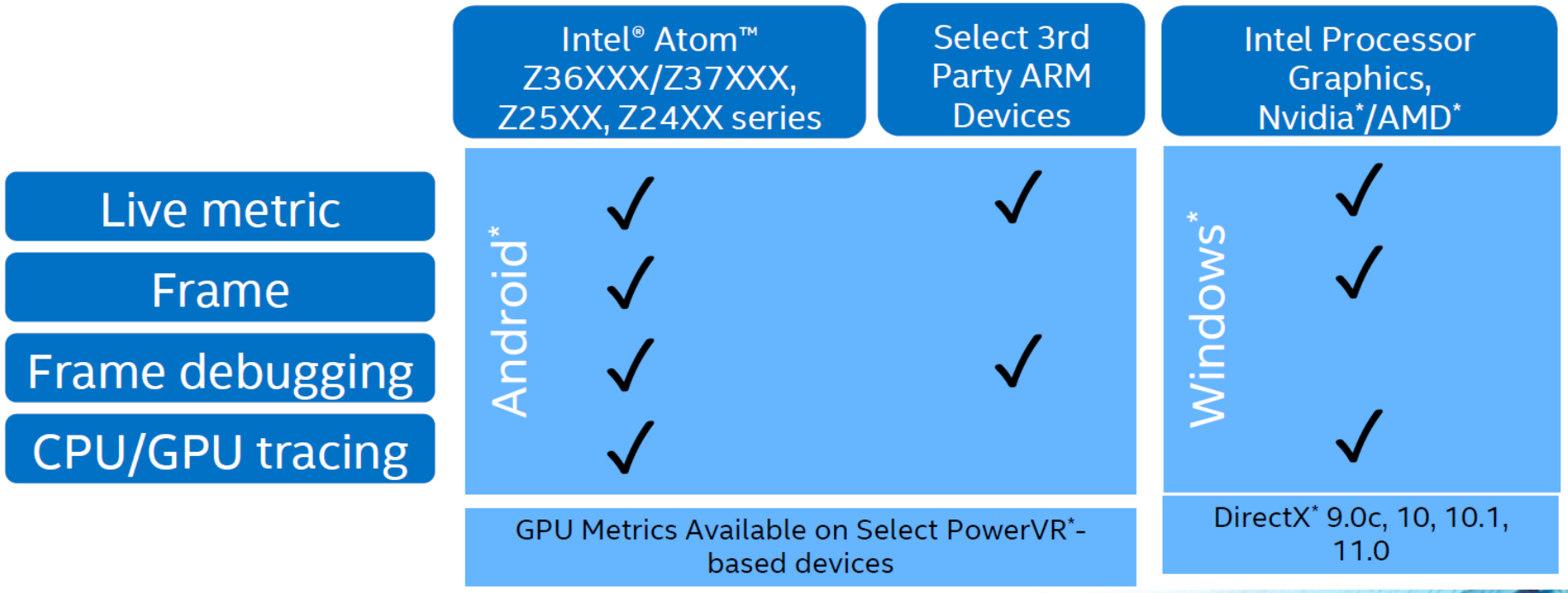
Platform Analyzer

Full system analysis of CPU metrics and workloads across multiple threads and cores, plus simultaneous GPU metrics

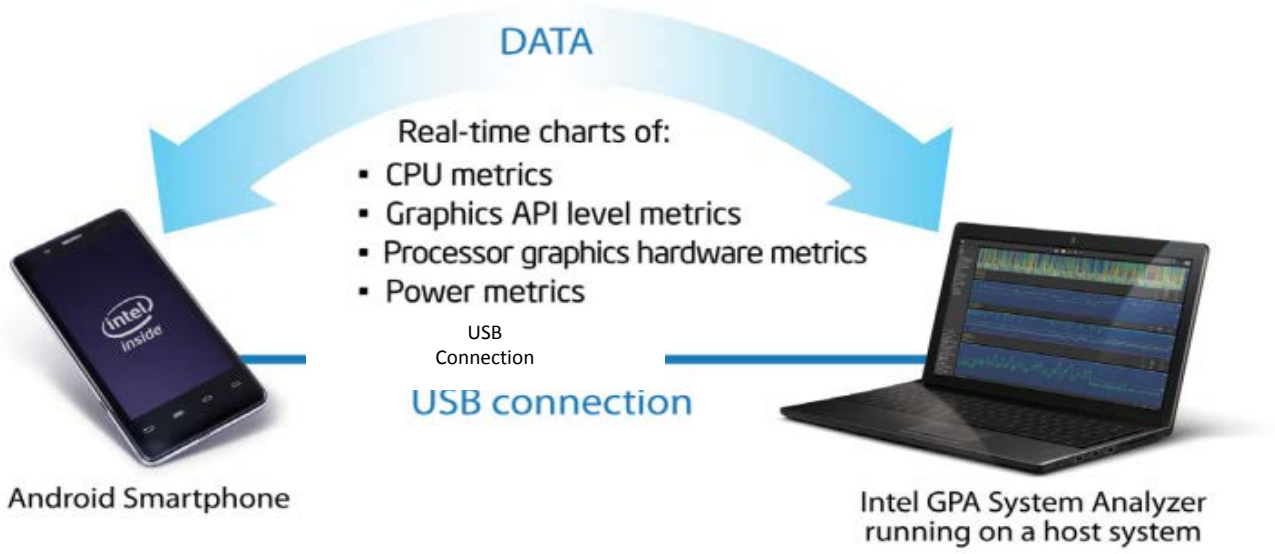


Intel Graphics Performance Analyzers

- Suite of tools for graphics analysis and optimization that can help you make games and other graphics-intensive applications run event faster



Intel® GPA: How to Use for Android



Live Demo

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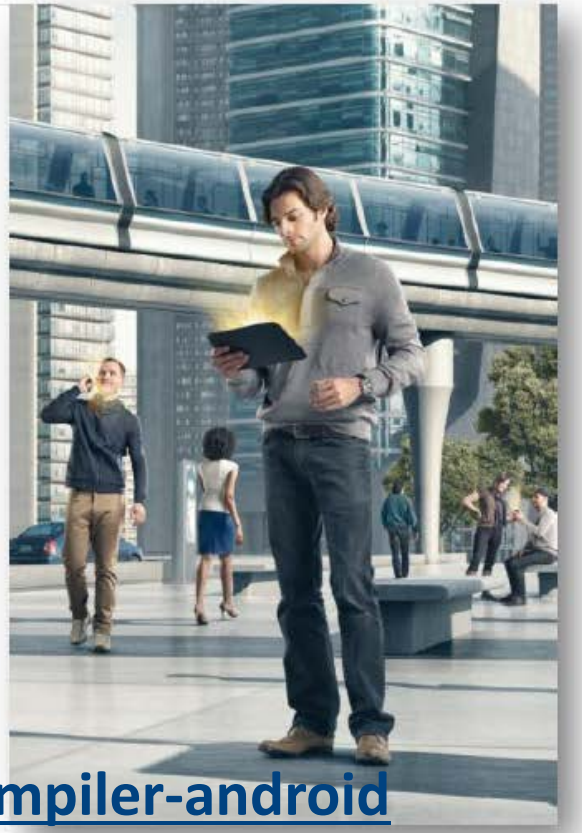


http://software.intel.com/en-us/c-compiler-android

High performance. GNU compatibility. Standard support.

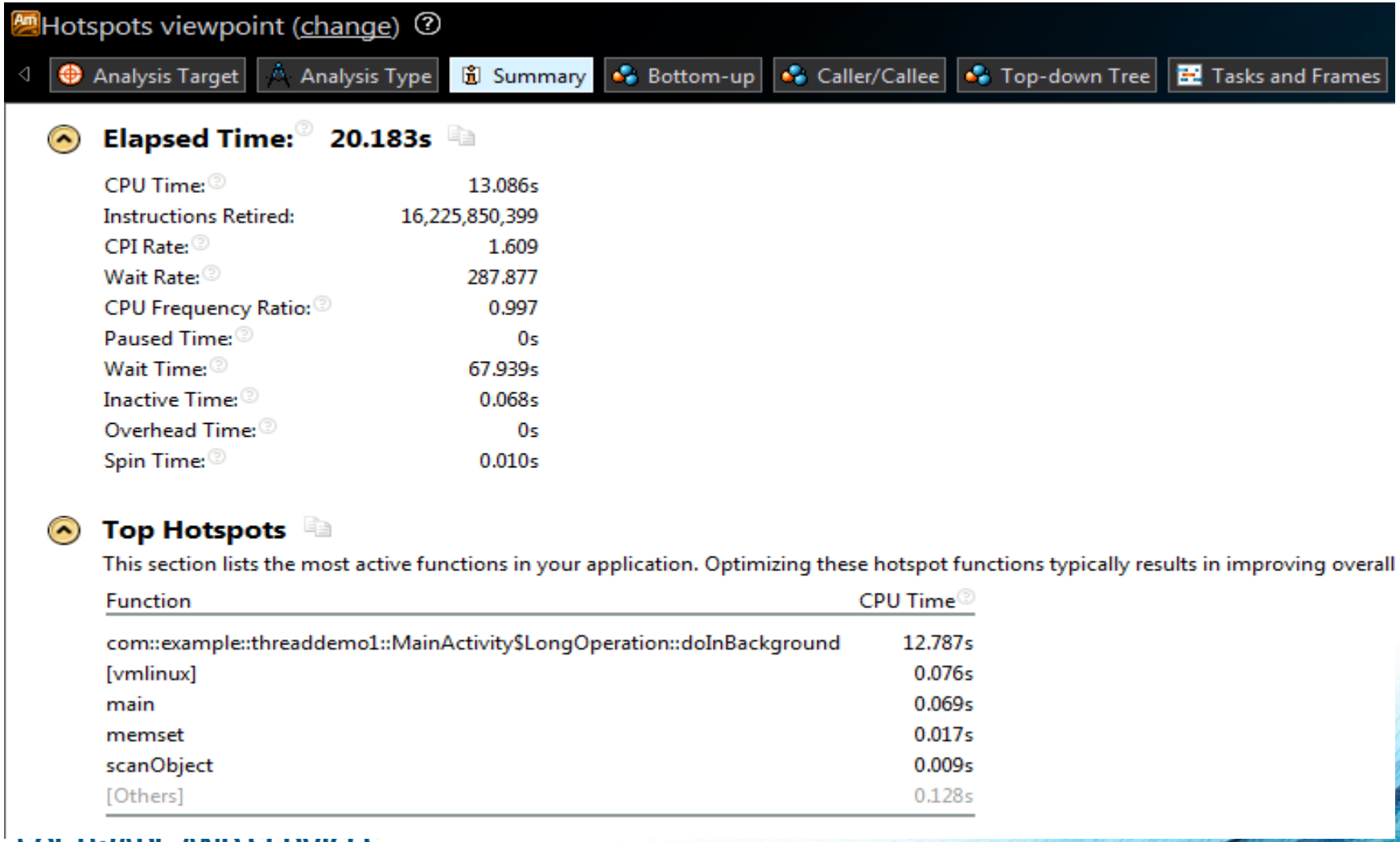
Using Intel C++ compiler for optimization – the app

- 800 Bouncing balls
- Collision detection
- Calculation of sphere
- Moving with random speed

Compare performance

	BayTrail
GCC	27 FPS
ICC	36 FPS
ICC with CPU and IPO option	39 FPS
Cilk Plus	50 FPS

Performance analysis – find out hotpots function - Summary



Performance analysis – find out hotpots function – Bottom-up

Hotspots viewpoint (change)

Analysis Target | Analysis Type | Summary | Bottom-up | Caller/Callee | Top-down Tree | Tasks and Frames

Grouping: Module / Function / Call Stack

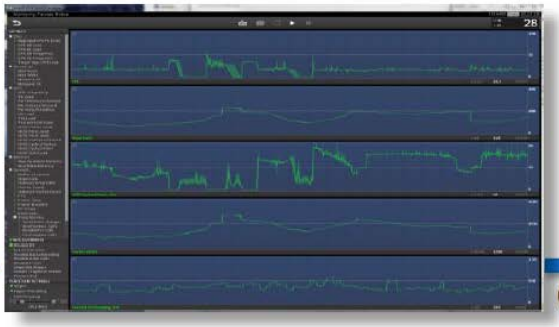
Module / Function / Call Stack	CPU Time by Utilization Idle Poor Ok Ideal Over	Overhea...		CPU Freq...	Mod..	Fun... (Full)	Sour... File	Start Add...	CPI Rate	Instructions Retired
		Ove...	Spin...							
[Dynamic code]	12.787s	0s	0s	1.000				0	1.596	16,029,250,075
com::example::threaddemo1::MainActivity$Lo	12.787s	0s	0s	1.000	[Dyn ...	com ...	Mai...	0x61 ...	1.596	16,029,250,075
dvmMterpStd ← dvmInterpret ← dvmCallM	12.787s	0s	0s	1.000	libd ...	dvm .		0x44 ...	1.596	16,029,250,075
libdvm.so	0.111s	0s	0s	0.810				0	2.476	72,332,022
vmlinux	0.076s	0s	0.002s	0.969				0	2.133	69,117,075
app_process	0.069s	0s	0.004s	0.799				0	5.913	18,744,644
libc.so	0.029s	0s	0.003s	1.115				0	2.333	27,876,967
libsrv_um.so.1.9.2291151	0.004s	0s	0.001s	0.500				0	1.913	2,103,925
libGLESv2_POWERVR_SGX544_115.so.1.9.2291151	0.004s	0s	0s	0.657				0	0.000	0
libpvrANDROID_WSEGL.so.1.9.2291151	0.004s	0s	0s	1.043				0	3.951	2,121,796
libstlport.so	0.002s	0s	0s	0.604				0	1.131	2,145,559
liblog.so	0s	0s	0s	0.000				0	0.000	2,158,336

- Which function is the hotpots function? How much CPU time it takes?

Intel Graphics Performance Analyzers Components

Performance & Debugging

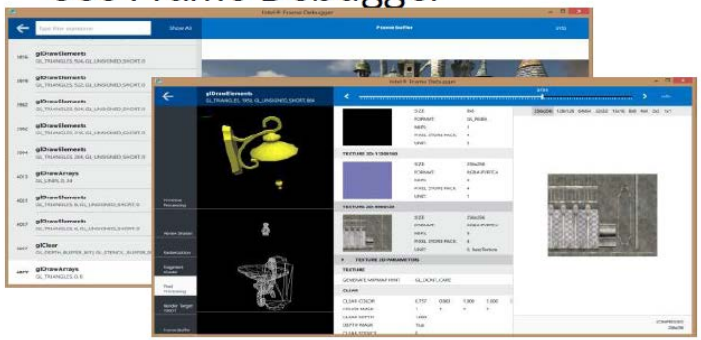
Use System Analyzer

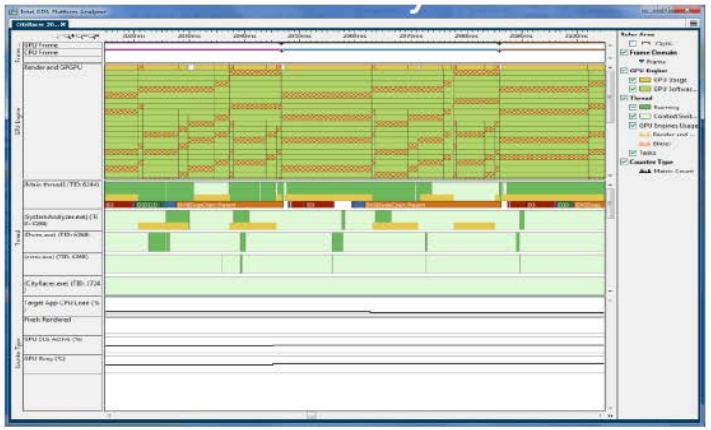


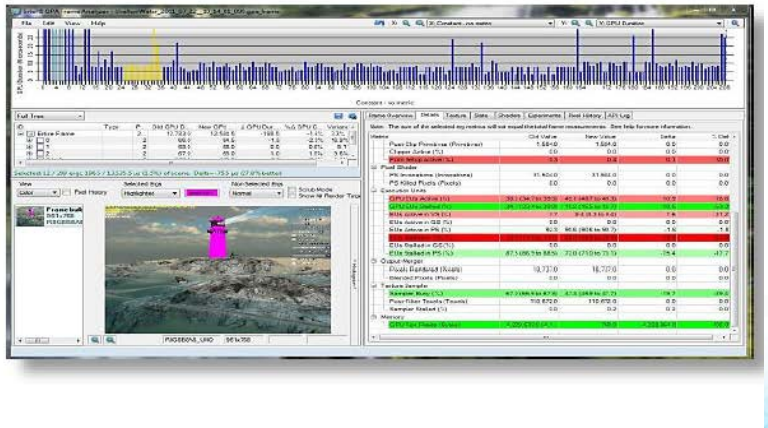
CPU-bound

GPU-bound

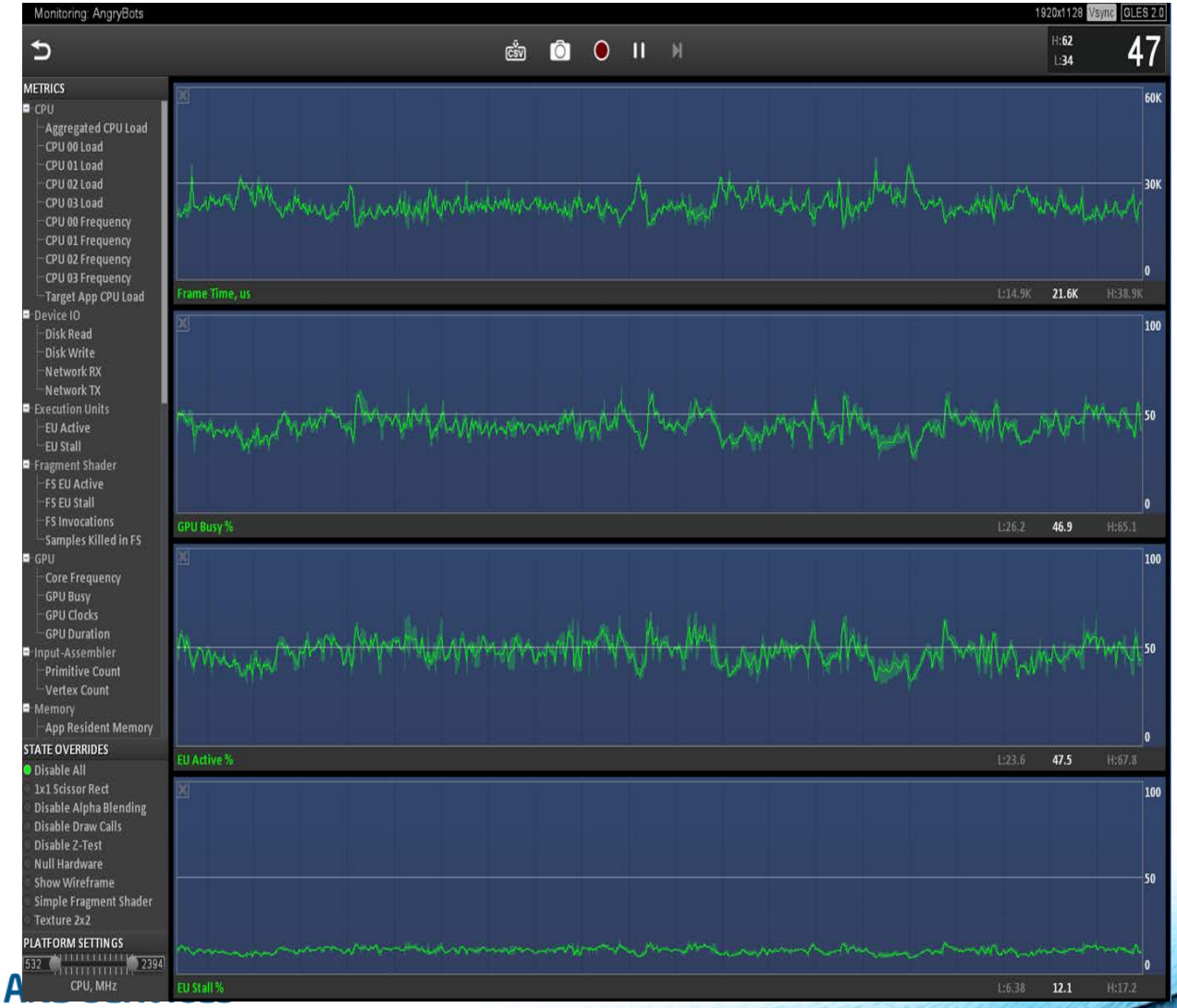
Use Frame Debugger



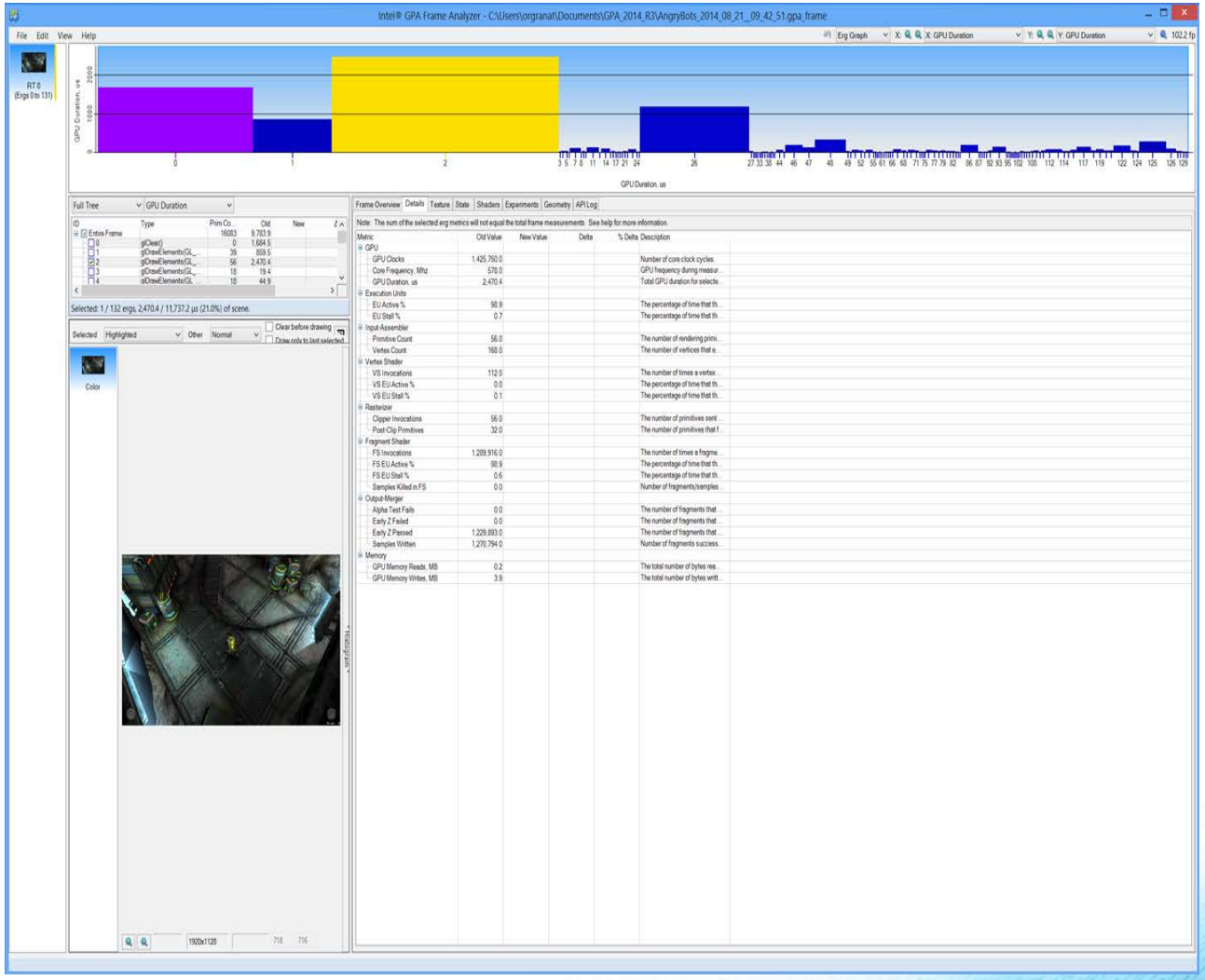




Intel GPA – System Analyzer



Intel GPA – Frame Analyzer

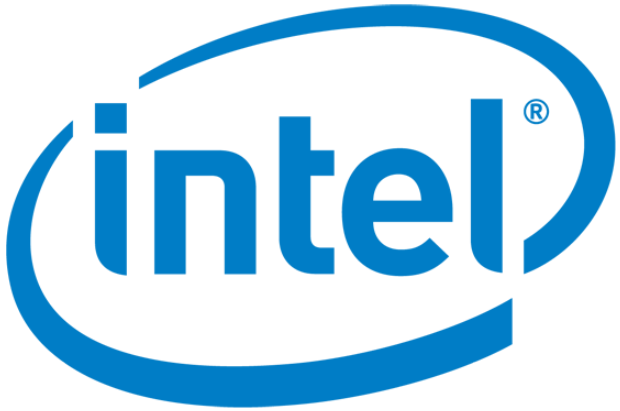


Resource

- Intel Software Android Community http://software.intel.com/android
- Beacon Mountain v0.6.1 for Android* http://software.intel.com/en-us/vcsource/tools/beaconmountain
- Intel for Android* Developers Learning Series Landing Page http://software.intel.com/en-us/blogs/2012/11/28/intel-for-android-developers-learning-series
- Android* Application Development and Optimization on the Intel® Atom™ Platform http://software.intel.com/en-us/articles/android-application-development-and-optimization-on-the-intel-atom-platform
- Android* Tutorial: Writing a Multithreaded Application using Intel® Threading Building Blocks http://software.intel.com/en-us/articles/android-tutorial-writing-a-multithreaded-application-using-intel-threading-building-blocks
- Finer Points of using SSE Instructions for Android* media apps on the Intel® Atom™ Platform http://software.intel.com/en-us/articles/finer-points-of-using-sse-instructions-for-android-media-apps-on-the-intel-atom-platform
- Hands-on Lab: Develop, Optimize, Debug, and Tune Applications for Android* https://intel.activeevents.com/sf13/connect/sessionDetail.ww?SESSION_ID=1115

Resource

- Using the Second-Screen API and Intel® Wireless Display from Android* Applications
  https://intel.activeevents.com/sf13/connect/sessionDetail.ww?SESSION_ID=1134
- Developing Native Applications on Android* and Optimizing for Intel® Architecture
  https://intel.activeevents.com/sf13/connect/sessionDetail.ww?SESSION_ID=1129
- Accelerating Your Software Development for Android* on Intel® Platforms
  https://intel.activeevents.com/sf13/connect/sessionDetail.ww?SESSION_ID=1228
- intel compiler download site http://software.intel.com/en-us/c-compiler-android/
- IPP download site http://software.intel.com/en-us/intel-ipp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