Performance Impact of Flash Memory on Multi-Core Android-Based Smartphone

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Motivations

- Many cell phone makers facing “Power Wall”
- Need to run more applications for a longer time
- Is Flash Memory a option?
- Created a Virtual Platform for Performance and Power Optimization
  - Enable Performance and Power Profiling and Tuning with running real Java Applications on Android
    - Application: Android application written in Java
    - SW Platform: Android SDK
    - HW Platform on VisualSim: ARM9/11 Library, Memory Libraries, etc.
- Huge expectations on Android Market
  - Many chip vendors are porting and demonstrating Android
    - ARM, TI, Qualcomm, NEC, Freescale, Marvell, Renesas
What is “Android on VisualSim”?

- Android HW/SW running on VisualSim platform
  - Execute any Android applications
  - Visualize what’s happening on SW and HW platform
    - Where is the bottle neck
- Visualize the Performance and the Power
  - “Performance Meter”
    - Performance Profile: Flash, CPU, SDRAM, WiFi
  - “Power Meter”
    - Power profile: CPU, SDRAM, Flash, WiFi, LCD, Touch Screen
- Optimize Application Software for Performance and/or Power
  - Need power control, smart
- Optimize Hardware architecture for Performance and/or Power
  - need Multi-Core, Low-Power memory, Back Light Control, etc.
Established in 1999, Tsukuba, Japan

TOPS Systems provides:

• **Heterogeneous multi-core Solutions**: wide range of energy-efficient and scalable Multi-Core solutions. These cores provide distinct advantages from optimizations through Architecture-Algorithm Co-Design and Hardware-Software Co-Design for Systems and SoC developers.

• **Heterogeneous multi-core processor IP**: TOPSTREAM™-based products are used in higher performance and lower power applications ranging from battery-driven information appliances.

• **Development service**: in Japan a range of services from initial architecture definition and software development through design verification as their extension to reduce total development costs and speed time to market.
VisualSim Model Screen Shot
Development Flow

Android Instruction Level SW Platform In QEMU

Android G1 HW Platform In VisualSim

Integration Performance & Power Analysis

(FileI/F) (CORBA I/F)
Android Instruction Level
SW Platform

Applications
(Java)

Boot Message

UART

FLASH

File System

• Generate Bus
Transactions
• Instruction Type

ARM11 ISS
(QEMU)

Instruction Level

Android SW Stack
Connection between SW model and HW model

Android G1 System
Cycle Accurate/ Instruction

Hardware Platform on VisualSim

QEMU

Application (Web, Map, YouTube, etc)

Java

Android SW Platform
Linux Dalvik lib

ARM ISA

QEMU

ARM

MMU

Cache

Memory

goldfish

FB LCD

KEY Touch Screen

WiFi Audio

Cycle Counter

Application (Web, Map, YouTube, etc)

Android SW Platform
Linux Dalvik lib

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WiFi Audio

Cycle Counter

Android G1 System
Cycle Accurate/ Instruction

Hardware Platform on VisualSim

NAND Flash (256MB) + DDR SDRAM (128MB) Samsung MCP K5E2G1GACM

Power AMP 802.11b/g Ti WL1251FE

Wi-Fi Transceiver 802.11b/g Ti WL1251FE

Power Management Qualcomm PM7540

LCD Controller

LCD Sharp 3.2" TFT HVGA (320 x 480)

Capacitive Touch Screen Controller Synaptics 1007A

Touch Screen

Key Board

Battery 35H00106-01M 1150mAh

Power AMP 802.11b/g Ti WL1251FE

Wi-Fi Transceiver 802.11b/g Ti WL1251FE

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Summary

- Released “Android™ on VisualSim” architecture exploration platform for multi-core phone design.
- Systems designers of Android devices can use this platform for hardware-software architecture exploration and power and performance analysis of consumer devices.
- Achieved 10-20 MIPS for a cycle-based and Approximately-Timed simulation running software applications.