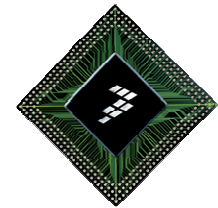


May, 2010

Freescal Android Platform Support for i.MX applications processors



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Freescale Multimedia Markets



Automotive

- Historic leadership in Telematics
- Ramping in radio and infotainment
- Initial designs in advanced clusters



Smart Mobile Devices

- Thought leader for smartbooks
- Focused investment in tablets
- Strong smartphone player

PHILIPS

Google™

SHARP



eReaders

- Dominant market share in emerging eReader market
- Aligned with market leaders



SONY



Embedded Multimedia

- Broad traction in the embedded market
- Connected display based devices in consumer and industrial markets



**Example of
Consumer usage:**

Applications Processors (i.MX) Roadmap

High tier smartbook

Smartbook
Smartphone

eReader

PMP

Next gen

i.MX51 family

- Cortex-A8, 800MHz
- Video (720p dec)
- Graphics
- 512MB DDR2

i.MX508

- Cortex-A8, 800 MHz
- Graphics
- E INK display Controller
- 512MB LP-DDR2

i.MX31 family

- ARM1136, 532MHz
- Graphics
- mDDR

i.MX35 family

- ARM1136, 532 MHz
- Graphics
- DDR2

i.MX27 family

- ARM926, 400MHz
- Video

STMP37xx

- ARM926, 266-400MHz
- Integrated PMIC

i.MX25 family

- ARM926, 400MHz

i.MX233

- ARM926, 454 MHz
- Integrated PMIC

Next gen

<2008

2009

2010






Right Edge = Consumer Qualification
Left Edge has no meaning

-  C90 i.MX Platform
-  C90/C85 STMP Platform
-  C65 A8 Platform

i.MX Value Proposition

- ▶ i.MX silicon and software solution that enables world-class smartbook/tablet products with real-world consumer benefits
- ▶ Complete hardware and software package provided to enable faster time to market and lower R&D investment
 - BSP's available for all major smartbook/tablet OS's
 - Full-featured media framework, including HW-accelerated Flash 10 and Skype
 - Significant investment in HW-acceleration for Linux and Android UI framework
 - Partners in place to provide UI and application customizations if needed
 - Design collateral up to and including complete form-factor reference design
 - Extensive tablet and smartbook consumer market research and thought leadership

Smartbook OS Options

OS	Target Markets	Comments
Chrome 	Clamshell	<ul style="list-style-type: none"> • Aimed at cloud computing • No touch screen support today
Android 	Smartphone Smaller tablets (<7 in) eReaders	<ul style="list-style-type: none"> • Optimized for smartphones • Touch screen support • Tremendous pull in multiple markets
Ubuntu 	Clamshell Large tablets (7-10 in)	<ul style="list-style-type: none"> • Supports netbook applications • Smartbook flavors
Milios 	Smartbook Smartphone	<ul style="list-style-type: none"> • Optimized applications
WinCE 	Small clamshell Tablet	<ul style="list-style-type: none"> • Highly integrated WinCE6 and WinCE 7 platforms



A few words about Android

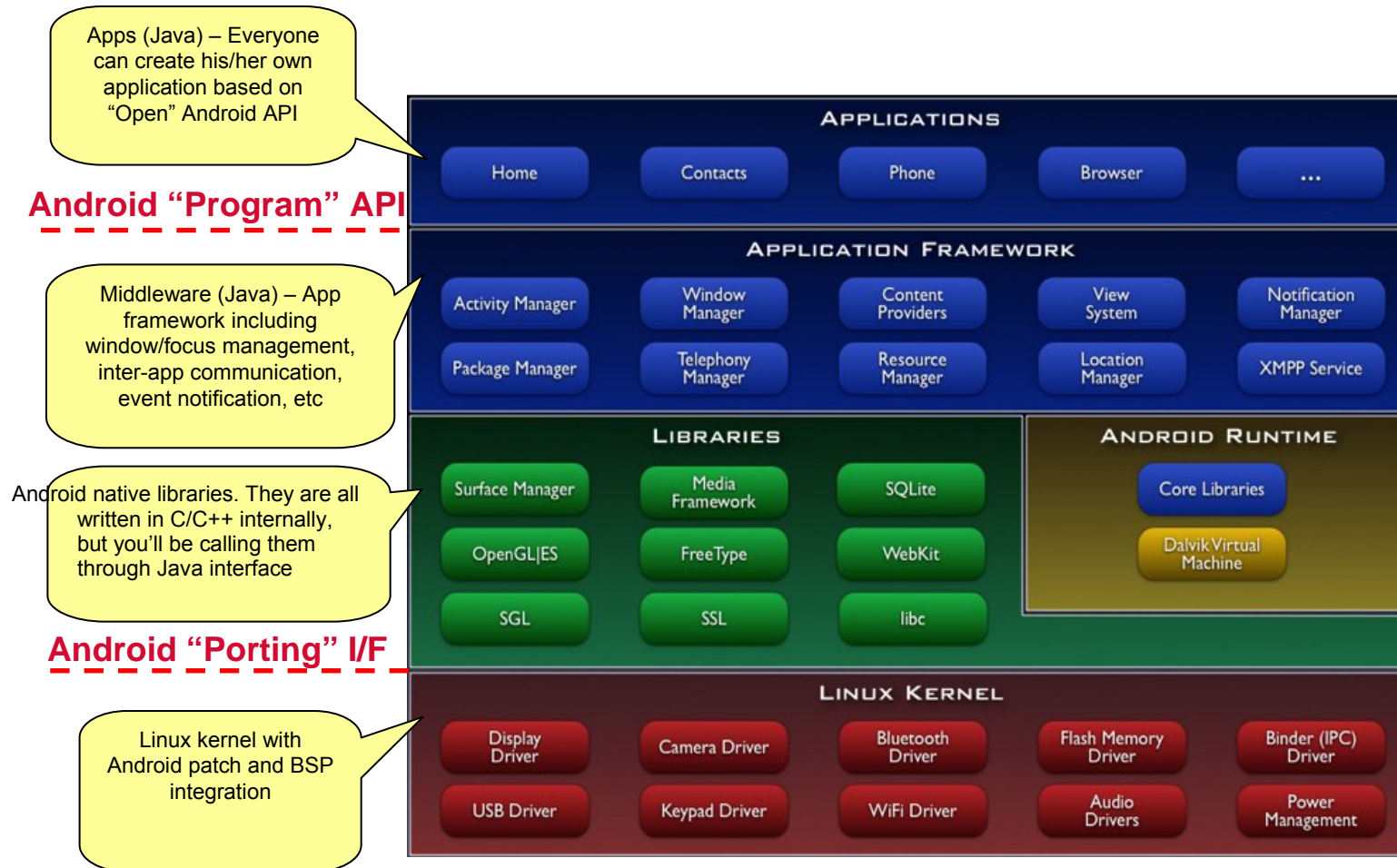
What is Android?

- ▶ A free, open source and fully customizable software platform and operating system for mobile devices
- ▶ Based on the Linux kernel
- ▶ Offers a full software stack: an operating system, middleware, and key applications
- ▶ Also contains a rich set of APIs that allows third-party developers to develop great applications
- ▶ Developed by Google and later the Open Handset Alliance (OHA)
- ▶ Allows writing managed code in the Java language
- ▶ Unveiling of the Android platform was announced on 5 November 2007 with the founding of OHA
- ▶ Android is under version 2 of the Apache Software License (ASL)

What is Open Handset Alliance (OHA)?

- ▶ A group of mobile and technology leaders responsible for the creation and proliferation of Android and an open mobile ecosystem
- ▶ Devoted to advancing open standards for mobile devices
- ▶ Develop technologies that will significantly lower the cost of developing and distributing mobile devices and services
- ▶ Freescale joined OHA in early 2010

Android Platform details



What Android Is and Is Not

- ▶ It's a software stack for mobile devices including **OS (Linux), middleware and key applications**
- ▶ It's a different Linux OS (or “distribution”) based on Linux kernel. The system libraries, system initialization and program interface in it are distinct from a “standard” Linux OS
- ▶ It's not ONLY an application framework for Linux, although it does include it's own app framework (window management, inter-app communication, event dispatch, ...)
- ▶ It's not ONLY a Java API for phone, although it does include a Java virtual machine (called “Dalvik”) and all system interfaces are exposed only through Java libraries
- ▶ It's not a full phone stack. It's ONLY SW running on application CPU. It will interact with wireless protocol (GSM/GPRS/WCDMA/...) running on separate baseband chip to implement telephony features

Some key features of Android

► Connectivity

- Supports connectivity technologies including GSM/EDGE, CDMA, EV-DO, UMTS, Bluetooth, and Wi-Fi

► Web browser

- Web browser available in Android is based on the open-source WebKit application framework

► Media

- Supports the following audio/video/still media formats: H.263, H.264 (in 3GP or MP4 container), MPEG-4 SP, AMR, AMR-WB (in 3GP container), AAC, HE-AAC (in MP4 or 3GP container), MP3, MIDI, OGG Vorbis, WAV, JPEG, PNG, GIF, BMP

► Hardware and graphics

- Can use video/still cameras, touchscreens, GPS, accelerometers, magnetometers, accelerated 2D bit blits (with hardware orientation, scaling, pixel format conversion) and accelerated 3D graphics

► Android Market place

- Catalog of applications that can be downloaded and installed to target hardware over-the-air, without the use of a PC

► Multi-touch

- Has native support for multi-touch which is available in newer handsets such as the Nexus One

► Dev environment

- Includes a device emulator, tools for debugging, memory and performance profiling, a plugin for the Eclipse IDE



Freescal Android strategy

i.MX Android Strategy

► Readiness

An “integrated” solution (kernel + Android framework + dev/debug environment) instead of a “Android compliant” kernel only. Customer should be able to directly develop applications on this “integrated” solution or easily modify/replace their own drivers based on our reference code. i.e. our BSP needs to be “glued” with Android framework seamlessly

► Performance

Our i.MX+Android integration shows higher performance by careful optimization (e.g. utilizing HW acceleration, SW codec optimization) on current Android base

► Contribution

Freescale is now an OHA member

Participate and actively contribute in the OHA community



Contents of a Freescale i.MX Android Release

Consist of three packages:

- ▶ Core – Images for board and source patches except FSL's parser/codec enhancement (HW video acceleration is still included in this package)
- ▶ Codec standard package - FSL's parser/codec enhancement, but exclude those parser/codec which need additional license agreement
- ▶ Codec excluded package - those parser/codec enhancement which need additional license agreement, including DivX/AC3/RMVB

i.MX5x Android Value Add and Roadmap

► Integrated and tested solution

- Kernel + Android framework + codecs + development/debug environment

► Performance Optimization

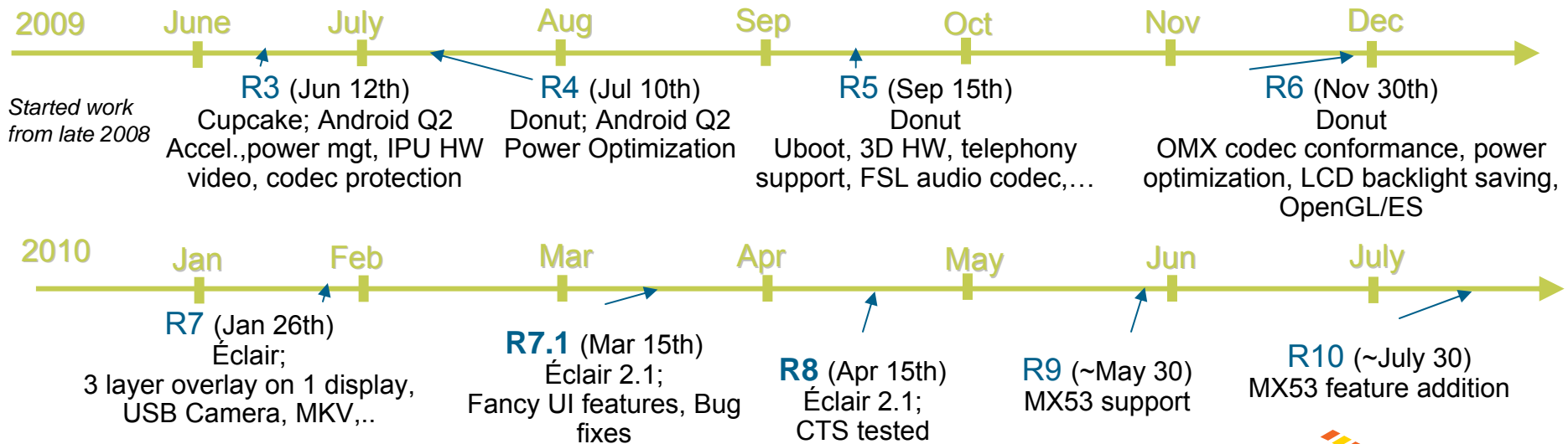
- Hardware acceleration for graphics and multimedia
- Optimized OpenMax and OpenGL/ES with on chip VPU/GPU

► Extensive Test Case

- System test: power, audio, video, graphics, camera, connectivity
- BSP and Codec test



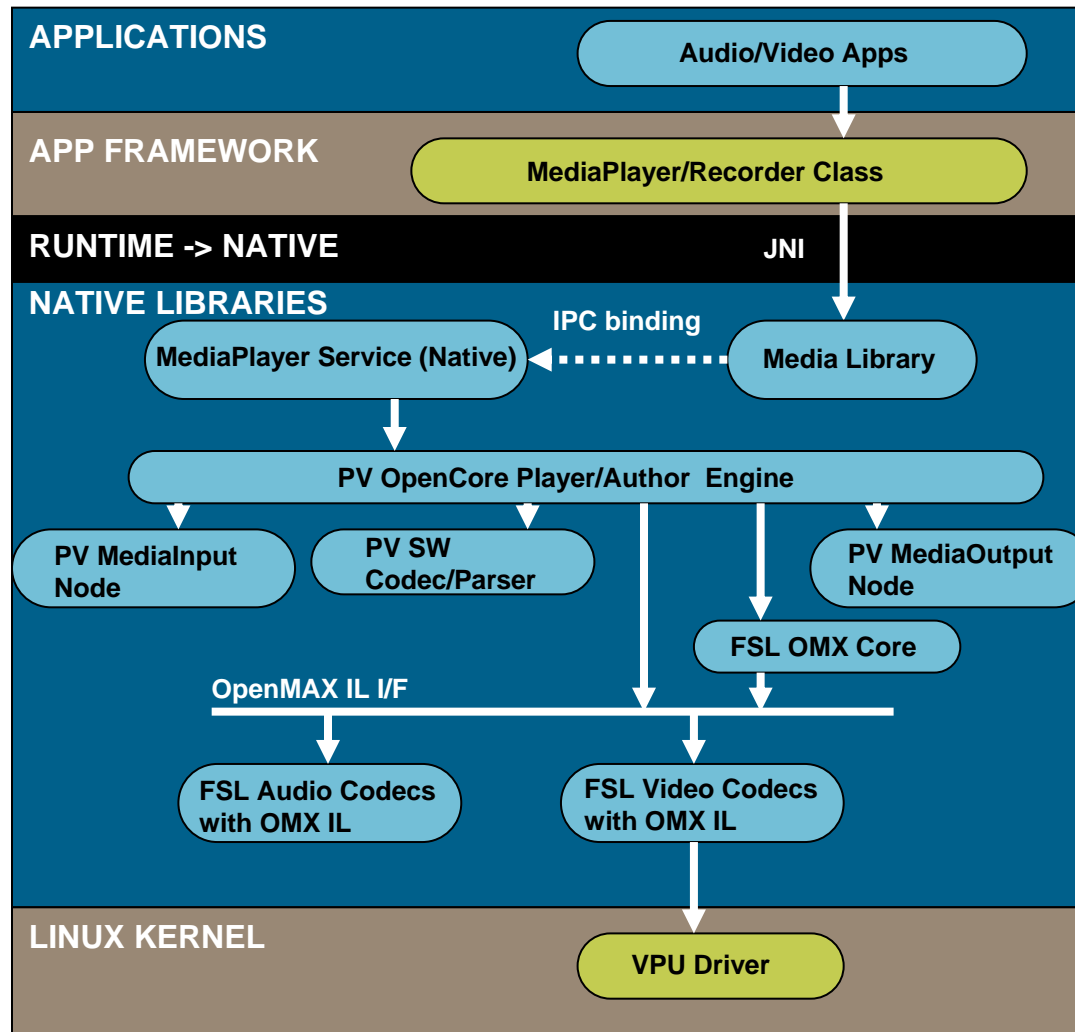
► New release ~ every two months



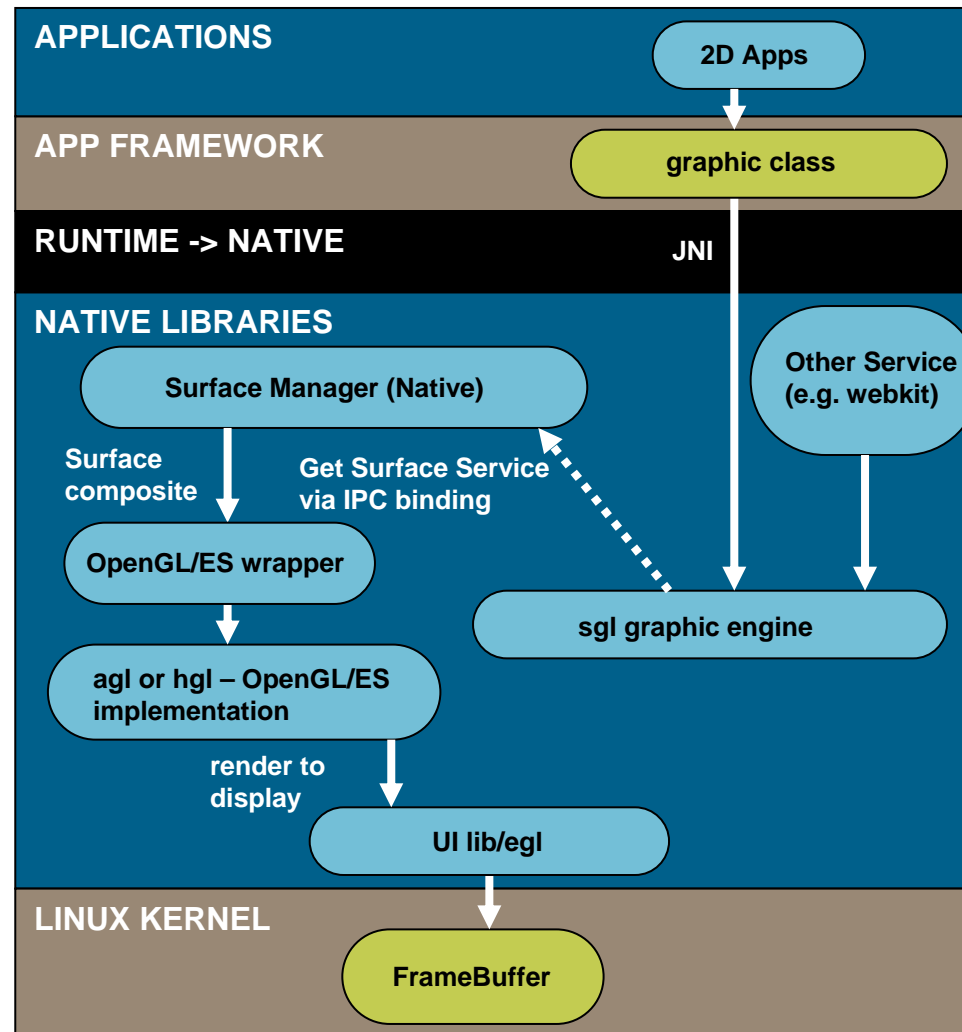
Freescal Android optimizations



Multimedia – Audio/Video Codec



Multimedia – Graphics



Freescal takes numerous optimization into Android

- ▶ **Performance optimization for video/audio playback**
 - Incorporated audio codecs optimized specific for Cortex-A8/Neon
 - Incorporated video accelerator to enable 720p playback
 - Incorporated video accelerator to enable D1 camcording
 - Video rendering
 - Rendering video through overlay instead of the SurfaceFlinger (UI)
 - Video overlay is accelerated by hardware
 - Frame buffers are shared between the decoder and renderer so avoid memory copy
- ▶ **Performance optimization for 3D and UI by using the GPU**
 - Incorporated the GPU for 3D processing
 - Hardware Bitblt to combine surfaces into the display buffer
- ▶ **Functional enhancement for Android OpenCORE**
 - Added more formats: AVI, MKV, FLV, ASF and RM
 - Added more codecs: WMV7/8/9, WMA, Ogg Vorbis and AC3 decoders
 - Added MP3 for audio encoding
- ▶ **Product-quality test**

Video playback performance comparison between un-optimized and optimized Android

Container	Video	Audio	Resolution/ Framerate	CPU loading		Frame Dropping Rate	
				Original	Optimized	Original	Optimized
MP4	MPEG-4	AAC-LC	320x240/30	56.5%	7.3%	0	0
			640x480/30	96.5%	8.7%	7.4%	0
			720x576/30	>97%	9.2%	27%	0
			1280x720/30	N/A	11%	N/A	0
	H.264		320x240/30	79.6%	7.0%	0	0
			640x480/30	N/A	7.6%	N/A	0
			720x576/30	N/A	8.2%	N/A	0
			1280x720/30	N/A	11.2%	N/A	0

Notes

- ▶ The test is carried out on Freescale Babbage 3.0 board with WVGA output
- ▶ N/A means this specification is not supported
- ▶ The original Android supports MPEG-4 up to VGA and H.264 up to CIF with acceptable quality
- ▶ Freescale version with optimization supports MPEG-4 and H.264 up to 720p without frame dropping

Android Test Methodology

- ▶ Freescale provides platform software components under the Android framework, to enable customers develop final Android-based solutions
- ▶ Our validation strategy consists of primarily validating the key platform pieces that constitute an Android port – which (as seen in the block diagram) is focused on the HAL, BSP and Codecs
- ▶ From a system stand point, we focus on the following pieces for integration and validation: Codecs, WiFi, Bluetooth, GPS, Camera, Graphics, and extensions that would feed into the Android stack.
- ▶ We will provide feedback on the Android stack to OHA but will not validate middleware features that are being handled by Google/OHA – we assume they are already extensively validated
- ▶ Validation with Android CTS

OHA contribution

- ▶ Android enabled kernel for i.MX SoC
- ▶ Android runnable configuration (and necessary binaries) which can be used for building Android for our open-available hardware platform
- ▶ Utilize HW (Image Processing Unit) for video surface rendering
- ▶ Utilize HW (Video Processing Unit) for video codec acceleration
- ▶ Utilize HW (Graphics Processing Unit) for OpenGL-ES graphic acceleration
- ▶ Utilize/verify Android HAL (GPS/WiFi/BT, Camera, sound with ALSA) on our Android platform

Summary

- ▶ Freescale Semiconductor enables customers with integrated hardware/software solutions to realize faster time to market. The Android platform provides a compelling and innovative end user experience to support this effort
- ▶ The i.MX51 Applications processor with Android is a full hardware and software solution that is ideal for high performance, low power and cost effective mobile devices, including smartphones and other smart mobile devices such as smartbooks and eReaders
- ▶ The i.MX51 EVK offers a fully integrated and tested Android platform with optimized codecs and graphics and a development and debug environment. This solution is based on the latest stable Android kernel/release
- ▶ Freescale is a member of the Open Handset Alliance™ - a group of mobile and technology leaders responsible for the creation and proliferation of Android and an open mobile ecosystem

Learn more on...

<http://www.freescale.com/imxandroid>

