June, 2010

Using Freescale Linux® Package to Take Full Advantage of the Rich Hardware Acceleration Blocks of the i.MX51 (Part 1)

FTF-ENT-F0665

Gerald Vahe & Marsha Chang
Field Applications Engineer & Product Marketer
Agenda

► Introduction
► Roadmap
► i.MX51 Markets and Focus
► Why Freescale’s ARM?
► i.MX51 Variants
► Graphics Acceleration & Demo
► Video Acceleration & Demo
► Development System … i.MX51EVK
► Software Enablement
► Partners/Third Party Ecosystem
► Conclusion
► Questions?
Freescale Applications Processor Value Proposition

► Performance
(MHz and Memory Efficiency)

► Low Power (Audio < 18 mW system,
HD720 Video < 250 mW)

► State-of-the-art Audio, Video,
Graphics and Codecs

► Consistent and scalable architecture

► Complete OS/SW platform

► Mixed signal integration
Freescale Mobile Consumer Leadership

► Pioneer in the portable media player market
► #1 market share in eBook application processors
► Shaping the smartbook product category
i.MX51 Family Target Markets

► Product Launch
   November 4, 2009

► The i.MX51 brings a new level of performance and integration to the i.MX family from Freescale, while maintaining the family’s commitment to low power consumption, product accessibility and device longevity.

Freescale extends its i.MX51 family to new markets with four processors based on ARM Cortex™-A8 technology

AUSTIN, Texas – Nov. 4, 2009
i.MX51 Key Advantages

► Performance

• The i.MX51 family of processors runs on the powerful ARM Cortex-A8 core at speeds up to 800 MHz, which allows for roughly 2 MIPS per MHz. In addition, the i.MX51 processor offers flexible memory support for mDDR, SDRAM, SLC/MLC NAND, popular lower-cost DDR2, a NEON™ co-processor and VFPU. The high performance of the i.MX51 family of processors enables life-like video and 3-D graphics reproduction and quick response times needed for advanced user interfaces and sophisticated video processing - the building blocks to power the next great applications.

► Integration

• The i.MX51 products integrates five engines including the ARM Cortex-A8 processor, Open VG™, OpenGL®-ES, D1 video encode/HD720 decode and ARM NEON™ technology. Depending on the intended application, different engines are enabled to achieve maximum performance/power ratios for each application space. This exceptional integration simplifies and shortens design time.

► Low Power Consumption

• The i.MX51 delivers extreme performance and low power consumption helping developers design products that meet today’s demands for energy efficiency. Advanced power management features used throughout the i.MX51 processor enable a rich suite of multimedia features and peripherals while maintaining minimal system power consumption in both active and low-power modes, which provides device end-users with long, long play times for hours of work or entertainment use.
What is an ARM processor?

- Advanced RISC Machines (ARM): 32-bit RISC processor architecture developed by ARM Limited widely used in embedded designs
- RISC – Reduced Instruction Set Computer
- Common open architecture

The benefits of ARM:

- Fixed 32-bit instruction size instead of variable
- Pipelined execution
- Best MIPS to Watts and MIPS cost ratio in the industry
- Power-saving features enable low power consumption
- Performance to meet demand for computing
- Smaller die sizes translate to lower costs and reduced power consumption
- Simple prototyping and development platform
- Extensive third party support system
Why Freescale?

- **High performance and low power**
  - ARM Cortex-A8
  - HW Acceleration of HD Video/Imaging path
  - Dual OpenVG and OpenGL graphics cores

- **Low power**
  - C65LPGP technology
  - HW acceleration
  - Advanced power management (DVFS)
  - Video Playback power (720p to WVGA): &~150mW
  - Audio Playback power (128kbps WMA): &~16mW

- **Reduced BOM**
  - Chipset price
  - DDR2 memory
  - Six-layer PCB, 0.8mm SoC and PMIC

- **Enablement collateral**
  - Complete BSPs targeting multiple operating systems
  - Complete Audio/Video codecs
  - Complete reference designs

- **Future roadmap**
  - Continued investment in i.MX5x and beyond
  - No proprietary DSP/other solutions, native ARM forward/backward compatibility

- **Deep experience developing and deploying Consumer/Automotive/Industrial/Military devices**

- **Product Longevity/Automotive Ties**
Freescale Introduces Product Longevity Program

► The embedded market needs long-term product support

► Freescale has a long-standing track record of providing long-term production support for our products

► Freescale is pleased to introduce a formal product longevity program for the market segments we serve

  • For the automotive and medical segments, Freescale will make a broad range of program devices available for a minimum of 15 years

  • For all other market segments in which Freescale participates, Freescale will make a broad range of devices available for a minimum of 10 years

  • Life cycles begin at the time of launch

► A list of participating Freescale products is available at: www.freescale.com/productlongevity
i.MX51 Family
# i.MX51 Family: 3-Digit Part Numbering

<table>
<thead>
<tr>
<th>Feature</th>
<th>i.MX512</th>
<th>i.MX513</th>
<th>i.MX514</th>
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<tr>
<td><strong>Target Markets</strong></td>
<td>Consumer, Industrial</td>
<td>Consumer, Industrial</td>
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<td><strong>Target Segments</strong></td>
<td>• Factory Automation (Ethernet)</td>
<td>• IP Camera</td>
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<td>• Smartbook</td>
<td>• Infotainment</td>
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<td></td>
<td>• HMI</td>
<td>• Media Phones</td>
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<td>• Rear Seat Entertainment</td>
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<td>• Portable/Tethered Printers</td>
<td>• Digital Signage</td>
<td>• Instrument Cluster</td>
<td>• PMPs</td>
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<td>• Medical Devices</td>
<td>• HMI (home appliances, etc.)</td>
<td>• Telematics</td>
<td>• Secure Devices</td>
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<td>• Ebooks</td>
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<td>• Advanced HMI</td>
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<td>• High-End PDAs</td>
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<td>Up to 600 MHz</td>
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<td><strong>Key Differences</strong></td>
<td>• DDR2</td>
<td>• i.MX512 +</td>
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<td>• i.MX514 +</td>
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<td></td>
<td>• Integrated USB Phy’s</td>
<td>• HW Video Codec: Multi-format D1</td>
<td>• OpenGL ES 2.0 3D</td>
<td>• OpenGL ES 2.0 3D</td>
<td>• HW Video Codec: Multi-format D1</td>
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<td>• Integrated Ethernet</td>
<td>video encode &amp; multi-format HD720</td>
<td>accelerator</td>
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<td>• Vector Floating Point</td>
<td>decode</td>
<td>• OpenVG 1.1 graphics accelerator</td>
<td>• Security: Sahara v4 &amp; Trust Zone</td>
<td>decode</td>
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<td></td>
<td>• HD 720 TV-Out</td>
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<td>• Security: Sahara v4 &amp; Trust Zone</td>
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<td>Video supported</td>
<td>Automotive support for graphics</td>
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<td>Full featured: Video, graphics</td>
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<td><strong>General Availability</strong></td>
<td>Now</td>
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<td>Now</td>
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</tr>
</tbody>
</table>
# i.MX51 Family Applications Processor

## Specifications
- **CPU**: Cortex A8, up to 800MHz
- **Process**: 65nm, LP/GP
- **Core Voltage**: 0.85-1.1V
- **Package**: 19x19 0.8mm
- **Temp Range**: -20 to 70°C* (Consumer), -40 to 85°C* (Industrial), -40 to 85°C* (Auto)
  - See Datasheet for case/junction temperatures

## Key i.MX515 Features and Advantages
- **High performance CPU**: Cortex A8
- **Low power multimedia**
- **Delivers rich graphics and UI in HW**
  - OpenGL ES 2.0 3D accelerator (AMD Z430)
  - OpenVG 1.1 graphics accelerator (AMD Z160)
  - Neon Vector floating point co-processor
  - Display up to WXGA
- **Drives high resolution video in HW**
  - Multi-format D1 video encode
  - Multi-format HD720 video decode
- **Mixed signal integration - HD720 TV out and high speed USB with embedded PHY**

## Available Parts
- i.MX512, i.MX513, i.MX514, i.MX515, i.MX516

## Availability
- **Market**: Consumer, Industrial and Auto
- **Sample**: Now
- **Production**: Now

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### System Control
- **Secure JTAG**
- **Power Mgmt**
- **PLL x 3**
- **Clock Reset**

### CPU Platform
- **ARM Cortex™-A8**
- **32KB i-cache**
- **32KB d-cache**
- **256KB L2-cache**
- **Neon**
- **ETM**

### Multimedia
- **OpenGL ES 2.0**
- **OpenVG1.1**
- **HW Video Codecs**
- **HD720 TV-Out**

### Imaging Processing Unit
- **Display Controller**
- **Resizing & Blending**
- **Inversion / Rotation**
- **Image Enhancement**
- **Camera**

### Connectivity
- **Fast IrDA**
- **HS MMC/SDIO x4**
- **CSPi HS x2 / LS x1**
- **UART x3**
- **I²C x3**
- **SS/I²S x3**
- **1-Wire**
- **ATA-6**
- **USB OTG HS+PHY**
- **USB HS Host x3**
- **SPDIF Tx**
- **GPIO**
- **Keypad**
- **Ethernet**
- **Ext Memory I/F**
  - mDDR 200 MHz
  - DDR2 200 MHz

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i.MX512 Applications Processor

Specifications
- **CPU**: Cortex A8, up to 800MHz
- **Process**: 65nm, LP/GP
- **Core Voltage**: 0.85-1.1V
- **Package**: 19x19 0.8mm
- **Temp Range**: -20 to 70°C (Consumer) -40 to 85°C (Industrial)
  
  *See Datasheet for case temperatures*

Key i.MX512 Features and Advantages
- High performance CPU: Cortex A8
- Mixed signal integration – HD720 TV out and high speed USB with embedded PHY

Availability
- **Market**: Consumer, Industrial
- **Sample**: Now
- **Production**: Now
i.MX513 Applications Processor

Specifications
- **CPU**: Cortex A8, up to 800MHz
- **Process**: 65nm, LP/GP
- **Core Voltage**: 0.85-1.1V
- **Package**: 19x19 0.8mm
- **Temp Range**: -20 to 70°C* (Consumer) -40 to 85°C* (Industrial)

  * See Datasheet for case temperatures

Key i.MX513 Features and Advantages
- **High performance CPU**: Cortex A8
- **Low power multimedia**
- **Drives high resolution video in HW**
  - Multi-format D1 video encode
  - Multi-format HD720 video decode
- **Mixed signal integration** – HD720 TV out and high speed USB with embedded PHY

Availability
- **Market**: Consumer, Industrial
- **Sample**: Now
- **Production**: Now

### i.MX513

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<td>Clock Reset</td>
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<tr>
<td>Timer x3</td>
<td>Neon</td>
<td>I²C x3</td>
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<tr>
<td>PWM x2</td>
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<tr>
<td>Watch Dog</td>
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<td><strong>Memory</strong></td>
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<td></td>
<td>DDR2 200 MHz</td>
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i.MX515 Applications Processor

Specifications

- **CPU:** Cortex A8, up to 800MHz
- **Process:** 65nm, LP/GP
- **Core Voltage:** 0.85-1.1V
- **Package:** 19x19 0.8mm
- **Temp Range**: -20 to 70°C* (Consumer)
  -40 to 85°C* (Industrial)

* See Datasheet for case temperatures

Key i.MX515 Features and Advantages

- High performance CPU: Cortex A8
- Low power multimedia
- Delivers rich graphics and UI in HW
  - OpenGL ES 2.0 3D accelerator (AMD Z430)
  - OpenGL 1.1 graphics accelerator (AMD Z160)
  - Neon Vector floating point co-processor
  - Display up to WXGA
- Drives high resolution video in HW
  - Multi-format D1 video encode
  - Multi-format HD720 video decode
- Mixed signal integration – HD720 TV out and high speed USB with embedded PHY

Availability

- **Market:** Consumer, Industrial
- **Sample:** Now
- **Production:** Now

### i.MX515 Specifications

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<td>DDR2 200 MHz</td>
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</tbody>
</table>
i.MX51 Applications Processor

► CPU
  • ARM Cortex-A8 w/ Neon
  • 32KB L1 (Instruction and Data cache)
  • 256KB L2 cache

► Multimedia *
  • Encode – D1 30fps (MPEG4 SP, H.264 BP, MJPEG)
  • Decode – HD720 30fps (MPEG2 MP, MPEG4 ASP, H.264 HP, VC-1 AP, DivX, RV10)
  • Graphics – OpenVG1.1, OpenGL ES 2.0 @ 27M Tri/sec
  • TV Encoder – Component, Composite or S-Video out at 720p

► Camera
  • Camera sensor I/F (x2)
  • Up to 8Mpixel @ 15fps, Up 133Mpixel/sec
  • Resizing, Inversion, Rotation
  • Color Space conversion, video/graphics combining

► Display
  • Up to WXGA display – 24 bit @ 60fps
  • Secondary Display Support

► Connectivity
  • High speed USB OTG w/ embedded Phy, Host HS x3
  • MobileDDR, DDR2 (Up to 200MHz bus speed )
  • SLC/MLC NAND Flash 8/16-bit, NAND/NOR
  • High speed MMC\SDIO, UART, I2C, SPI
  • ATA-6
  • 3.3V support on HD, SDIO, and SIM I/F
  • Ethernet controller

► Security *
  • TrustZone
  • AES, DES/3DES, SHA-1, SHA-224, SHA-256
  • Run time integrity checker (RTICv3)
  • Secure High Assurance Boot
  • Security Controller (SCC), including Secure RAM
  • Security Monitor
  • Random Number Generator Accelerator (RNGA)
  • Secure JTAG Controller (with electrical fuses)
  • Secure real-time clock
  • Universal Unique Identification
  • Tamper Detection

► Power Management
  • Advanced power management (DVFS)
  • State retention power gating
  • Multiple independent clock and power domains

* Dependent on processor
Best-in-Class Balance of High Performance and Low Power

► SoC
  • 65nm technology
  • Mix of Low Power (low leakage) and General Purpose (high performance) transistors
  • Allows high performing CPU with minimal SoC power consumption
  • Hardware acceleration of all performance intensive multimedia tasks independent of CPU

► ARM CPU design
  • High speed (up to 800MHz @ 1.1V)
  • Low operating voltage (down to 0.85V, 167MHz)
  • State Retention Power Gating to reduce leakage in GP process
  • L2 cache for minimized access to external memory, reducing the power consumption and increasing performance

► Dynamic Voltage & Frequency Scaling (DVFS)
  • Two independent domains with h/w monitoring: CPU, Peripherals

► Hardware Accelerator Power Gating
  • Unused accelerators can be dynamically power gated to reduce leakage current
i.MX51 Graphics

► **Native OpenGL ES 2.0** 3D based on ATI/AMD Unified Shader Architecture
  - Same architecture and same content tools as in **Xbox 360** and AMD’s PC graphics chips
  - Licensed by several industry leaders, providing for a strong foundation for a content creation ecosystem
  - Binning architecture provides for low memory/power requirements
  - 27 M triangles/sec
  - 166 M pixels/sec raw performance (1 pixel/clock)
    - 500 M pixels/sec (effective w/3x overdraw)

► **A native OpenVG 1.1** 2D hardware implementation
  - Driving high-quality UIs and Flash based internet browsing with extremely low power consumption
  - Free 16x antialiasing for very high-quality fonts and graphics
  - Capable of delivering a full 3D user interface experience beyond anything on the market today with a fraction of the power consumption compared to any other solution
  - 166 M pixels/sec raw performance (1 pixel/clock)
## ARM1176 v. Cortex-A8: Key Differentiators

<table>
<thead>
<tr>
<th>Freescale ARM1176</th>
<th>Freescale ARM-Cortex-A8 (As implemented on i.MX51)</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Maximum frequency = 532 MHz</td>
<td>• Maximum frequency = 800 MHz (consumer)</td>
</tr>
<tr>
<td>• 32-bit SIMD Instruction Set</td>
<td>• NEON instruction set extension (64-bit SIMD Instruction set with improved DSP support)</td>
</tr>
<tr>
<td>• Single instruction pipeline execution</td>
<td>• Dual instruction pipeline execution</td>
</tr>
<tr>
<td>• Compiler support</td>
<td>• Availability of Open-Consortium Khronos OpenMAX libraries and SIMD vectorizing compiler for accelerated optimized SW development</td>
</tr>
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</table>

### Summary

- ARM Cortex A8 with Neon significantly improves the performance of multimedia applications compared to ARM1176
- Cortex-A8 Dhrystone MIPS are about 50% better than ARM11 core. (If the ARM-Cortex A8 compiler is allowed to utilize NEON, the benchmark is a 1.8x improvement of ARM-Cortex A8 more than ARM1176)
General Codec Benchmarks

► Summary Results – Similar tests of performance between the SoC-ARM1176 and the i.MX51-ARM-Cortex-A8 were done for a variety of codecs.

<table>
<thead>
<tr>
<th></th>
<th>SoC-ARM1176</th>
<th>i.MX51-ARM-Cortex-A8</th>
</tr>
</thead>
<tbody>
<tr>
<td>WMA-v10 decoder, 44.1K, 320Kb/s</td>
<td>16MHz</td>
<td>9MHz</td>
</tr>
<tr>
<td>MPEG2 Encoder @ D1 resolution @ 30fps</td>
<td>1800MHz</td>
<td>600MHz</td>
</tr>
<tr>
<td>Video De-interlace @ D1 resolution @ 30fps</td>
<td>100MHz</td>
<td>50MHz</td>
</tr>
</tbody>
</table>

► Conclusion

• When factoring in the dual instruction set architecture of the ARM-Cortex-A8, the NEON 64-bit SIMD-DSP instruction set architecture of the ARM-Cortex-A8 and a more efficient memory subsystem …

… the i.MX51 Applications processor is about 1.8x-2.0x more MIPS efficient than an ARM1176 based applications processor with smaller caches when running low level optimized codec code.
## i.MX51 Video Processing Unit

<table>
<thead>
<tr>
<th>HW Decoder</th>
<th>Format</th>
<th>Profile</th>
<th>Resolution</th>
<th>Bitrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPEG-2</td>
<td>Main-High</td>
<td>HD720p</td>
<td>20Mbps</td>
<td></td>
</tr>
<tr>
<td>MPEG-4</td>
<td>SP</td>
<td>HD720p</td>
<td>20Mbps</td>
<td></td>
</tr>
<tr>
<td>MPEG-4</td>
<td>ASP</td>
<td>HD720p</td>
<td>20Mbps</td>
<td></td>
</tr>
<tr>
<td>DivX</td>
<td>3/4/5/6</td>
<td>HD720p</td>
<td>20Mbps</td>
<td></td>
</tr>
<tr>
<td>H.263</td>
<td>P0/P3</td>
<td>HD720p</td>
<td>20Mbps</td>
<td></td>
</tr>
<tr>
<td>H.264</td>
<td>BP/MP/HP</td>
<td>HD720p</td>
<td>20Mbps</td>
<td></td>
</tr>
<tr>
<td>VC1</td>
<td>SP/MP/AP</td>
<td>HD720p</td>
<td>20Mbps</td>
<td></td>
</tr>
<tr>
<td>RV10</td>
<td>8/9/10</td>
<td>HD720p</td>
<td>20Mbps</td>
<td></td>
</tr>
<tr>
<td>MJPEG</td>
<td>Baseline</td>
<td>32Mpixels</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>HW Encoder</th>
<th>Format</th>
<th>Profile</th>
<th>Resolution</th>
<th>Bitrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPEG-4</td>
<td>Simple</td>
<td>D1</td>
<td>8Mbps</td>
<td></td>
</tr>
<tr>
<td>H.263</td>
<td>P0/P3</td>
<td>D1</td>
<td>8Mbps</td>
<td></td>
</tr>
<tr>
<td>H.264</td>
<td>Baseline</td>
<td>D1</td>
<td>10Mbps</td>
<td></td>
</tr>
<tr>
<td>MJPEG</td>
<td>Baseline</td>
<td>64Mpixels</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The i.MX51 multimedia system, is mainly composed of HW accelerators which handle most tasks autonomously. Notable advantages include:

- Cortex core processing is free to execute/run application code
- Lower power consumed (dedicated HW modules)
- Optimize data path – reduce DDR load, allow use of 32-bit DDR Memories for the task

**IPU – Image Processing Unit**

- Serve as Display controller to LCD/TV out devices.
- Used for image manipulations and processing
- Manages Camera interface
- Much more …

**VPU (Video Processing Unit) – Video CODEC**

- Multiple compression formats
- Rate: up to 720p decode, D1 two-way

**GPUs (Graphics Processing Units) – Graphics Generation**

- 3D: OpenGL-ES 2.0
- 2D: OpenVG 1.1

**TVE (Analog TV output)**
The Video and Graphics System in i.MX51

VPU (Video Processing Unit)
Video encoding and decoding

GPU (Graphics Processing Unit)
Graphics generation

IPU (Image Processing Unit)
Comprehensive support for the flow of data from video sources and/or to display devices.
- Connectivity to relevant devices
- Image processing: conversions, enhancement...
- Synchronization and control

TVE
Analog TV output

Full HW support
The CPU does not have to touch pixels

Video Sources

Displays
The IPU in i.MX51 (IPUv3EX) – Dual-Display Capabilities

**Notes**

- Maximal peak rate (including blanking overhead)
  - Single display: 110 MP/sec
  - Total: 120 MP/sec
- For TV, the peak rate (and blanking overhead) is fixed by the standards:
  - SDTV: 13.5 MP/sec, 720p/1080i: 74.25 MP/sec
- For LCDs
  - The assumed screen refresh rate is 60 Hz
  - “Marginal support” – Depends on the display, requires a more careful evaluation

<table>
<thead>
<tr>
<th>First Display</th>
<th>Second Display</th>
<th>WQVGA (400x240)</th>
<th>SDTV 480i30/576i25</th>
<th>WVGA</th>
<th>WSVGA</th>
<th>HDTV 720p60/1080i30</th>
</tr>
</thead>
<tbody>
<tr>
<td>WVGA (800x480 ~ 0.4 MP)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>WSVG (1000x600 ~ 0.6 MP)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td>Marginal</td>
</tr>
<tr>
<td>WXGA (1366x768 ~ 1.0 MP)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SXGA (1280x1024 ~ 1.3 MP)</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
MC13892 Power Management and User Interface IC

► POWER and BATTERY
- 4 multi-mode buck switchers – 1.05A, 3x800mA programmable outputs, 2 with DVS/DPTC interface
- 2 boost switchers – 5V, 28V adaptive
- 12 LDO regulators, 4 GPOs, power gating
- Main battery and coincell chargers, GP ADC
- Series WLED backlight drivers (main/aux, keypad)
- 1 bank RGB drivers, charger LED drive
- Standalone battery charging with auto disable if battery is out of temperature range
- Standby/user off configurations
- Coulomb counter

► INTERFACE and CONTROL
- SPI/I2C control and register interface
- Resistive touch screen
- 32KHz crystal oscillator, real time clock/calendar alarms
- Package
  - 7x7mm BGA, 0.5mm pitch, 139 pins
  - 12x12mm BGA, 0.8mm pitch, 186 pins

Questions? Please contact your local Freescale sales person.

Part Numbers
MC13892JVK  7x7 mm
MC13892JVL  12x12 mm
## MC13892 Key Features, Advantages and Benefits

<table>
<thead>
<tr>
<th>Features</th>
<th>Advantage</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>High level of integration</td>
<td>Reduces size, weight and design time for speed time to market. Integrates both user interface and power functions</td>
<td>Reduces the need for separate design. Allows the use of cost effective display technologies</td>
</tr>
<tr>
<td>Optimized for use with the i.MX family of processors</td>
<td>Freescale’s mixed signal process technology allows for analog, digital and power circuitry on the same IC</td>
<td>Created with input from i.MX design engineers, the device is ideal for use with i.MX35 and i.MX51 applications processors. Meets systems expectations for power and software.</td>
</tr>
</tbody>
</table>
SGTL5000: Stereo Codec w/Headphone Amp

- **Playback performance:**
  - 98dB Dynamic Range (AWtd) @ < 4mW power, < -80dB THD+N
  - Quiescent power, I2S->DAC->HP, VDDA = 1.8V

- **ADC performance:**
  - 85dB Dynamic Range (AWtd), -70dB THD+N, VDDA=1.8V
  - 92dB Dynamic Range (AWtd), -78dB THD+N, VDDA=3.3V

- **Headphone output:** 9mW (32ohm, 1.8V) to 45mW (16ohm, 3.3V)
  - -80dB THD+N at full scale output

- **PSRR > 80dB (1kHz)**

- **Footprint:** 20QFN, 3mm x 3mm (32QFN 5mm x 5mm available)
**i.MX51 Evaluation Kit (EVK) – $699 Resale**

### Single Board Development Platform–Price, Performance, Personality

### i.MX51 Evaluation Kit Features

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>i.MX51 Applications Processor</td>
<td>529 BGA</td>
</tr>
<tr>
<td>4 x 128MB DDR2</td>
<td></td>
</tr>
<tr>
<td>4MB SPI NOR</td>
<td></td>
</tr>
<tr>
<td>PMIC – Atlas APL (MC13892JV or MC13892JVL)</td>
<td></td>
</tr>
<tr>
<td>NAND and EIM Header</td>
<td></td>
</tr>
<tr>
<td>Debug Serial Port</td>
<td></td>
</tr>
<tr>
<td>JTAG</td>
<td></td>
</tr>
<tr>
<td>Reset, boot switches</td>
<td></td>
</tr>
<tr>
<td>Debug LED</td>
<td></td>
</tr>
<tr>
<td>Power Source</td>
<td></td>
</tr>
<tr>
<td>Power on/off button</td>
<td></td>
</tr>
<tr>
<td>Power Measurement Header</td>
<td></td>
</tr>
<tr>
<td>7” WVGA Touchscreen LCD Display (add-on module)</td>
<td></td>
</tr>
<tr>
<td>Expansion board (add-on module)</td>
<td></td>
</tr>
<tr>
<td>2 LVDS connectors</td>
<td></td>
</tr>
<tr>
<td>DVI-I connector</td>
<td></td>
</tr>
<tr>
<td>2 SD/MMC Card Slots</td>
<td></td>
</tr>
<tr>
<td>USB Host x2/USB OTG x1</td>
<td></td>
</tr>
<tr>
<td>Ethernet Port</td>
<td></td>
</tr>
<tr>
<td>Mini PCIe</td>
<td></td>
</tr>
<tr>
<td>SATA HDD connector</td>
<td></td>
</tr>
<tr>
<td>SIM Card connector</td>
<td></td>
</tr>
<tr>
<td>Keyboard connector</td>
<td></td>
</tr>
<tr>
<td>Mic input, stereo headphone output (jack), V2IP Headphone</td>
<td></td>
</tr>
<tr>
<td>Speaker connector</td>
<td></td>
</tr>
<tr>
<td>USB Camera connector</td>
<td></td>
</tr>
<tr>
<td>PS-2 TP connector</td>
<td></td>
</tr>
<tr>
<td>RGB output through DVI-I connector</td>
<td></td>
</tr>
<tr>
<td>Expansion Header</td>
<td></td>
</tr>
<tr>
<td>Ambient light sensor footprint</td>
<td></td>
</tr>
<tr>
<td>FM receiver footprint</td>
<td></td>
</tr>
</tbody>
</table>

**Board size = 5” x 5”**

**MCIMX51EVKJ**

[www.freescale.com/imx51evk](http://www.freescale.com/imx51evk)
i.MX51 LCD & Expansion Board

- i.MX51 LCD module
- MCIMX51LCD
- $250 Resale
- CPT 7” WVGA with resistive touch screen

- i.MX51 Expansion Board
- MCIMX51EXP
- $200 Resale
- Features
  - CMOS Camera
  - TV out
  - Keypad
  - UART

Assembled with EVK
Available now
MCIMX51EVKJ – A True Single Board Computer (SBC)
MCIMX51EVKJ – PCB Bottom

- UART (DB9-F)
- LVDS Con-2
- SATA HDD Connector
- SIM Card connector
- Mic conn.
- Speaker Conn.
- USB Camera conn.
- SD/MMC-1
- JTAG Connector
- Key-board connector
- PS-2 TP connector
# i.MX51 Linux Software Support

<table>
<thead>
<tr>
<th>Software</th>
<th>Description</th>
</tr>
</thead>
</table>
| **Linux BSP SDK 0912 L2.6.31 Available Now** | Display/Imaging & Graphics:  
  LCD display driver for CPT 7" WVGA, Touchscreen  
  Frame buffer, DVI monitor, VGA monitor, WVGA, LVDS, GPU (2D/3D)  
  Multimedia:  
  IPU V3, V4L2 Output/Capture, Camera, TV Out, VPU  
  Video Post-process: De-interlace  
  Power Management:  
  PMIC (MC13892), Low power mode, DVFS-core, CPU Freq, XEC  
  Sound:  
  S/PDIF, Asoc (SSI/AUDMUX), SGTL5000  
  Memories:  
  MobileDDR, DDR2 (Up to 200MHz bus speed)  
  SLC/MLC NAND Flash 8/16-bit, NAND, SPI NOR  
  MMC/SD/SDIO  
  Harddrive by USB mass storage  
  Other:  
  Redboot, U-Boot  
  Input: Keypad, Touch Panel  
  Ethernet (FEC)  
  USB Host, USB Device, USB OTG (ID pin detect)  
  Security, MMC/SD/SDIO  
  SRTC, Watchdog, I2C, SPI, 1-wire, PWM  
  GPIO, Serial, WiFi (Atheros WiFi SDIO card) |
| **Codecs**            | Video decode: MPEG2, MPEG4, H.263, H.264, VC-1, RV, DivX  
  Video encode: MPEG4, H.263, H.264  
  Audio decode: MP3, AACLC, HE-AAC, WMA10 Std, WMA10 Pro, WMA9 Lossless, AC-3, RA-6, FLAC, BSAC, Ogg Vorbis  
  Audio encode: MP3, WMA-8  
  Speech encode/decode: G.711, G.723.1, G.726, G.729AB, NB_AMR, WB_AMR  
  Image decoder: JPG, PNG, BMP, GIF  
  Image encoder: JPEG |
# i.MX51 Windows Embedded CE Software Support

<table>
<thead>
<tr>
<th>Software</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WinCE 6.0 R3</td>
<td><strong>Display/Imaging:</strong> DVI, VGA analog, LVDS, TV Out (PAL, NTSC, 720P, 1080i)</td>
</tr>
<tr>
<td>SDK 0912</td>
<td><strong>Multimedia:</strong> IPU Display, Camera, VPU</td>
</tr>
<tr>
<td>Available Now</td>
<td>DirectDraw</td>
</tr>
<tr>
<td></td>
<td>Video Post-process: De-interface</td>
</tr>
<tr>
<td></td>
<td><strong>Graphics:</strong> IP wrapper for Z160 2D / Z430 3D hardware acceleration</td>
</tr>
<tr>
<td></td>
<td>- OpenGL/ES, OpenVG</td>
</tr>
<tr>
<td></td>
<td><strong>Power Management:</strong> PMIC (MC13892)</td>
</tr>
<tr>
<td></td>
<td>DVFS</td>
</tr>
<tr>
<td></td>
<td><strong>Sound:</strong> S/PDIF</td>
</tr>
<tr>
<td></td>
<td>Audio CODEC (SGTL5000)</td>
</tr>
<tr>
<td></td>
<td><strong>Other:</strong> X-Loader, Bootloader</td>
</tr>
<tr>
<td></td>
<td>- Boot from SPI NOR, MMC/SD</td>
</tr>
<tr>
<td></td>
<td>- Image download over ethernet or USB</td>
</tr>
<tr>
<td></td>
<td>KITL – ethernet, USB</td>
</tr>
<tr>
<td></td>
<td>Input: Touch screen, Keypad, USB Keyboard, Soft input panel</td>
</tr>
<tr>
<td></td>
<td>HS OTG Host / Device (ID pin detect) and USB HS HOST1</td>
</tr>
<tr>
<td></td>
<td>1-Wire, Ethernet (FEC), SRTC, MMC/SD/SDIO, Watchdog, I2C, HS12C, eCSPI, GPIO, Notification LED, Serial</td>
</tr>
<tr>
<td>Codecs</td>
<td>Video decode: WMV playback with Microsoft CODEC, DivX, H.263, H.264, MJPEG, MPEG2, MPEG4, RV, VC-1</td>
</tr>
<tr>
<td></td>
<td>Video encode: H.263, H.264, MJPEG, MPEG4</td>
</tr>
<tr>
<td></td>
<td>Audio decode: AAC, aacPlus, AC3, AMR, MP3, RA, WMA Standard, WMA Pro, WMA Lossless, FLAC, Ogg Vorbis</td>
</tr>
<tr>
<td></td>
<td>Audio encode: MP3, WMA</td>
</tr>
<tr>
<td></td>
<td>Speech encode/decode: SBC, G.711, G.723.1, G.726, G.729AB, NB_AMR, WB_AMR</td>
</tr>
<tr>
<td></td>
<td>Image decoder: JPEG, PNG, BMP, GIF</td>
</tr>
</tbody>
</table>
Ubuntu

- Full Desktop Support on i.MX515
  - Gnome-based desktop UI
  - Full open office support document, presentation and spreadsheet SW
  - Support for multiple browsers (incl. Opera, Mozilla, etc)
  - Large pool of applications (instant messaging, etc.)

- Popular commercial Ubuntu Desktop Edition was released for ARM in April 2009

- Enablement of All-Day Computing devices
Freescale Partners With Google on Android
Package Area: 218 – 410 mm²  
Complexity: 646 pins

Package Area: 667 mm²  
Complexity: 1690 pins

* Circed components are for debug and can be removed for production.
i.MX515 v. Incumbent
<table>
<thead>
<tr>
<th>Company</th>
<th>Type</th>
<th>Contact</th>
<th>URL</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allgo Systems</td>
<td>H/W</td>
<td>Aji Anirudhan - <a href="mailto:aji@allgosystems.com">aji@allgosystems.com</a></td>
<td><a href="http://www.allgosystems.com">www.allgosystems.com</a></td>
<td>IDH</td>
</tr>
<tr>
<td>Pegatron</td>
<td>H/W</td>
<td>Jeremy Shu - <a href="mailto:jeremy_shu@pegatroncorp.com">jeremy_shu@pegatroncorp.com</a></td>
<td><a href="http://www.pegatroncorp.com">www.pegatroncorp.com</a></td>
<td>ODM</td>
</tr>
<tr>
<td>Skytone</td>
<td>H/W, S/W</td>
<td>Nixon Ng - <a href="mailto:Nixon@skytone.net.cn">Nixon@skytone.net.cn</a></td>
<td><a href="http://www.skytone.net.cn">www.skytone.net.cn</a></td>
<td>IDH</td>
</tr>
<tr>
<td>Portalinks Technology Co</td>
<td>H/W</td>
<td>Paul Chang - <a href="mailto:paul@portalinks.com.tw">paul@portalinks.com.tw</a></td>
<td><a href="http://www.portalinks.com.tw">www.portalinks.com.tw</a></td>
<td>IDH</td>
</tr>
<tr>
<td>M2Coretech Co, Ltd</td>
<td>H/W, S/W</td>
<td>James Jeong - <a href="mailto:james@m2coretech.com">james@m2coretech.com</a></td>
<td><a href="http://www.m2coretech.com">www.m2coretech.com</a></td>
<td>IDH</td>
</tr>
<tr>
<td>CodeSourcery</td>
<td>Tools</td>
<td>N/A</td>
<td><a href="http://www.codesourcery.com">www.codesourcery.com</a></td>
<td>Linux tools: compiler / debugger / profiler</td>
</tr>
<tr>
<td>Device</td>
<td>Partner</td>
<td>Focus</td>
<td>URL</td>
<td>Key Board Features</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
<td>----------------------------------------------------------------------</td>
<td>----------------------------</td>
<td>------------------------------------------</td>
</tr>
</tbody>
</table>
| i.MX51 | Digi        | • Design capabilities  
• BSPs: WinCE                                              | www.digi.com                | Integrated 802.11a/b/g/n                  | ![Image](image1.png)       |
| i.MX51 | Karo        | • BSPs: WinCE & Linux  
• Development services                                          | www.karo-electronics.de    | SoM only 26mm                             | ![Image](image2.png)       |
| i.MX51 | Eukrea      | • Designs hardware and software solutions optimized for embedded Linux | www.eukrea.com              | SoM + dev board                          | ![Image](image3.png)       |
| i.MX51 | Bluetechnix | • High-quality, easy-to-use Linux distribution (Ubuntu)            | www.bluetechnix.com        | Single board computer                     | ![Image](image4.png)       |
| i.MX51 | Boundary Devices | • Maximizing multimedia performance while minimizing the power consumption. | www.boundarydevices.com   | Single board computer                     | ![Image](image5.png)       |
| i.MX51 | Micro/Sys   | • Interchangeable peripheral modules  
• CAN supported  
• Zigbee add-on module                                      | www.embeddedsys.com        | Single board computer solutions           | ![Image](image6.png)       |
Summary

► Newest members of the industry-leading i.MX51 family of processors deliver performance, integration and energy efficiency required for automotive, industrial and consumer markets.

► i.MX51 simplifies the development and design process by integrating industry leading graphics accelerators and hardware accelerated video codecs.

► i.MX51’s unique architecture design enables the development of cost efficient solutions for a wide range of applications.

► For more information visit www.freescale.com/imx51