i.MX families offer the most versatile platforms for multimedia and display applications, bringing personality and interactivity to a whole new world of products

Francisco Ramírez
Field Applications Engineer
Agenda

• i.MX6 Introduction
• i.MX6 Review / Characteristics
• i.MX6 Benefits
• i.MX6 Environment
• i.MX6 for Multimedia
• i.MX6 Tools
i.MX6
Introduction

Francisco Ramírez
Field Applications Engineer
Trend: New Computing Cycles Supported by 10x More Devices

Computing Growth Drivers Over Time, 1960-2020E

Note: PC installed base reached 100mm in 1993, cellphone / Internet users reached 1B in 2002 / 2005 respectively; Source: ITU, Mark Lipacis, Morgan Stanley Research
The Tablet Usage Model is Rapidly Evolving

Today

- Good, Better, Best
- Small, Medium, Large Form Factors
- Price Segments

Near Term

- General purpose
- Printer
- Home multimedia
- Color eReaders
- eLearning
- Gaming
- Ruggedized/Industrial
- Business productivity
- Medical
- IPTV
- Auto infotainment
- Enterprise VOIP phones
- IP Phones
- Media phones
- Smart monitors
- Appliance displays

Longer Term

- Introduction
- Value (Traditional) Segmentation
- Segmentation Proliferation/Maturity

- Good, Better, Best
- Small, Medium, Large Form Factors
- Price Segments
• **i.MX 6 series** provides not only key solutions for consumer products, but also the emerging/general market that will define the “smart devices” of the future

• Two models emerging for smart device design:
  - **Good/better/best** versions of one application
  - Different applications from one platform for **portfolio of products**
i.MX: Enable Multimedia Everywhere

It’s about consumerization of… Everything

From:
Specialized (low-end) hardware with RTOS

To:
High-performance hardware + OpenOS + Specialized apps

Car infotainment
Medical
IPTV
IP Phones
Appliances
Education devices
Industrial HMI
Digital signage
DECT phones
Enterprise tablets

In-flight infotainment
i.MX 6: One Platform, Differentiated Products

Saves development costs and improves time to market. Scalability with multiple cores is key to implement this strategy.
Media Tablet and Reader Applications Processors Unit Share: Q2’11 and Q3’11

Others include: Amlogic, Telechips, Rockchip, Marvell, Intel, Ingenic Semiconductor, Anyka, Renesas, Other

Worldwide Media Tablets and eReaders Applications Processor 3Q10-3Q11 Vendor Shares
Multimedia Applications Division

Multimedia Revenue by Market

![Pie chart showing market segmentation: Consumer, Automotive, Industrial/Other]

Key Customers

- Amazon
- Ford
- Sony
- Huawei
- Lenovo
- HP
- GE
Freescale Differentiation

Multiple Markets; Embedded Leadership

Scalable Platforms

Targeted SW

Ease of Use

Secure Solutions

Trusted Partner

Freescale

Ref Soln

SW/Pin Compatibility

Out of the Box Experience

fast boot

Docs

Channel Partner Program

PMIC

Support

Longevity

Out of the Box Experience

BOM

Competitors
i.MX Smart Devices, 1 of 2

- Acer - i.MX51
- Toshiba i.MX53
- QOOQ - i.MX37
- Fujitsu i.MX53
- ZTE i.MX53
- Creative Zen Touch 2 - i.MX51
- Orange Tabbee 2
- Isabella Visit - i.MX31
- Hercules i.MX51
- Logitech Squeezebox – i.MX25
- Elonex eTouch
- Telstra T-hub i.MX31
- Technicolor Media Touch 2.0 – i.MX51
- Huawei MC850 – i.MX51
- RealEase Shogo – i.MX37
- Philips Go Gear Connect – i.MX51
- HP Photosmart eStation - i.MX51
- Sharp Galapagos – i.MX51
- Yulong "Coolpad N900"
- Genesi – i.MX51
- China Telecom – Lifepad A800
- Eben- i.MX53
- Logitech Harmony 1000 Remote i.MX21
- Vodafone i.MX51
- Kobo Vox i.MX51
Some i.MX Smart Devices with telephony features

- China Telecom P7 Media Phone – i.MX51
- Telstra T-hub – i.MX51
- Huawei MC850 – i.MX51
- ACN IP Phone – i.MX27
- BlackBerry Curve - MXC
- Yulong smartphone – i.MX31
- Coolpad 8910 smartphone – i.MX51
- Coship E89 smartphone – i.MX31
- PCCW Eye Home Smartphone – i.MX51
- PCCW Eye – i.MX21
- Skype DECT phone – i.MX28
- Invoxia HD Phone - i.MX50
- Gigset DECT phone – i.MX233
- Yulong TV phone – i.MX31
- Orange Livephone Touch – i.MX31
- Avaak Vue Personal Video Network – i.MX25
- Icephone Medical Phone – i.MX31
- Huawei MC850 – i.MX51
- Coolpad 8910 smartphone – i.MX51
- Yulong smartphone – i.MX31
- i.MX2x : ARM9
- i.MX3x : ARM11
- i.MX5x : ARM Cortex A8
Freescale-based E Ink eReaders

Amazon

- Kindle DX & Kindle 2
  - i.MX31

- Kindle 3
  - i.MX35

- Kindle, Kindle Touch
  - i.MX50

Sony

- i.MXL

- i.MX31

- i.MX50

Kobo (Fnac/WHSmith)

- i.MX35

- i.MX50

Google / iRiver

- i.MX50

Ectaco

- i.MX50

Hanvon

- i.MX50

Pocketbook

- i.MX35

- i.MX50

Bebook Booq

- i.MX31

Acer Medion

- i.MX35

Onyx Greenbook

- i.MX50

Jinke
i.MX 6 Series
Breaking the Boundaries of User Experience

Industry’s **most scalable** family of multimedia applications processors

Easily build scalable product lines with the i.MX 6 series—**ultimate versatility** with compatible single, dual and quad core devices

**Best-in-Class Performance** enabled by quad core processing, low power consumption and bleeding-edge multimedia and graphics

**Optimized peripheral sets** tailored to serve auto, industrial and consumer markets

**Fast development** through simplified hardware design, flexible interfaces and easy-to-use development kits
Enabling Next Generation Consumer Products

**Being the Same Is Different**
Scalable multicore processors enables **one software design** for a portfolio of products.

**Do More with Less Power**
24 hours of video playback, 30+ days of standby time through unique low-power design and multicore utilization.

**i.MX 6 Series**
*Built on ARM® Cortex™-A9*

**Make It Look Good**
Get clean, crisp and complex graphics powered by 200MT/s. Three dedicated graphics engines for uncompromised user experience.

**Make It Pop**

Industry’s most **scalable** and **powerful** platform for multimedia and display applications.
## Specifications

- **CPU:** i.MX 6Quad 4x Cortex-A9 @1.2 GHz, 12000 DMIPS
  - i.MX 6Dual 2x Cortex-A9 @1.2 GHz, 6000 DMIPS
- **Process:** 40nm
- **Core Voltage:** 1.1V
- **Package:** 21x21 0.8mm Flip-chip BGA
  - 12x12 PoP (LP-DDR2, NAND)

## Key Features and Advantages

- Multi-core architecture for high performance, 1MB L2 cache
- 64-bit LP-DDR2, DDR3 and raw / managed NAND
- S-ATA 3Gbps interface (SSD / HDD)
- Delivers rich graphics and UI in HW
  - OpenGL/ES 2.x 3D accelerator with OpenCL EP support and OpenVG 1.1 acceleration
- Drives high resolution video in HW
  - Multi-format HD1080 video decode and encode
  - 1080p60 decode, 720p60 encode
  - High quality video processing (resizing, de-interlacing, etc.)
- Flexible display support
  - Four simultaneous: 2x Parallel, 2x LVDS, MIPI-DSI, or HDMI
  - Dual display up to WUXGA (1920x1200) and HD1080
- MIPI-CSI2 and HSI
- Increased analog integration simplifies system design and reduces BOM
  - DC-DC converters and linear regulators supply cores and all internal logic
  - Temperature monitor for smart performance control
- Expansion port support via PCIe 2.0
- Car network: 2xCAN, MLB150 with DTCP, 1Gb Ethernet with IEEE1588

Updated from i.MX53

### Multimedia
- Graphics: OpenGL/ES 2.x, OpenCL/EP, OpenVG 1.1 acceleration
- Audio: ASRC
- 2x Imaging Processing Unit
  - Resizing & Blending
  - Inversion / Rotation
  - Image Enhancement

### Connectivity
- USB2 OTG & PHY
- USB2 Host & PHY
- USB2 HSIC Host x2
- S-ATA & PHY 3Gbps
- PCIe 2.0 (1-lane)
- FlexCAN x2
- MLB150 + DTCP
- 1Gb Ethernet + IEEE1588
- MIPI CSI2
- NAND Ctrl (BCH40)
- LP-DDR2, DDR3 / LV-DDR3 x32/64, 533 MHz
i.MX 6DualLite Multimedia Processor

Specifications
- **CPU**: 2x Cortex-A9 @ 1GHz
- **Process**: 40nm
- **Core Voltage**: 1.1V
  - **Package**: 0.8mm 21x21 BGA (pin compatible to i.MX 6Dual/Quad/Solo)

Key Features and Advantages
- High performance Cortex-A9 up to 1GHz with 512KB L2 cache
- 2x32 or x64 LP-DDR2, DDR3/LV-DDR3 at 400MHz, raw / managed NAND support, and 8/16/32-bit parallel NOR
- **EPD controller** for next gen display support
- Delivers rich graphics and UI in HW OpenGL/ES 2.0 3D accelerator and OpenVG 1.1 acceleration
- Drives high resolution video in HW
  - Multi-format HD1080 video decode and encode
  - High quality video processing (resizing, de-interlacing, etc.)
- Flexible display & camera support
  - Dual display up to WXGA (1366x768) and support for HD1080
  - 2x Parallel, LVDS, MIPI-DSI or HDMI
  - MIPI CSI2 (2 lanes) and 2x CSI for camera
- Expansion port support via PCIe 2.0
- Car network: 2xCAN, MLB 6-wire, 1Gb Ethernet with IEEE1588

Connectivity
- MMC 4.4 / SD 3.0 x3
- MMC 4.4 / SDXC
- NAND Ctrl (BCH40)
- UART x5
- I²C x3, SPI x4
- USB2 OTG & PHY
- USB2 Host & PHY
- USB2 HSIC Hostx2
- 1Gb Eth + 1588
- MIPI HSI
- SMBus, GPIO, Keypad
- ESAI, I²S/SSI x3
- S/PDIF Tx/Rx
- Audio: ASRC
- PCIe 2.0
- FlexCAN x2, MLB150
- X64 LP-DDR2 / DDR3 / LV-DDR3
## Specifications
- **CPU:** 1x Cortex-A9 @ 1GHz
- **Process:** 40nm
- **Core Voltage:** 1.1V
  - **Package:** 0.8mm 21x21 BGA (pin compatible to i.MX 6DualLite/Dual/Quad)

## Key Features and Advantages
- **High performance Cortex-A9 up to 1GHz with 512KB L2 cache**
- **x32 LP-DDR2, DDR3/LV-DDR3 at 400MHz, raw / managed NAND support, and 8/16/32-bit parallel NOR**
- **EPD controller** for next gen display support
- **Delivers rich graphics and UI in HW OpenGL/ES 2.x 3D accelerator and OpenVG 1.1 acceleration**
- **Drives high resolution video in HW**
  - Multi-format HD1080 video decode and encode
  - High quality video processing (resizing, de-interlacing, etc.)
- **Flexible display & camera support**
  - Dual display up to WXGA (1366x768) and support for HD1080
  - 2x Parallel, LVDS, MIPI-DSI or HDMI
  - MIPI CSI2 (2 lanes) and 2x CSI for camera
- **Expansion port support via PCIe 2.0**
- **Car network:** 2xCAN, MLB 6-wire, 1Gb Ethernet with IEEE1588

## CPU Platform
- **1x Cortex-A9**
- **32KB I-cache**
- **32KB D-cache**
- **NEON**
- **512KB L2-cache**
- **PTM**

## Graphics
- **Graphics:** OpenGL/ES 2.x, OpenVG 1.1

## Video
- **Video Codecs:** 1080p

## Imaging Processing Unit
- **Resizing, Blending Inversion / Rotation Image Enhancement**

## LCD & Camera Interfaces
- **HDMI & PHY**
- **MIPI DSI**
- **MIPI CSI2, 20-bit CSI**
- **24-bit RGB, LVDS**

## Connectivity
- **MMC 4.4 / SD 3.0 x3**
- **MMC 4.4 / SDXC**
- **NAND Ctrl (BCH40)**
- **UART x5**
- **I²C x3, SPI x4**
- **USB2 OTG & PHY**
- **USB2 Host & PHY**
- **USB2 HSIC Hostx2**
- **1Gb Eth + 1588**
- **MIPI HSI**
- **ESAI, I²S/SSI x3**
- **S/PDIF Tx/Rx**
- **Audio:** ASRC
- **PCie 2.0**
- **FlexCAN x2, MLB150**
- **X32 LP-DDR2 / DDR3 / LV-DDR3**

## Security
- **RNG**
- **TrustZone**
- **Ciphers**
- **Security Ctrl**
- **Secure RTC**
- **eFuses**

## Power Mgmt
- **DCDC, LDO**
- **Temp Monitor**

## Internal Memory
- **ROM**
- **RAM**

## System Control
- **Secure JTAG**
- **PLL, Osc**
- **Clock & Reset**
- **Smart DMA**
- **IOMUX**
- **Timer x3**
- **PWM x4**
- **Watch Dog x2**

## External Memory
- **X32 LP-DDR2 / DDR3 / LV-DDR3**

---

*Freescale, the Freescale logo, ARMvec, C-5, CodeTEST, CodeWarrior, ColdFire, C-Ware, the Energy Efficient Solutions logo, mobileDT, PowerQUICC, QorIQ, StarCore and Symphony are trademarks of Freescale Semiconductor, Inc. Reg. U.S. Pat. & Trademark and in other countries. Honeywell and FlexiSim are registered trademarks of Honeywell International Inc. Stamper and Mentor Graphics are registered trademarks and trademarks of Mentor Graphics Corporation. All other product or service names are the property of their respective owners. © 2011 Freescale Semiconductor, Inc.*
# Core Complex – i.MX 6 series

<table>
<thead>
<tr>
<th>Model</th>
<th>Cortex-A9 Configuration</th>
<th>I-cache</th>
<th>D-cache</th>
<th>NEON/FPU per Core</th>
<th>PTM per Core</th>
<th>L2-cache</th>
</tr>
</thead>
<tbody>
<tr>
<td>i.MX 6Dual / 6Quad</td>
<td>2x / 4x</td>
<td>32KB</td>
<td>32KB</td>
<td></td>
<td></td>
<td>1MB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>I-cache</td>
<td>D-cache</td>
<td>NEON/FPU</td>
<td>PTM</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i.MX 6DualLite / 6Solo</td>
<td>2x / 1x</td>
<td>32KB</td>
<td>32KB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>I-cache</td>
<td>D-cache</td>
<td>NEON/FPU</td>
<td>PTM</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>i.MX 6SoloLite</td>
<td>1x</td>
<td>32KB</td>
<td>32KB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>I-cache</td>
<td>D-cache</td>
<td>NEON/FPU</td>
<td>PTM</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>256KB</td>
</tr>
</tbody>
</table>
Supreme Scalability: One Design, Many Products

Scalable series of five ARM Cortex A9-based SoC families

- **i.MX 6SoloLite**
  - 1x 1GHz
  - x32 400MHz DDR3
  - No HW video accel.
  - 2D graphics (2 GPUs)
  - LCD, EPD

- **i.MX 6Solo**
  - 1x 1GHz
  - x32 400MHz DDR3
  - Other: same as 6DualLite

- **i.MX 6DualLite**
  - 2x 1GHz
  - x64 400MHz DDR3
  - HD1080p video
  - 2D+3D (2 GPUs), 35Mtri/s
  - LCD, EPD

- **i.MX 6Dual**
  - 2x 1/1.2GHz
  - Other: same as 6Quad

- **i.MX 6Quad**
  - 4x 1/1.2GHz
  - x64 533MHz DDR3
  - Dual HD1080p video
  - 2D+3D (3 GPUs), 200 Mtri/s
  - LCD

Pin-to-pin Compatible

Software Compatible
Freescale i.MX 6: unmatched pin-compatibility

Competitors

Pin-compatibility inside a family (typically frequency scaling)

Freescale

Pin-compatibility between families

i.MX 6Solo
i.MX 6DualLite
i.MX 6Dual
i.MX 6Quad

Pin-compatibility inside a family (frequency scaling, fewer features, different qualifications)
# i.MX 6 Series At a Glance

## i.MX 6SoloLite
- Single ARM® Cortex™-A9 at 1.0GHz
- 256KB L2 cache, Neon, VFPv16, Trustzone
- 2D graphics
- 32-bit DDR3 and LPDDR2 at 400MHz
- Integrated EPD controller

## i.MX 6Solo
- Single ARM Cortex-A9 at 1.0GHz
- 512KB L2 cache, Neon, VFPv16, Trustzone
- 3D graphics with 1 shader
- 2D graphics
- 32-bit DDR3 and LPDDR2 at 400MHz
- Integrated EPD controller

## i.MX 6DualLite
- Dual ARM Cortex-A9 at 1.0GHz
- 512KB L2 cache, Neon, VFPv16, Trustzone
- 3D graphics with 1 shader
- 2D graphics
- 64-bit DDR3 and 2-channel 32-bit LPDDR2 at 400MHz
- Integrated EPD controller

## i.MX 6Dual
- Dual ARM Cortex-A9 at 1/1.2GHz
- 1 MB L2 cache, Neon, VFPv16, Trustzone
- 3D graphics with 1 shader
- 2D graphics
- 64-bit DDR3 and 2-channel 32-bit LPDDR2 at 533MHz
- Integrated SATA-II

## i.MX 6Quad
- Quad ARM Cortex-A9 at 1.2GHz
- 1 MB L2 cache, Neon, VFPv16, Trustzone
- 3D graphics with 4 shaders
- Two 2D graphics engines
- 64-bit DDR3 and 2-channel 32-bit LPDDR2 at 533MHz
- Integrated SATA-II

### i.MX 6 Series Highlights
- ARM Cortex-A9 based solutions ranging up to 1.2GHz
- HD 1080p encode and decode (except 6SL)
- 3D video playback in High definition (except 6SL)
- Low power 1080p playback at 350mW Integrated IO’s that include HDMI v1.4, MIPI and LVDS display ports, MIPI camera, Gigabit Ethernet, multiple USB 2.0 and PCI-Express
- SW support: Google Android™, Windows® Embedded CE, Ubuntu, Linux®, Skype™

Features vary by product family
Intelligent Integration of Multi-Media

i.MX 6Dual/6Quad VPU
- H.264 MVC1080p60 decode
- H.264 MVC 720p60 encode
- 350mW power consumption for single video!

i.MX 6Dual/6Quad IPU
- Four Display support (2x MIPI-DSI, Parallel, HDMI v1.4a)
- Stereoscopic camera input
- Color adjustments and gamut mapping
- Gamma correction and contrast stretching
- Compensation for low-light conditions & backlight reduction

Recording Video

Movie Content

Game Content

Image capture

VPU

2x/4x ARM Cortex- A9s

IPU

2D/3D Graphics

i.MX 6Dual/6Quad Triple-Play Graphics
- 3 engines: 3D, OpenVG and BLT
- 200 MT/s, 4 shaders, 3 separate engines
- High quality 3D games optimized for mobile
- Augmented reality views (real world + 3D objects)
- Advanced 3D video formats (source/depth format)

i.MX 6Dual/6Quad – 2x/4x cores
- Create, transform, enhance, & publish multimedia fast!
- Intuitive User Interfaces for content viewing
- Scalability for ‘the next big use case’

3D LCD

3D Television
quad core enables lower power than Dual core

HD1080P 60fps HDMI out; VPU-accelerated

3D gaming; GPU-accelerated

Webkit Browser page rendering and scrolling

Jan 2012
Android
Ice Cream Sandwich

Watch it live!
http://www.youtube.com/watch?v=dE5TIzOz9NI&list#t=7m07

<table>
<thead>
<tr>
<th></th>
<th>1 Core</th>
<th>2 Core</th>
<th>4 Core</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPU utilization</td>
<td>99%</td>
<td>~55-67%</td>
<td>~33%</td>
</tr>
</tbody>
</table>
i.MX 6 Series Low Power Video Processing

11 to 24 hours of HD playback
- 1080p30 fps or 720p60 fps h.264 High Profile
- Single Stream at 50Mbps
- 350mW decode power

7 to 15 hours of 3D video playback
- 1080p60 h.264 MVC
- Dual stream at 25Mbps each
- 700mW decode power

12 hours of 1080p video encode
- 1080p30fps H.264
- Single stream at 20Mbps
- 300mW encode power

8 hours of 3D video encode
- 720p60 h.264 MVC
- Dual stream at 25Mbps each
- 700mW decode power
Video/Graphics Subsystem in i.MX6

- Video Sources
- Displays
- Data Control
- Memory Interface
- External Memories
- IRAM
- ARM CPU
- GPUs
- IPUs
- DCICs
- VDOA
- VPU
- i.MX6 Dual/Quad

Bridges

Memory Interface

External Memories

IRAM

VPU

VDOA

DCICs

IPUs

GPUs

ARM CPU

i.MX6 Dual/Quad

Data Control

Video Sources

Displays

Bridges

Memory Interface
Vivante GC2000 Ultra-threaded GPU
**i.MX 6 Series: Triple-Play Graphics Solution**

**Vector Graphics**
- GPU-VG @ 500MHz
- 350M pixels / sec raw performance
- Native OpenVG™ 1.1 Khronos conformance with hardware tessellation

**3D + GPGPU**
- GPUv4 @ 533MHz
- 200M triangles / sec
- 4 Shader Cores: 30 GFLOPS
- Halti support

**Composition**
- GPU-2Dv1 @500Mhz
- Up to 1G pixels / sec raw performance

**DirectX®**

---

Freescale, the Freescale logo, AMIIVc, C-5, CodeTEST, CodeWarrior, ColdFire, C-Ware, the Energy Efficient Solutions logo, mobileST, PowerQUICC, QorIQ, StarCore and Symphony are trademarks of Freescale Semiconductor, Inc., Reg. U.S. Pat. & Tm. Off. BeeKit, BeeStack, ColdFire+, CoreNet, Flexis, Kinetics, MAC, Platform in a Package, Processor Expert, QorIQ Domengine, Qoriva, QUICC Engine, SMARTMOS, TurboLink, VirtiQa and Xtrinsic are trademarks of Freescale Semiconductor, Inc. All other product or service names are the property of their respective owners. © 2011 Freescale Semiconductor, Inc.
<table>
<thead>
<tr>
<th>i.MX 6 Series feature list (1/3)</th>
<th>i.MX53</th>
<th>i.MX 6SoloLite</th>
<th>i.MX 6Solo</th>
<th>i.MX 6DualLite</th>
<th>i.MX 6Dual</th>
<th>i.MX 6Quad</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Core</strong></td>
<td>1x 1/1.2GHz Cortex-A8, 256KB L2 cache, 32K+32K I/D L1</td>
<td>1x 1GHz Cortex-A9, 256KB L2 cache, 32K+32K I/D L1</td>
<td>1x 1GHz Cortex-A9, 512KB L2 cache, 32K+32K I/D L1</td>
<td>2x 1GHz Cortex-A9, 512KB L2 cache, 32K+32K I/D L1</td>
<td>2x 1/1.2 GHz Cortex-A9, 1MB L2 cache, 32K+32K I/D L1</td>
<td>4x 1/1.2 GHz Cortex-A9, 1MB L2 cache, 32K+32K I/D L1</td>
</tr>
<tr>
<td><strong>DMIPS</strong></td>
<td>2400 DMIPS</td>
<td>2500 DMIPS</td>
<td>2500 DMIPS</td>
<td>5000 DMIPS</td>
<td>5000 DMIPS</td>
<td>10000 DMIPS</td>
</tr>
<tr>
<td><strong>Process Tech</strong></td>
<td>65nm, LPG</td>
<td>40nm, LP</td>
<td>40nm, LP</td>
<td>40nm, LP</td>
<td>40nm, LP</td>
<td>40nm, LP</td>
</tr>
<tr>
<td><strong>DDR Memory</strong></td>
<td>x32 DDR2, LP-DDR2, LV-DDR2, DDR3, Page interleaving</td>
<td>x32 LP-DDR2, DDR3, LV-DDR3, Page interleaving</td>
<td>x32 LP-DDR2, DDR3, LV-DDR3, Page and channel interleaving</td>
<td>2x32 LP-DDR2, 1chx64 DDR3 / LV-DDR3, Page and channel interleaving</td>
<td>2x32 LP-DDR2, 1chx64 DDR3 / LV-DDR3, Page and channel interleaving</td>
<td></td>
</tr>
<tr>
<td><strong>Max DDR Speed</strong></td>
<td>400MHz (800MT/s)</td>
<td>400MHz (800MT/s)</td>
<td>400MHz (800MT/s)</td>
<td>400MHz (800MT/s)</td>
<td>533MHz, (1066MT/s)</td>
<td>533MHz, (1066MT/s)</td>
</tr>
<tr>
<td><strong>NAND</strong></td>
<td>SLC/MLC, 16-bit ECC</td>
<td>-</td>
<td>SLC/MLC, 40-bit ECC, ONFI2.2, DDR</td>
<td>SLC/MLC, 40-bit ECC, ONFI2.2, DDR</td>
<td>SLC/MLC, 40-bit ECC, ONFI2.2, DDR</td>
<td>SLC/MLC, 40-bit ECC, ONFI2.2, DDR</td>
</tr>
<tr>
<td><strong>Video Codecs</strong></td>
<td>Decode: MPEG-2, H.264, VC1, MPEG-4/Xvid DivX 6, H.263, MJPEG. Encode: H.264, H.263, MPEG-4, MPEG-2, MJPEG</td>
<td>SW Only</td>
<td>i.MX53 + VP6 / WebM VP8, H.264 MVC</td>
<td>i.MX53 + VP6 / WebM VP8, H.264 MVC</td>
<td>i.MX53 + VP6 / WebM VP8, H.264 MVC</td>
<td>i.MX53 + VP6 / WebM VP8, H.264 MVC</td>
</tr>
<tr>
<td><strong>Video Decode</strong></td>
<td>1080p30</td>
<td>SW Only</td>
<td>1080p30 + D1</td>
<td>1080p30 + D1</td>
<td>1080p60or30 + D1</td>
<td>1080p60or30 + D1</td>
</tr>
</tbody>
</table>
### i.MX 6 Series feature list (2/3)

<table>
<thead>
<tr>
<th></th>
<th>i.MX53</th>
<th>i.MX 6SoloLite</th>
<th>i.MX 6Solo</th>
<th>i.MX 6DualLite</th>
<th>i.MX 6Dual</th>
<th>i.MX 6Quad</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Display (@60Hz)</strong></td>
<td>WXGA (1280x800)</td>
<td>WXGA (1366 x 768)</td>
<td>2 x WXGA (1366 x 768)</td>
<td>2 x WXGA (1366 x 768)</td>
<td>2 x 4XGA (2048x1536) or 2 x [1080p + WXGA (1280x720)]</td>
<td>2 x 4XGA (2048x1536) or 2 x [1080p + WXGA (1280x720)]</td>
</tr>
<tr>
<td><strong>Display Interfaces</strong></td>
<td>Types: 1x parallel, 1xLVDS, 1xserial VGA, two outputs</td>
<td>Types: EPDC, Parallel, Two outputs</td>
<td>Types: 2x Parallel, LVDS, MIPI-DSI, HDMI, EPDC Two outputs</td>
<td>Types: 2x Parallel, LVDS, MIPI-DSI, HDMI, EPDC Two outputs</td>
<td>Types: 2x Parallel, LVDS, MIPI-DSI, HDMI, EPDC Two outputs</td>
<td>Types: 2x parallel, 2x LVDS, MIPI-DSI, HDMI Four outputs</td>
</tr>
<tr>
<td><strong>Camera Interface</strong></td>
<td>2x 20-bit parallel, Two simultaneous inputs</td>
<td>16-bit parallel</td>
<td>2x20-bit parallel, MIPI-CSI2 (2 lanes) Two input</td>
<td>2x20-bit parallel, MIPI-CSI2 (2 lanes) Two input</td>
<td>2x 20-bit parallel, MIPI-CSI2 (4 lanes), Three simultaneous inputs</td>
<td>Types: 2x 20-bit parallel, MIPI-CSI2 (4 lanes), Three simultaneous inputs</td>
</tr>
<tr>
<td><strong>GPU 2D (Vector Graphics)</strong></td>
<td>AMD Z160 166 Mpixel/s OpenVG 1.1, OpenVG 1.1</td>
<td>Vivante GC355 300Mpilor/s OpenVG 1.1</td>
<td>(Emulated on GPU 3D)</td>
<td>(Emulated on GPU 3D)</td>
<td>Vivante GC355 300Mpilor/s, OpenVG 1.1</td>
<td>Vivante GC355 300Mpilor/s, OpenVG 1.1</td>
</tr>
<tr>
<td><strong>GPU 2D (Composition)</strong></td>
<td>(Accelerated on other GPUs)</td>
<td>(Accelerated on the other GPU)</td>
<td>Vivante GC320 600Mpilor/s, BLIT</td>
<td>Vivante GC320 600Mpilor/s, BLIT</td>
<td>Vivante GC320 600Mpilor/s, BLIT</td>
<td>Vivante GC320 600Mpilor/s, BLIT</td>
</tr>
<tr>
<td><strong>Hard Drive I/F</strong></td>
<td>P-ATA, S-ATA II 1.5Gbps</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>S-ATA II 3Gbps</td>
<td>S-ATA II 3Gbps</td>
</tr>
<tr>
<td><strong>Audio accel</strong></td>
<td>n/a</td>
<td>n/a</td>
<td>ASRC</td>
<td>ASRC</td>
<td>ASRC</td>
<td>ASRC</td>
</tr>
<tr>
<td><strong>Audio Interfaces</strong></td>
<td>3x I2S, SPDIF Tx/Rx, ESAI</td>
<td>3x I2S, SPDIF Tx/Rx</td>
<td>3x I2S, SPDIF Tx/Rx, ESAI</td>
<td>3x I2S, SPDIF Tx/Rx, ESAI</td>
<td>3x I2S, SPDIF Tx/Rx, ESAI</td>
<td>3x I2S, SPDIF Tx/Rx, ESAI</td>
</tr>
</tbody>
</table>

Red indicates change from column to the left.
## i.MX 6 Series feature list (3/3)

<table>
<thead>
<tr>
<th>Expansion Ports</th>
<th>i.MX53</th>
<th>i.MX 6SoloLite</th>
<th>i.MX 6Solo</th>
<th>i.MX 6DualLite</th>
<th>i.MX 6Dual</th>
<th>i.MX 6Quad</th>
</tr>
</thead>
<tbody>
<tr>
<td>3x SD/MMC 4.3, 1x SD/MMC 4.4</td>
<td>3x SD/MMC 4.4, 1x SDXC</td>
<td>3x SD/MMC 4.4, 4x SPI, 5x UART, 3x I2C, MIPI-HSI PCIe 2.0 (1 lane)</td>
<td>3x SD/MMC 4.4, 4x SPI, 5x UART, 4x I2C, MIPI-HSI PCIe 2.0 (1 lane)</td>
<td>3x SD/MMC 4.4, 1x SDXC</td>
<td>3x SD/MMC 4.4, 1x SDXC</td>
<td>3x SD/MMC 4.4, 1x SDXC</td>
</tr>
<tr>
<td>3x SPI, 5x UART, 3x I2C</td>
<td>5x UART, 3x I2C</td>
<td>4x SPI, 5x UART, 4x I2C, MIPI-HSI PCIe 2.0 (1 lane)</td>
<td>4x SPI, 5x UART, 4x I2C, MIPI-HSI PCIe 2.0 (1 lane)</td>
<td>5x SPI, 5x UART, 3x I2C, MIPI-HSI PCIe 2.0 (1 lane)</td>
<td>5x SPI, 5x UART, 3x I2C, MIPI-HSI PCIe 2.0 (1 lane)</td>
<td>5x SPI, 5x UART, 3x I2C, MIPI-HSI PCIe 2.0 (1 lane)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>USB I/F</th>
<th>i.MX53</th>
<th>i.MX 6SoloLite</th>
<th>i.MX 6Solo</th>
<th>i.MX 6DualLite</th>
<th>i.MX 6Dual</th>
<th>i.MX 6Quad</th>
</tr>
</thead>
<tbody>
<tr>
<td>1x HS OTG + PHY, 1x Host + PHY, 2x Host + ULPI/IC-</td>
<td>Three USB2.0: 1x HS OTG + PHY, 1x Host + PHY, 1x Host USB HSIC</td>
<td>Four USB2.0: 1x HS OTG + PHY, 1x Host + PHY, 1x Host USB HSIC</td>
<td>Four USB2.0: 1x HS OTG + PHY, 1x Host + PHY, 1x Host USB HSIC</td>
<td>Four USB2.0: 1x HS OTG + PHY, 1x Host + PHY, 1x Host USB HSIC</td>
<td>Four USB2.0: 1x HS OTG + PHY, 1x Host + PHY, 1x Host USB HSIC</td>
<td>Four USB2.0: 1x HS OTG + PHY, 1x Host + PHY, 1x Host USB HSIC</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ethernet</th>
<th>i.MX53</th>
<th>i.MX 6SoloLite</th>
<th>i.MX 6Solo</th>
<th>i.MX 6DualLite</th>
<th>i.MX 6Dual</th>
<th>i.MX 6Quad</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/100 Mbps + IEEE1588</td>
<td>10/100 Mbps</td>
<td>1 Gbps + IEEE1588</td>
<td>1 Gbps + IEEE1588</td>
<td>1 Gbps + IEEE1588</td>
<td>1 Gbps + IEEE1588</td>
<td>1 Gbps + IEEE1588</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Boot</th>
<th>i.MX53</th>
<th>i.MX 6SoloLite</th>
<th>i.MX 6Solo</th>
<th>i.MX 6DualLite</th>
<th>i.MX 6Dual</th>
<th>i.MX 6Quad</th>
</tr>
</thead>
<tbody>
<tr>
<td>Updated boot sources</td>
<td>Updated boot sources</td>
<td>Updated boot sources</td>
<td>Updated boot sources</td>
<td>Updated boot sources</td>
<td>Updated boot sources</td>
<td>Updated boot sources</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Temperat. Monitor</th>
<th>Yes</th>
<th>Yes</th>
<th>Yes</th>
<th>Yes</th>
<th>Yes</th>
<th>Yes</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>PMU</th>
<th>i.MX5x Baseline</th>
<th>PMU integration</th>
<th>PMU integration</th>
<th>PMU integration</th>
<th>PMU integration</th>
</tr>
</thead>
<tbody>
<tr>
<td>2x Osc, 2x LDO</td>
<td>PMU integration</td>
<td>PMU integration</td>
<td>PMU integration</td>
<td>PMU integration</td>
<td>PMU integration</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Security</th>
<th>i.MX5x Baseline with improvements</th>
<th>i.MX5x Baseline with improvements</th>
<th>i.MX5x Baseline with improvements</th>
<th>i.MX5x Baseline with improvements</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Assurance Boot, secure RAM, crypto accelerator, TrustZone, NIST- approved RNG</td>
<td>i.MX5x Baseline with improvements</td>
<td>i.MX5x Baseline with improvements</td>
<td>i.MX5x Baseline with improvements</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Package</th>
<th>i.MX53</th>
<th>i.MX 6SoloLite</th>
<th>i.MX 6Solo</th>
<th>i.MX 6DualLite</th>
<th>i.MX 6Dual</th>
<th>i.MX 6Quad</th>
</tr>
</thead>
<tbody>
<tr>
<td>13x13 0.5P PoP</td>
<td>13x13 0.5m PoP</td>
<td>na</td>
<td>12x12 0.4mm POP</td>
<td>21x21 0.8P BGA pin-compatible</td>
<td>21x21 0.8P BGA pin-compatible</td>
<td>21x21 0.8P BGA pin-compatible</td>
</tr>
<tr>
<td>19x19 0.8P BGA</td>
<td>13x13 0.5m BGA</td>
<td>13x13 0.5m BGA</td>
<td>21x21 0.8P BGA pin-compatible</td>
<td>21x21 0.8P BGA pin-compatible</td>
<td>21x21 0.8P BGA pin-compatible</td>
<td>21x21 0.8P BGA pin-compatible</td>
</tr>
</tbody>
</table>

Red indicates change from column to the left.
# Origin of Android Components

## Applications

<table>
<thead>
<tr>
<th>Home / Widget</th>
<th>Phone</th>
<th>Browser</th>
<th>Camera</th>
<th>3D Media Player</th>
<th>Live Wallpaper</th>
<th>Input</th>
<th>Providers</th>
</tr>
</thead>
</table>

## Application Framework

<table>
<thead>
<tr>
<th>Activity Manager</th>
<th>Window Manager</th>
<th>View System</th>
<th>Package Manager</th>
<th>Telephony Manager</th>
<th>Location Manager</th>
<th>WiFi Manager</th>
<th>Tethering</th>
<th>Content Provider</th>
<th>Notification Manager</th>
<th>Resource Manager</th>
</tr>
</thead>
</table>

## Libraries

<table>
<thead>
<tr>
<th>Surface Manager</th>
<th>OpenGL/ES</th>
<th>Skia</th>
<th>Media Framework</th>
<th>SQLite</th>
<th>FreeType</th>
<th>SSL</th>
<th>Dalvik Virtual Machine</th>
<th>Core Libraries</th>
<th>Recovery</th>
<th>Fastboot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daemons</td>
<td>Webkit</td>
<td>LibC</td>
<td>Audio Manager</td>
<td>Audio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Runtime

<table>
<thead>
<tr>
<th>Graphics</th>
<th>Audio</th>
<th>Camera</th>
<th>Bluetooth</th>
<th>GPS</th>
<th>Sensors</th>
<th>WiFi</th>
<th>Radio (RIL)</th>
</tr>
</thead>
</table>

## Utilities

<table>
<thead>
<tr>
<th>Hardware Abstraction Layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kernel Upgrade</td>
</tr>
<tr>
<td>Freescale Customized</td>
</tr>
</tbody>
</table>

## Linux Kernel

- Kernel Upgrade
- Display / Camera Drivers
- Audio Driver
- USB Gadget
- Power management
market Specific Reference Designs

- **SABRE for Tablet**
  - Optimized for consumer user experience
    - Android 2.3/3.0
    - 10 inch capacitive touch display
    - Battery powered and optimized
    - Consumer components
    - Targeted expandability

- **SABRE for Automotive Infotainment**
  - Optimized for maximum flexibility
    - Auto OS support
    - Baseboard re-use from 5 to 6 Series
    - Automotive specific interfaces
    - Automotive components
    - Connectivity plug-in modules
i.MX SABRE for Automotive Infotainment
Modular Reference Design Concept

• Main Board
  - Expanded connectivity options (CAN, MOST, USB, dual displays, SDIO)
  - Connectors for Processor Module and Wireless Modules

• Wireless Modules
  - GPS Module
  - Bluetooth/WiFi Module
  - 3G Modern Module
  - Radio Tuners
  - IAP
Quick Start Board

- **Cost-effective ($399)**, open source development platform
- Designed to **simplify product evaluation**

SABRE Smart Device

- **Smart Device Market-focused ($999)**
- Form-factor ready to **accelerate design & time to market**
Quick Start Board for i.MX 6

i.MX 6Quad 1Ghz Cortex-A9 Processor
• Freescale PF-Series PMIC
• 1 GB DDR3 memory (non terminated)
• 3” x 7” 8-layer PCB

Display
• 2x LVDS connectors
• Parallel LCD add-on card via expansion connector
• 24 bit 4.3” 800x480 WVGA with 4-wire touch screen
• HDMI Connector

Audio
• Wolfson Audio Codec
• Microphone and headphone jacks

Expansion Connector
• Camera CSI port signals
• I2C, SSI, SPI signals

Connectivity
• Full-size SD/MMC card slot
• 7-pin SATA data connector
• 10/100/1000 Ethernet port
• 1x high-speed USB host port
• PCI-e connector

Debug
• JTAG connector
• Serial to USB connector

Additional Features
• 3-axis Freescale accel
• Power supply- USB plug
• No battery charger

OS Support
• Linux and Android IceCream Sandwich from Freescale;
  Windows Compact 7 from Adeneo

Tools Support
• Segger/CodeSourcery, Macgraiigor, IAR debug/IDE tool chain
SABRE Smart Device for i.MX 6

i.MX 6Quad 1Ghz Cortex-A9 Processor
• Freescale PF-Series PMIC
• 1 GB DDR3 memory (non terminated)
• 3” x 7” 8-layer PCB

Display
• Native 1024x768 LVDS display with kit
• 2nd LVDS connector
• Parallel LCD add-on card via expansion connector
• 24 bit 4.3” 800x480 WVGA with 4-wire touch screen
• HDMI Connector
• MIPI DSI connector

Audio
• Wolfson Audio Codec
• Microphone and headphone jacks
• Dual 1W Speakers

Expansion Connector
• Enables parallel LCD or HDMI output
• Camera CSI port signals
• I2C, SSI, SPI signals

Connectivity
• Full-size SD/MMC card slot
• 7-pin SATA data connector
• 10/100/1000 Ethernet port
• 1x high-speed USB host port
• PCI-e connector

Debug
• JTAG connector
• Serial to USB connector

Additional Features
• 3-axis Freescale accel
• GPS receiver
• Dual 5MP Cameras
• Power supply- USB plug
• Battery Charger
• Battery connectors

OS Support
• Linux and Android IceCream Sandwich from Freescale;
  Windows Compact 7 from Adeneo

Tools Support
• Segger/CodeSourcery, Macgraior, IAR debug/IDE tool chain
Linux / Android
Time to Market is Driven by SVV
Software, Verification, Validation

Source: IBS 2009

Breakdown of average total IC design costs for different design activities at different technology nodes:
- Orange: Software
- Red: Verification
- Green: Validation
- Blue: Physical
- Blue-green: Architecture

Design Cost ($M) vs. Technology Node
Linux Driver Similarity

i.MX 6DualLite/Solo Compared to i.MX 6Quad/Dual Linux BSP Drivers

System Call Interface

Applications, Shell
Utilities, Libraries
GUI
MM Framework & CODECs
VTE Test Framework & Unit Tests

Legend

Utilities, Libraries
GUI
MM Framework & CODECs
VTE Test Framework & Unit Tests

OS Services

– threads, synchronization, memory mgmt, etc.

Machine Specific Layer

Applications, Shell
GUI
MM Framework & CODECs
VTE Test Framework & Unit Tests

System Call Interface

Utilities, Libraries
GUI
MM Framework & CODECs
VTE Test Framework & Unit Tests

Legend

OS Services

– threads, synchronization, memory mgmt, etc.

Machine Specific Layer
Linux Driver Similarity

i.MX 6SoloLite Compared to i.MX 6Solo Linux BSP Drivers

System Call Interface

Utilities, Libraries

GUI

MM Framework & CODECs

VTE Test Framework & Unit Tests

Applications, Shell

OS Services – threads, synchronization, memory mgmt, etc.

Legend

- Removed
- Modified MX5x/6Q driver
- New driver
- Reused MX5x/6Q driver
- User space apps and libraries
- H/W Independent Kernel Code

Legend

- Removed
- Modified MX5x/6Q driver
- New driver
- Reused MX5x/6Q driver
- User space apps and libraries
- H/W Independent Kernel Code

Legend

- Removed
- Modified MX5x/6Q driver
- New driver
- Reused MX5x/6Q driver
- User space apps and libraries
- H/W Independent Kernel Code
www.imxcommunity.org

A Freescale supported open web community of developers sharing common interest in transforming i.MX applications processors into practically anything imaginable.

i.MX Community

• Support and enablement for i.MX processors and software
• Forums, Groups and Blogs Posts
• News, Photos and Videos
• Training, Events and Promotions