

# i.MX21 Applications Processor



Smart Multimedia for a Mobile World

# The Smart Video Solution

The i.MX21 multimedia applications processor is designed to help you create multimedia-capable devices with the multitasker in mind. Bring consumers the video they demand—and don't ask them to give up any of the other functions on which they depend. The i.MX21 not only enables smart LCD displays and exceptional video, it also powers versatile multitasking capabilities.

## Enhanced Video

An Enhanced Multimedia Accelerator (eMMA) offers you independent pre- and post-processing modules as well as simultaneous

MPEG-4 and H.263 encode and decode acceleration that deliver exceptional image and video quality. The video processing modules save power by offloading the ARM926EJ-S™ core. So consumers can watch exceptional quality videos for a longer time than ever before.

The i.MX21 also helps to ensure that a mobile device can run multiple applications simultaneously, without affecting performance. For example, a user can watch a video and send an e-mail to a colleague commenting on the video without interrupting the video in play.

## Smart LCD Displays

Designed for optimal battery performance, the i.MX21 enables smart LCD displays, which save battery life and help eliminate the need for users to recharge their devices constantly.

A traditional standard LCD does not have memory or a controller integrated. It requires a separate controller and memory for buffering the image. Thus the display must be constantly refreshed, as it cannot identify if an image has changed or not. And that eats away at performance and valuable battery life.

## Video features include:

- > Support for real-time MPEG-4 and H.263 encoding and decoding of images up to CIF at 30 fps
- > Ability to support PacketVideo®, RealNetworks® and Windows Media™
- > Pre-processing for color space conversion and image resizing for viewfinder display
- > Post-processing for de-block, de-ring, image resize and color space conversion to create a sharper, clearer image, regardless of format

## HARDWARE VS. SOFTWARE APPROACH

Parameters	Software Approach	Hardware Approach (i.MX21)
Codec engine	MIPS processing	Dedicated hardware block
Image size	Limited by the processing capabilities of the processor	Scalable up to 1:4 ratio
Image quality	Compromised to save general-purpose processor resources	Optimal due to dedicated processing modules
Frame rate	Compromised to save general-purpose processor resources	Scalable up to CIF 30 fps
OS overhead	Affected by OS overhead and reduces actual performance	Not affected by OS overhead as dedicated built-in hardware IP
Bus loading	High CPU loading during computationally intensive tasks	Smart Speed Switch removes bus loading conflicts
CPU loading	High CPU loading during computationally intensive tasks such as motion estimation	Less CPU loading as processing dedicated to built-in hardware IP
Power consumption	More clock cycles are required to perform the same computation, consuming more power	Specific set of algorithms allows fewer clock cycles to perform the same computation, saving power

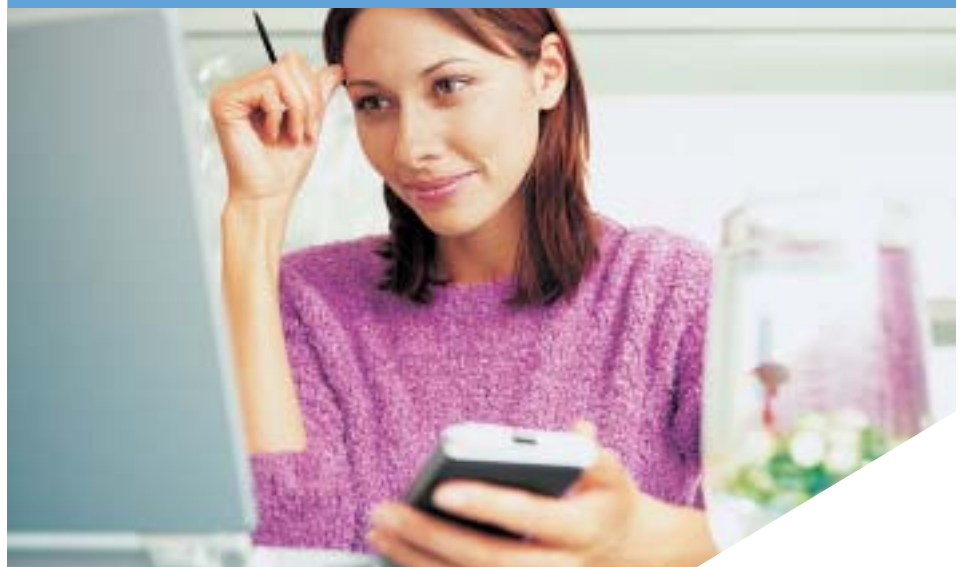


**“The best performing mobile devices have the ability to deliver to consumers a rich combination of multimedia and handheld computing that do not adversely affect battery life. Mobile device designers need applications processors with the right mix of performance, power efficiency, flexibility and reliability.”**

—Max Baron,  
Principal Analyst, In-Stat/MDR

## USE CASE

A company CEO receives a video of a new office building for lease. As she views the video, the leasing agent calls. She is able to view the uninterrupted video while getting answers to specific questions about the property.



## USE CASE

Two kids share a handheld device to play the latest networked 3-D racecar game.



*The i.MX21 offers users a better experience watching video and running graphics-intensive applications such as 3-D gaming.*

“Motorola’s state-of-the-art microprocessors helped Palm create the first commercially successful personal digital assistant in 1996. Since that time, Motorola processors have powered more than 20 million PDAs. We are proud that new generations of Palm Powered® products will continue to be able to take advantage of Motorola’s famed combination of low power consumption and high levels of integration and performance to deliver the capabilities and value that customers seek in modern PDAs and smartphones.”

—David Nagel,  
CEO, Palm, Inc.

**“We’re partnering with Motorola because of its market leadership in the handheld space and its ability with i.MX to deliver high-performance graphics and long battery life.”**

—Peng Lim,  
CEO and Founder, Tapwave

\*The Semiconductor Products Sector of Motorola, Inc. became Freescale Semiconductor, Inc. in 2004.

## Meeting the Graphics Challenge

Don’t just get in the game, get ahead of it. Today’s video games are created with lifelike 3-D images that would have blown your mind just a few years ago. The i.MX21 multimedia applications processor helps you design mobile devices that can do them justice.

The i.MX21 offers users a better experience watching video and running graphics-intensive applications such as 3-D gaming. High-performance graphics support starts with a solid rendering engine based on the ARM926EJ-S core and the i.MX21’s L1 cache. The i.MX21 elevates overall system performance through a bus master interface that reduces the overhead to external multimedia coprocessors such as those from ATI Technology, Inc. It can also support advanced graphics software standard APIs such as Mobile Java™ 3D and OpenGL®-ES, as well as 3-D software engines such as Superscape®, HI Corp® and Fathammer™. The graphics interface also supports 2-D software graphics operations including LineDraw, BitBit and FillRect.

## Smart Speed

All the creativity in the world doesn’t make a great product if it runs out of power when the user needs it most. And if you’re putting video in the wireless mix, mastering your low-power goal can translate into high-design anxiety. You don’t just need speed; you need smart speed. You’ll have to use every trick in the book to extend battery life so consumers can focus on what’s important to them rather than worry about recharging their devices. Freescale can help.

Smart power management is at the heart of the i.MX21 applications processor design. It starts with support for three power modes: run, doze and stop. Since clock distribution is a key factor in controlling power, the i.MX21 implements aggressive clock gating within modules. That’s complemented by the ability to change system clock or CPU frequency on the fly, and by process-enabled innovations that reduce leakage current, such as active well-biasing.



*The i.MX21 not only enables smart displays and exceptional video, it also powers versatile multitasking capabilities.*

“We selected the i.MXL chip because of its strong capability for real-time applications enabled by the ARM9™ microprocessor core and the rich set of peripherals and features integrated by the Motorola® design team.”

—Cliff Pemble,  
Director of Engineering,  
Garmin International

#### USE CASE

The i.MX21 delivers a rich user experience that lasts and lasts. Be it 3-D interactive gaming; cinematic videos; digital music while remotely updating a presentation; checking e-mail; or confirming directions via GPS, the user might run out of energy before the battery does.



#### USE CASE

A daughter sends her father a photo of her new college friends. Her dad views the picture on his smartphone and then sends the image to a printer so that other family members can see his daughter's new friends.



## Total System Performance for Longer Battery Life

The i.MX21 delivers speed and performance with stamina. This can be accomplished by leveraging the architectural advantages that have made the i.MX Family a widely used solution in the market place.

A feature of the i.MX21, the Smart Speed Switch, is an advantage that achieves true parallelism resulting in more effective data per CPU cycle. The switch allows up to four simultaneous transactions, which can provide the effective throughput of a 532 MHz bus. This allows enriched multimedia experiences, such as V2oIP, with exceptional quality that exceeds the performance of higher MHz processors.

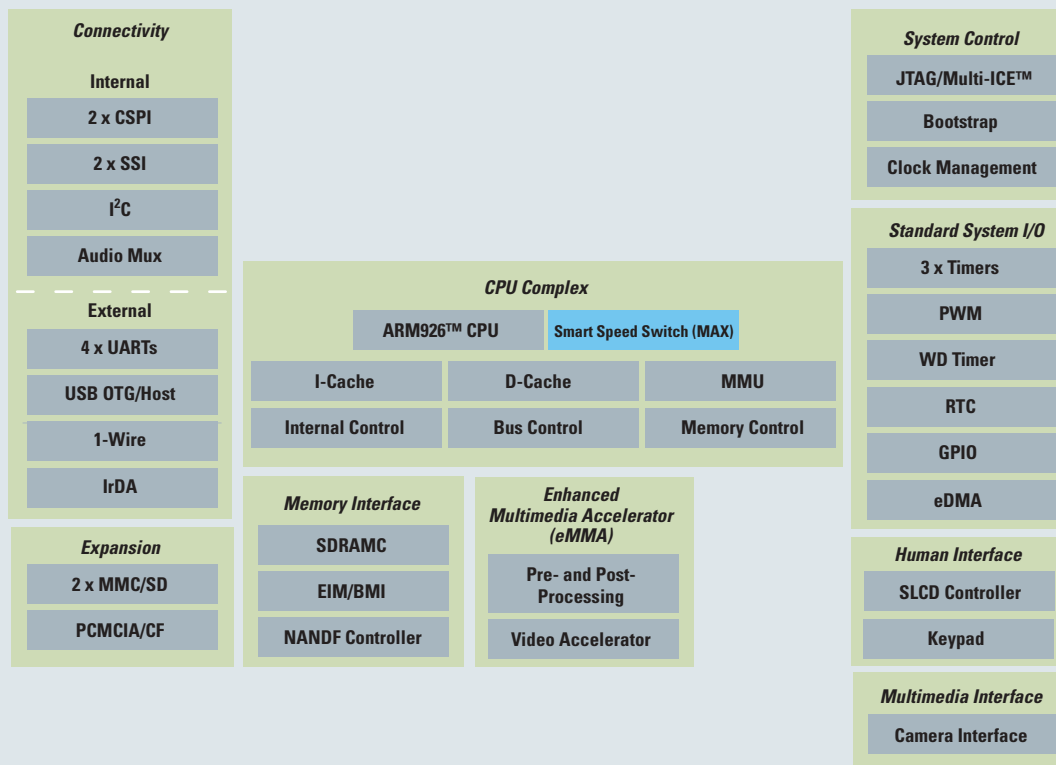
While slowing down the CPU, a designer can take advantage of the architecture to achieve high performance while maintaining the low power capabilities. This gives the developer greater flexibility when choosing to use either software running on the ARM core only, or leveraging enhanced functionality to achieve parallelism and lower power when using the various IP blocks within the system. Freescale's combination of power savings techniques and specialized processing IP blocks enable greater processing capabilities with lower clock speeds, resulting in longer battery life.

## USB On-The-Go

Smartphones, PDAs, digital cameras and other mobile devices that connect to PC peripherals such as printers or MP3 players become even more flexible when they can connect directly with each other. The possibilities for these devices grow exponentially: A digital camera could transmit data directly to a printer for quick printing of photos; a mobile phone and PDA could share information directly, anywhere their owners choose to connect them.

The USB On-The-Go standard defines a way for mobile devices to connect directly with other peripherals, taking the PC out of the connectivity loop. The i.MX21 multimedia applications processor is designed to make that connectivity easier with USB-OTG technology. In addition to providing connectivity on the go, in smartphones, this feature gives the host direct control over the smartphone modem for debug or production programming. The i.MX21 is among the first applications processor designs to provide a dedicated OTG port for an external OTG transceiver. That can translate into a savings of up to \$1.50US or more per device compared to using an external module.

## i.MX21 APPLICATIONS PROCESSOR BLOCK DIAGRAM



### Smart Multimedia for a Mobile World

The mobile world wants to watch a video of the winning goal while discussing the game with a friend six time zones away. View a favorite movie while waiting out a travel delay. Organize weekly appointments on a PDA while listening to downloaded music. Master the latest 3-D game before anyone else has time to learn the rules.

Consumers want mobile multimedia now, no matter where they are. They want unmatched video capability. And they want it built into the devices they're already carrying without draining power and cramping their style. Whether you're designing a smartphone, a wireless PDA or a totally new product, you need the means to add today's hottest features without compromising the rest of your design.

With Freescale's i.MX21 applications processor, you're up to the challenge. The i.MX21 applications processor is designed to enable crystal-clear video quality, smart LCD displays, and the peace of mind that information is being stored and securely delivered to its intended destination. It's smart speed: high-performance processing

optimized for low-power consumption. Imagine CIF 30 fps video encode and decode; sending e-mail while playing an MP3; videoconferencing at 15 fps using 35 percent to 65 percent less power.\*

\* Improvement over the i.MX1.

### Key Features of the i.MX21

#### CPU Complex

- > ARM926EJ-S™ (16 KB I-Cache, 16 KB D-Cache)
- > ARM Jazelle™ technology for Java™ acceleration
- > Smart Speed Switch

#### Human Interface

- > 16/18-bit color LCD controller up to SVGA
- > Smart panels support (SLCDC)

#### Connectivity

- > 4 x UARTs, IrDA (MIR and FIR)
- > USB On-The-Go (two-host port)

#### Expansion

- > Dual slot MMC and SD/SDIO card interface
- > PCMCIA support

#### Multimedia

- > MPEG-4 and H.263 encode/decode acceleration up to CIF 30 fps
- > High-speed CMOS sensor I/F and I²C
- > External bus master I/F (BMI)

#### Special Functions

- > NAND Flash controller
- > 16-channel DMA
- > 16/32-bit SDRAM controller

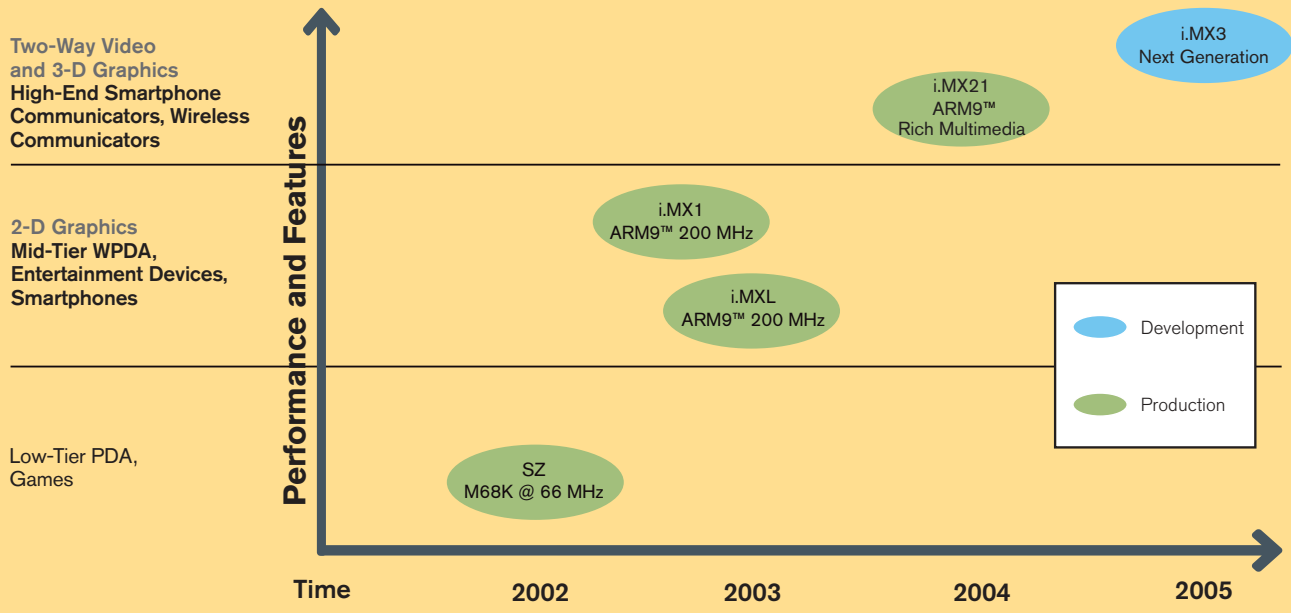
#### Performance

- > CPU complex: starting at 266 MHz
- > System: 133 MHz @ 1.8V

#### Technology

- > 289 ball, 0.65 mm pitch MAPBGA
- > 0.13 μm

The i.MX family of applications processors is designed with migration in mind. The i.MXL, i.MX1 and now, the i.MX21 offer solutions for different tiers of handheld devices, from mid-tier wireless PDAs, smartphones and gaming devices to high-end smartphones and wireless communicators.



**The i.MX Family**

The i.MX21 is the latest addition to Freescale's i.MX family of applications processors. This family builds on the low-power, high-performance heritage of Freescale's industry-founding applications processors, of which more than 50 million chips have already shipped. That means you can start smart by picking products with a technology pedigree to handle all the creativity you can pump into them.

The i.MX Family features the DragonBall™ SZ applications processor for inexpensive PDAs; the i.MX1 and i.MXL with smart speed for WPDAs, entertainment devices and smartphones; and now, the new i.MX21.

**Software**

The i.MX21 supports a broad range of industry-leading platforms such as those based on Microsoft® Windows CE, Palm OS®, Linux® and Symbian® operating systems. Like the other members of the i.MX

Family, it offers an extensive selection of software tools and, through a broad network of alliances, is supported by software solutions such as Internet browsers, location-based services, industry-specific human interfaces, multimedia applications and more.

**Tools**

High-performance hardware deserves a world-class software development system. Metrowerks' CodeWarrior™ Development System—ARM Architectures for i.MX offers you a fully integrated development environment to design, debug and deploy solutions for handheld devices, all from one graphical user interface.

Among the CodeWarrior features that specifically target ARM cores are full support for the ARM Instruction Set Architecture (ISA) and Thumb Architecture Extension. There's no need to leave the CodeWarrior environment at any time during the entire development cycle.

**AgentM Network**

Freescale's AgentM Network is designed to provide you with the platforms, tools, technology and expertise to get your product to market faster. With early access to the newest tools, AgentM members are better equipped to deliver mobile wireless solutions to a global audience in less time, with less effort, and at a lower cost. Join the AgentM Network and accelerate your next development project. For details, and to become an agent today, visit [www.freescale.com/agentm](http://www.freescale.com/agentm).

**Learn more**

To learn more about the i.MX Family and Freescale's Innovative Convergence portfolio of platforms, visit: [www.freescale.com/imx](http://www.freescale.com/imx).

For more information about Freescale products, please visit [www.freescale.com](http://www.freescale.com).

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