Nomadik®: A Mobile Multimedia Application Processor Platform

Maurizio Paganini
Application Processor Division
STMicroelectronics
Grenoble, France
Tel : +33-4-7658-5616
Fax : +33-4-7658-5870
e-mail : maurizio.paganini@st.com

Abstract - The Nomadik® platform supports a range of consumer-oriented multimedia applications, and is specifically designed for mobile applications. The combined use of industry standard host processor, and multiple low-power DSPs associated with dedicated hardware accelerators make for a flexible, yet low-cost and low-power solution.

I. Introduction

The current deep submicron technology era presents two opposing challenges: rising SoC platform development costs and shorter product market windows [1]. The rising platform development costs are due to four main sources: the continued rise in gate count, the emergence of deep submicron effects, the rising proportion of embedded software development costs, and finally, rising mask set costs.

As a result, the significant investment to develop the platform requires to maximize the *time-in-market* for a given platform. On the other hand, the consumer-led product cycles imply increasingly shorter *time-to-market* for the applications supported by the platform. Addressing these two conflicting requirements will come from the development of more flexible platforms that can be used across a wider range of applications and can evolve with short-term market requirements [3].

Next-generation mobile systems are bound to these same commercial realities. Moreover, competition is extremely high which causes extreme pressure on costs. Differentiation is increasingly coming from the ability to offer distinctive functionality quickly. Multimedia functions such as enhanced audio, video recording and playback, digital still imaging and 3D graphics are becoming stronger and stronger mandatory features in this market.

Providing advanced multimedia functions at low power requires the effective use of parallelism. The use of multiple low-frequency, simple processors is a more power effective means of delivering a specific performance target than a single, high-speed processor with deep pipelines, branch prediction and complex memory hierarchies.

Moreover, the combined use of heterogeneous RISC and multimedia-oriented DSPs allows to deliver a given function on the most appropriate processor architecture class – with control functions running on the general purpose RISC, and multimedia-oriented functions on the DSPs. Moreover, the multimedia DSPs are closely coupled with highly parallel hardware accelerators used for regular, stable functions with high computational needs. Flexible access and utilization of the hardware accelerators is provided by these DSPs.

We will illustrate this approach with STMicroelectronics' Nomadik® mobile multimedia platform. We present the target applications and an overview of the architecture.

II. Target Applications

The Nomadik® family of multimedia application processor chips [2] enables battery powered terminals to perform several multimedia functions, e.g., play music, take pictures, record and playback video, host multi-way video communication in real time. They are aimed at 2.5G/3G mobile phones, personal digital assistants and other portable wireless products with multimedia capability. Nomadik® products are also providing capabilities serving automotive multimedia applications.

III. Features of Nomadik® Platform

The Nomadik family is built around a few fundamental concepts, like ultra-low power consumption, an open platform strategy, industry-leading video and audio quality, very small footprint, and scalable performances. The current generation of Nomadik® application processors, the STn8815, is the last of a series of breakthroughs in innovative algorithms, video-coding efficiency, and chip-implementation techniques. The chip not only integrates leading hardware accelerator technology, developed specifically for the delivery of multimedia content on mobile platforms, but it also offers a simple and open programming model that greatly reduces software development time.

All Nomadik®'s Smart Multimedia Accelerators deliver high multimedia quality while maximizing battery life. The Smart Imaging Accelerator (SIA) operates as a real-time, programmable image-reconstruction engine up to 80 Mpixels/sec. This capability enables camera-phone systems, based on sensors up to 5 Mpixel, to execute noise reduction, auto-focus and exposure control, and other fundamental algorithms, therefore eliminating the need for an external imaging co-processor and reducing the system BOM (bill-of-materials). The SIA, coupled with the Smart Video Accelerator (SVA), which is capable of 30 Mpixel/s JPEG-image encoding, allows high-performance multi-shot

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camera capabilities, as well as low-power video encoding. The STn8815 integrates two SMIA (Standard Mobile Imaging Architecture) CCP2 (Compact Camera Port 2) camera interfaces, and supports 10-bit raw Bayer RGB data formats.

The SIA joins the smart-video and -audio accelerators established in earlier Nomadik® devices, and the new Smart Graphics Accelerator which supports 2D/3D graphics-intensive applications.

The STn8815 fits high-quality camcorder applications, thanks to the accelerated 30-frame/s SDTV (standard-definition) MPEG-4 encoding which runs in parallel to complex audio processing. The H264/AVC decoding, accelerated via the SVA, and supporting up to VGA format at 30frames per second, enables significantly improved performance for mobile TV.

The Smart Audio Accelerator (SAA) supports multiple audio standards such as MP3, AAC, AAC+, WMA, Midi synthesis, plus all major speech codecs, with a dedicated audio processor to perform noise reduction, echo canceling, stereo enhancements, and surround effects.

By distributing demanding multimedia processing onto the accelerators – which operate independently and concurrently to handle specific codec functions – the Nomadik® architecture off-loads the host CPU (central-processing unit), which becomes available as a general purpose application execution engine. Most competing mobile processors are based on a single CPU, or on a combined CPU and DSP, which need to use high clock frequencies leading to higher power consumption. Moreover, the Nomadik® CPU, like the rest of the device, can also enter progressively lower power saving states which preserve battery life; aggressive power management turns off inactive parts of the chip and keeps the CPU in lowest power state to fulfill the application needs.

The Nomadik® STn8815 hosts an ARM926EJ RISC (Reduced Instruction Set Computer) processor core, which provides continuity with prior generations of Nomadik® processor software and exploits the significant ARM9-based software legacy in the industry. The core operates at a clock frequency up to 334MHz, delivering 1000 MIPS (32-bit RISC-equivalent), on top of the performance of the hardware accelerators for video, audio, imaging, and graphics. Moreover, an embedded SRAM contributes to both the acceleration of multimedia processing and the containment of power consumption opening the way to complex multimedia combinations. The platform provides direct support for high-level operating systems such as Symbian OS™ and Windows Mobile®.

Nomadik® uses stacked-chip technology to provide memory variants, including SDRAM (Synchronous Dynamic Random Access Memory) and NAND Flash memory within the same package. It supports a rich set of industry-standard connectivity options, including all common removable external memory cards.

V. Summary and Outlook

The Nomadik® platform provides a rich set of multimedia functions at low-power and low-cost. The development environment supports effective access to the base functions supported by the platform multimedia subsystems, allowing ST customers to personalize the platform for a specific market segment.

In addition, ST research labs are currently working to further enhance the multi-processing programming capabilities of the platform, via a well-defined programming model developed for next generation Nomadik® products [3].

References

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