TECHNOLOGY WHITE PAPER

Next-Generation Strategies for DSP & ARM Development

Programming for DSP and ARM devices presents a common set of challenges for software engineers. Business managers will choose chipsets based on specific requirements, such as price, performance, history, and business relationships among other factors. Yet, it is software engineers that are burdened with compatibility and testing issues and ultimately will have to write code to multiple processors, likely with highly varied code bases.

While the future dominance of the DSP and ARM processor market can be debated, devices built with either processor will likely remain in the market for many years to come. This paper offers cross-platform software solutions and a vision for next-generation software development.

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DSP or ARM: No Clear Winner in Sight

DSP Market Overview

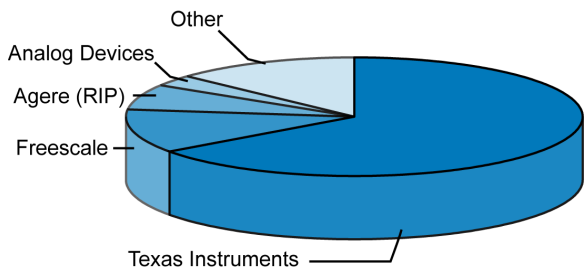
The Digital Signal Processing (DSP) market is experiencing double-digit growth rates for both revenue and shipments. The mobile phone market alone continues to generate more DSP revenue than all other applications combined.

It is expected that nearly 1.6 billion DSPs to be shipped this year and over 3.3 billion shipments by year 2013, representing an average growth rate of 16 percent per year. As average selling prices are expected to consistently drop over the forecast period, revenues will see a smaller, but still strong, growth rate of 11 percent. Like many other semiconductor products, DSP revenues largely come from countries in the Asia Pacific region, which accounts for 65 percent of all DSP sales).

The major application for DSP is in mobile phones, however a DSP can be found in a number of other electronic devices in varied applications. Audio systems such as personal media players and automotive audio systems utilize DSP, while video and imaging applications in the consumer and medical markets are also significant.

The largest players in the DSP market are Texas Instruments, Freescale, LSI Corporation (formerly Agere), Analog Devices and others including NXP, NEC and Renesas.

DSP Market Share 2007



Modern DSPs

The latest generation of DSPs provides far better performance because of both technological and architectural advancements like lower design rules, fast-access two-level cache, (E) DMA circuit and a wider bus system.

Of course not all DSPs provide the same speed and many kinds of signal processors exist, each one of them being better suited for a specific task ranging in price from US$1.50 to US$300.

Most DSPs use fixed-point arithmetic because in real world signal processing the additional range provided by floating point is not needed, and there is a large speed benefit and cost benefit due to reduced hardware complexity. Floating point DSPs may be invaluable in applications where a wide dynamic range is required. Product developers might also use floating point DSPs to reduce the cost and complexity of software development in exchange for more expensive hardware, since it is generally easier to implement algorithms in floating point.

Generally, DSPs are dedicated integrated circuits, however DSP functionality can also be realized using Field Programmable Gate Array chips.

ARM Market

The ARM unique business model is simply to sell IP cores to be used by licensees to create microcontrollers and CPUs. The most successful ARM was the ARM7TDMI, which boasts hundreds of millions sold in almost every kind of microcontroller-equipped device. The Original Design Manufacturer (ODM), or licensees, combine the ARM core with a number of optional parts to produce a complete CPU, one that can be built on old semiconductor fabs and still deliver substantial performance at a low cost.

ARMv4 is the most popular processor on Smartphones, Personal Digital Assistants and other handheld devices. ARMv5TE processors such as XScale and ARM926 processors, which in part are aimed at competing with DSPs, are now more numerous in high-end devices than the ARMv4 based processors (StrongARM, ARM925T and ARM7TDMI).

As of January 2008, over 10 billion ARM cores have been built, and iSuppli predicts that 5 billion a year will ship in 2011.[1]

ARM Responds

To improve the ARM architecture for digital signal processing and multimedia applications, a few new instructions were added to the set. These are commonly identified by an "E" in the name of the ARMv5TE and ARMv5TEJ architectures. The new instructions are common in digital signal processor architectures. They are variations on signed multiply-accumulate, saturated add and subtract, and count leading zeros.

Embedded general-purpose RISC processors are becoming increasingly DSP in functionality. For example, ARM Cortex-A8 has a 128-bit wide SIMD unit that can have impressive 16- and 8-bit performance for industry standard benchmarks.

C++ Toolkits for DSP, ARM and Other Processors

Engineers developing for DSP and ARM processors can take advantage of development tools and platforms that have been proven in the enterprise and mobile arenas and provide lightweight applications/services and multimedia capabilities (i.e. video) combined with the portability across all devices and chipsets.

Recursion Software offers a C++ DSP Toolkits that bring object serialization, design patterns, cross platform network and multi-threading APIs to DSPs, ARMs and many other processors. Toolkit libraries give developers the unique advantage of writing the same C++ application code to run on workstations, DSP devices, ARM devices, etc.

More specifically, the C++ Toolkits are an extensive set of portable, reusable C++ class libraries for software engineers. Included in the C++ Toolkits are libraries for date, time, helper, io, file, pipe, network, security, web, math functions, STL, threads and universal object serialization services.

Toolkit Benefits

Toolkits enable engineers to write code once and run it on all platforms without having to study the operating system primitives available on each platform in low-level C code. You can wrap C coding into classes to reduce errors and number of lines of code. Using the C++ Toolkits promotes adherence to the Object-Oriented Paradigm.

A unique benefit is that full source code is provided and there are no run-time charges. A library of more than 500 examples are included. The C++ Toolkits come with a complete set of documentation including an Installation Guide and User Guide, as well as technical support from Recursion engineers. Initialization is easy and straight-forward, with outstanding exception handling. Recursion Toolkits support over 50 systems configurations including the latest 64-bit processors.

Among the technical features are a full set of abstractions for date, time, interval, internationalization, timers, alarms and stopwatch; process control which includes threads, thread management and synchronization; encapsulated O/S functional utilities such as: file, directory, process, process group, resource, signal, this process, system and POSIX classes and message queue; functor utilities; inter-thread communication including producer/consumer queue, stream classes and templates, buffered stream classes and templates, pipe classes and templates; pattern framework include singleton, observable, creator, dispatcher and TCP framework adaptors.

C++ DSP Toolkits come in the following packages:

STL Toolkit™ - The STL Toolkit is a high performance implementation of the ANSI/ISO Standard Template Library (STL) and includes String, Exception and Utility classes.

ETL Toolkit™ - ETL Toolkit contains a unique set of collections packaged to enhance the STL. It includes Sorted Vector, Dynamic Array, Hash Table, Heap as well as List, Stack, Queue, and Set structures.

Foundations Toolkit™ - The Foundations Toolkit consists of a Thread library for writing multi-threaded applications, a Helper library that includes STL helper functions and a Time Library with 64 bit time and date classes.

Communications Toolkit™ - The Communications Toolkit contains eight class libraries: Streaming, Network, Pipe, File, Security, IO, Framework, and UNIX.

Math Toolkit™ - The Math Toolkit provides pre-written performance-oriented, scientific-computing solutions.

Web Toolkit™ - The Web Toolkit enables you to write web page logic and structure with C++ objects and existing C++ interfaces. The Web Toolkit supports HTML2 and HTML3 web page elements.

Database Toolkit™ - The Database Toolkit provides programmatic access to a wide range of ODBC-compliant databases.

Beyond the DSP and ARM Universe

Implementing with Recursion Toolkits frees engineers to develop truly innovative applications by streaming media files and other business objects from/to devices containing DSP and ARM processors to other types of devices. Yet, the next step in DSP and ARM development offers the ability to write and extend distributed services across DSP or ARMs to any processor or device regardless of type or their “native” language or platform, such as Java or .NET.

This would require an advanced, universal C++, Java and .NET software platform which would be built on top of the Toolkits to allows software engineers to easily build applications and services that can be hosted on any of the aforementioned processors, devices and platforms. Such a platform would allow engineers to build advanced rich media, mobile applications that can be shared amongst peers and dynamically assembled peer groups of devices that can span not only smart phones, but MIDs, UMPCs, PND’s, set-top boxes, computers etc.

Recursion’s pervasive Voyager platform, already available for Java and/or .NET development, will soon extend these capabilities to the C++ universe. The Voyager platform was designed for wireless peer-2-peer and peer-2-group messaging, gaming, rich media sharing and collaboration, and social networking between any wireless or embedded device. Stay tuned for this exciting development in Spring 2009.

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[1] ARM Technology, 22 January 2008