META LTP & MTP
SoC Embedded Processors

Imagination

With the increasing complexity of electronics products – and the software within them - ready access to key software components is critical in reducing development costs and achieving on-time product delivery. Imagination offer a broad spectrum of software for their range of META processors including a range of Operating Systems, market proven Audio Codecs, and pre-ported application-specific Libraries.

Imagination offer both single and multi-threaded processors for the embedded market, as part of their META LTP SoC Embedded Controller and META MTP SoC Embedded Processor families. The synthesizable 32-bit embedded processors deliver high performance combined with low power consumption and low system cost.

META processors are used by some of the world's leading semiconductor manufacturers, who together have shipped in excess of one hundred million processors since launch.

Architecture

META processors cover a wide range of performance and features enabling system designers to create solutions for their precise requirements whilst sharing a common instruction set, architecture, system bus interfaces, and tools simplifying migration between them.

All META processors include a debug adaptor port that enables access, via JTAG, to both the core and to devices connected to its bus interfaces, offering non-invasive debugging, high speed code download and ROMless boot during software development. The PC hosted CODESCAPE debugger additionally includes a rich set of debugging features, and can be connected to META targets thoughout SoC development on FPGA, emulator, or silicon using either USB or Ethernet JTAG DAs (Debug Adaptors).

	LTP220	LTP240	MTP220	MTP230
Threads	1	1	2	2
DSP	-	-	Yes	Yes
Linux capable MMU	-	-	-	Optional
Cache	-	16K/16K	-	16K/16K
DMIPS/MHz	0.9*	1.0	1.27	1.47
Area incl. Cache (65LP)	0.1mm^2	0.47mm^2	0.45mm^2	1.07mm^2

* Preliminary Information

Features

- Multi-threaded processor core (MTP)
- 16-bit instruction set support
- Co-processor interface
- Optional floating point unit (FPU)
- Non-invasive debugging via JTAG

Benefits

- Real-time and application code without interactions (MTP)
- Unified core replaces multiple CPU and DSP cores
- Each virtual processor (thread) can run an independent OS
- Mature Toolchain
- Lower cost than multi-processor approach
- Scalable performance – add more threads

Applications

- Smart Energy
- VoIP
- Audio
- Medical

Multi-threading

META Embedded Processors use multi-threaded hardware to present multiple virtual processors to the programmer with no context switching overheads. This offers many significant advantages over more conventional CPUs:-

- Each virtual processor (thread) can run an independent OS allowing mixing of Linux and real-time operating systems, or applications code and real-time code, on a single core without penalty.
- When execution of one thread stalls due to a cache miss – unlike conventional processors whose pipeline sits idle until the cache line fills – other META threads continue running in the pipelines unaffected, with the stalled thread catching up later thanks to AMA (Automatic MIPS Allocation).
- Superthreading allows more than one thread to execute on each cycle where they are using different internal resources

DSP

META Embedded Processors offer a rich, high performance, DSP instruction set, which sits alongside the general-purpose instructions. DSP instructions offer features such as hardware looping, instruction templating, multiply accumulate (MAC) with rounding and saturation, complex data types, and butterfly operations. Configurable DSP memory in each data unit supports extensive temporary data stores.

The SIMD DSP supports up to two 16-bit MACs/cycle, or one 32-bit MAC/cycle. Instruction templating facilities a VLIW-like complex DSP operation combining four instructions into a single operation.

META MTP SoC Embedded Processor

This compact class of META multi-threaded processor is targeted at embedded applications requiring high performance signal processing, protocol stacks, or a combination of the two.

META's multi-threading combined with its high performance DSP capabilities allows a single META processor core to optimally address problems traditionally solved with multiple processors and DSP cores. Real-time or modem code can be segregated from communications or application code by running on separate META threads, removing unwanted interactions between the two disparate tasks yet keeping them together on a common core, streamlining development, and minimising licensing / development / tools costs.

Typical applications include the decoding and post-processing of audio in consumer applications, smart energy devices, or complete VoIP stacks.

META MTP cores can include a demand page virtual memory MMU (to support Linux) and/or single precision floating point unit (FPU). META MTP cores deliver up to 1.47 DMIPS/MHz and have been proven at frequencies up to 740 MHz in 40LP.

META LTP SoC Embedded Controller

This ultra-compact class of META processor is targeted at ultra-low cost deeply embedded applications that traditionally used 8-bit or 16-bit processors or hardware state machines, but now require additional processing headroom for the inclusion of protocol stacks or abstracted drivers within the device itself.

Though single-threaded, it still shares development tools and instruction set with the multi-threaded META processors. These high level tools targeting standard C bring significant productivity benefits over coding on legacy processors in assembler.

META LTP cores typically operate from core memories, though cached variants are available, and deliver up to 1.0 DMIPS/MHz.

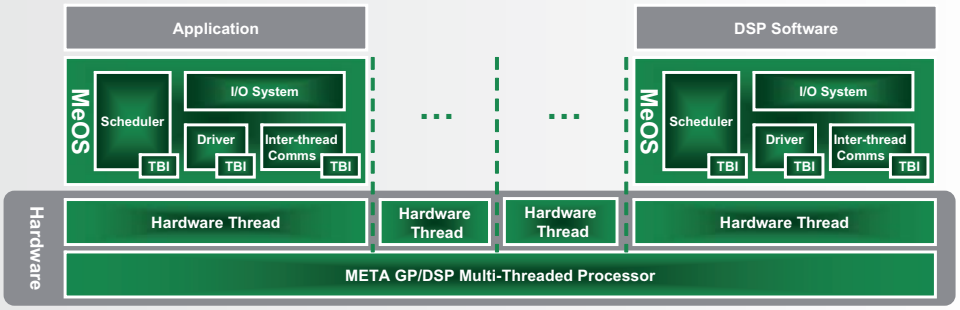
Operating Systems

Imagination directly support a range of operating systems for META embedded processors

- META MeOS Embedded Real-time Operating System
- Linux 2.6 Kernel

META MeOS Embedded Real-time Operating System

META MeOS is a compact real-time operating system for small to medium-sized embedded systems. It provides a comprehensive set of facilities for multi-tasking software designs, whilst avoiding complex features the increase code size and reduce performance.



META MeOS Real Time Operating System

MeOS is the ideal solution for consumer electronics products and has been successfully deployed in hundreds of products and millions of shipped systems. It has unique features to support the META processor's multi-threading and DSP capability but also includes traditional RTOS features such as a flexible pre-emptive scheduler, message mailboxes, driver model, resource locking, and memory management.

MeOS is free of both up-front licensing costs and per unit royalties, is provided as a standard component within the META processor toolkits, and is used by many of Imagination's IP platforms.

A wide range of support modules are available, including device drivers, filing systems, a TCP/IP stack and support for disk and memory cards.

Features

- Pre-emptive scheduler
- META Hardware thread support
- META DSP support
- Efficient memory management

Benefits

- Proven RTOS for META provides low-risk solution
- Small memory requirements by design to ensure low system cost
- OS-ware debug support within CODESCAPE debugger streamlines development

Linux 2.6

META Linux is a port of the Linux OS for MMU equipped META processors.

META Linux enables developers of META processor based SoCs to access the wealth of application and device support available for Linux-based systems, whilst simultaneously able to use real-time DSP functionality on other hardware threads of that same META processor.

Support for SMP Linux across multiple META hardware threads together with hotplugging of threads enables access to all the advantages META's multi-threaded architecture brings over conventional processor cores.

Imagination provides the GPL licensed software of the Linux kernel, the GCC toolchain, and also proprietary components such as Inter-Thread Communications (ITC) drivers and a bootloader. The bootloader independently loads proprietary real-time applications prior to loading META Linux.

The META Linux kernel and Linux applications can interact with code running in any of the META hardware theads via Imagination's proprietary TBI (Thread Binary Interface) and ITC technologies. This enables real-time applications to run independently of Linux but with efficient communications between the systems.

Features

- Compatible with existing Linux device drivers and applications
- Compiler and development tools included
- Flexible Bootloader
- Integration with CODESCAPE debugger

Benefits

- Standard Linux 2.6 OS provides access to a wealth of drivers, open source software and powerful middleware
- Enables true single-core real-time systems via META's multiple hardware threads and efficient inter-thread comms
- Clean separation between GPL and proprietary components

Audio Codecs

The META Advanced Audio Framework (AAF) is a collection of popular audio codecs and post-processing effects, highly tuned to run efficiently on META DSP threads and presented in an easy-to-use framework using component-based stream construction.

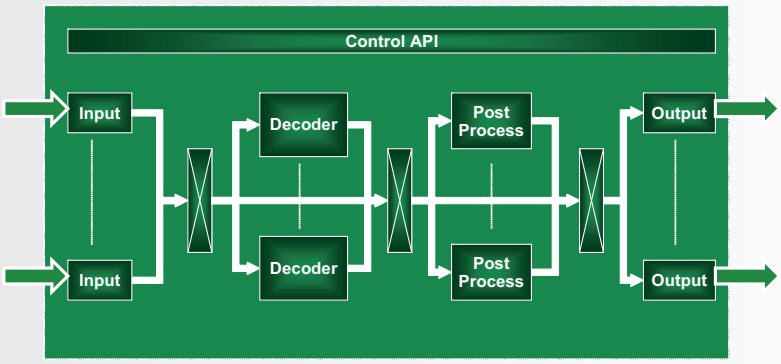
The META AAF can run on a single META thread to provide a self-contained subsystem or be partitioned across multiple threads to optimize loading for complex multiple-input multiple-output systems.

Codec packs – containing appropriate codecs and post-processing effects – are available for many different application areas including Digital Radio, Connected Audio, Mobile TV, Standard Definition and High Definition Television.

An audio stream consists of a processing chain of individual audio components that can be dynamically configured and reconfigured via the API. A minimum set of components consists of one source, any number of processes, and at least on sink. Source and Sink may be data streams directly from/to audio peripherals such as I2S or SPDIF interfaces, or may be buffers of data passed to/from an application via API calls.

Imagination can offer the AAF integrated with the GStreamer multimedia framework, as adapted by Imagination, running on the Linux Operating System. This provides the flexibility to enable a wide variety of different products to be produced from a common software and hardware architecture.

A single META processor is able to meet all of the audio processing requirements of a bluray player when synthesized in 65LP



META Advanced Audio Framework

Features

- Comprehensive collection of audio codecs and post-processing effects for META DSP
- Abstract API for audio-stream management
- Component based stream construction
- Extensive streaming protocol support in conjunction with gStreamer

Benefits

- Fast time-to-market for applications requiring digital audio support
- Optimised META DSP implementation of popular codecs
- Easy-to-use framework
- All functionality from a single META processor core, including Linux & gStreamer

Imagination

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