Open Virtual Platforms™
Fast Processor Models

Electronics systems are becoming more complex, and the driver of this complexity is software. Software embodies the key features of the products, enabling the differentiation required for new products to succeed. Software development is also on the critical path to the on-time, high quality, successful delivery of a new product.

New products, whether full systems or systems on chips (SoCs), integrate multiple processors and other components. These complex designs make it essential that the software development starts as early as possible in the product design cycle.

Virtual platforms, or virtual prototyping, or software simulation is one technique that is being rapidly adopted by teams developing these leading edge products. Whether for mobile devices, home entertainment products, automotive / medical / military electronics, or other systems, virtual platforms provide the best solution to early development of software.

Open Virtual Platforms (OVP) modeling and simulation technology enable the simulation of embedded systems running at 100s of million instructions per second. These simulations are instruction accurate, and can be used to model individual processors, chips, boards, subsystems and complete systems.

Open Virtual Platforms

Visit www.OVPworld.org to download models and simulator

OVP™ Components

OVP has three main components:

- the OVP APIs that enable a C model to be written
- a library of open source processor / peripheral models
- OVPsim™: a simulator that executes these models

Use OVP to create a simulation model of a platform including all components and connect it to your debugger to provide a very efficient fast embedded software development environment.

	Altera Nios II			ARM32			Imagination MIPS32		
Benchmark	Simulated Instructions	Run time	Simulated MIPS	Simulated Instructions	Run time	Simulated MIPS	Simulated Instructions	Run time	Simulated MIPS
linpack	3,075,857,171	1.8s	1718	6,105,766,856	4.32s	1413	9,814,621,392	4.83s	2032
Dhrystone	1,810,082,387	1.08s	1676	2,250,079,359	2.08s	1083	1,795,088,667	1.05s	1710
Whetstone	5,850,887,389	2.67s	2200	1,185,959,501	0.96s	1238	1,890,420,892	0.8s	2368
peakSpeed2	22,000,013,458	3s	7335	22,400,008,766	4.6s	4872	22,800,009,853	3.07s	7427
	Xilinx MicroBlaze			ARM AARCH64			Imagination MIPS64		
Benchmark	Simulated Instructions	Run time	Simulated MIPS	Simulated Instructions	Run time	Simulated MIPS	Simulated Instructions	Run time	Simulated MIPS
linpack	6,386,275,159	3.2s	2002	2,403,904,724	3.7s	650 *	1,558,856,686	0.75s	2079
Dhrystone	3,770,115,740	2.42s	1564	11,510,061,362	11.36s	1013	1,590,094,345	1.05s	1516
Whetstone	27,108,532,655	11.49s	2359	2,623,931,374	3.01s	872 *	2,133,926,552	0.88s	2453
peakSpeed2	22,000,023,433	4.38s	5034	44,800,003,885	6.7s	6687	17,100,018,075	3.26s	5249
	PowerPC			Renesas v850			Synopsys ARC		
Benchmark	Simulated Instructions	Run time	Simulated MIPS	Simulated Instructions	Run time	Simulated MIPS	Simulated Instructions	Run time	Simulated MIPS
linpack	3,163,966,113	2.24s	1419	4,991,344,159	3.66s	1368	4,184,162,664	3.15s	1328
Dhrystone	2,205,068,239	1.53s	1441	6,410,133,101	3.63s	1766	3,155,082,476	2.23s	1412
Whetstone	6,424,865,755	3.34s	1929	10,296,940,591	6.16s	1674	7,883,567,047	3.77s	2091
peakSpeed2	22,400,002,937	4.37s	5126	22,400,007,569	3.29s	6809	22,000,002,100	3.83s	5744

All measurements on 3.50GHz Intel i7-4770K, Linux FC20, OVPsim 20140731.0

* Hardware Floating Point Instructions

As seen in the table above, OVP Fast Processor Models run fast, very fast. 100s and 1,000s of millions of instructions per second. OVPsim, the execution engine for these models, uses state of the art code morphing simulation technology to get this performance. This applies not only to single core processors, but also to the leading edge multicore processors from ARM and MIPS. This industry leading performance is not just available in simple benchmarks. For example, an OVP virtual platform will boot Linux in less than 10 seconds.

Many development teams have adopted SystemC for virtual platform behavioral and peripheral components, utilizing IEEE 1666 compliant simulators. All OVP processor core models include a native SystemC TLM-2.0 interface, enabling easy use in SystemC simulation environments. In fact, OVP models have been used with the OSCI simulator, as well as with the SystemC simulators from all the major vendors.

OVP™ Fast Processor Models

The OVP Fast Processor Model library includes the following cores:

ARM
- ARM7
- ARM7TDMI
- ARM920T
- ARM922T
- ARM940T
- ARM926EJS
- ARM946ES
- ARM966ES
- ARM968ES
- ARM1020E
- ARM1026EJS
- ARM1136J-S
- ARM1156T2-S
- ARM1176JZ-S
- ARM Cortex-A5
- ARM Cortex-A7
- ARM Cortex-A8
- ARM Cortex-A9
- ARM Cortex-A15
- ARM Cortex-A53
- ARM Cortex-A57
- ARM Cortex-A72
- ARM Cortex-M3
- ARM Cortex-M4
- ARM Cortex-M4F
- ARM Cortex-R4
- ARM Cortex-R4F
- ARM Cortex-M0, M1

Contact Imperas
- ARM Cortex-R5, R7, A35

MIPS
- MIPS M4K
- MIPS 4KEc
- MIPS 4KEm
- MIPS 4KEp
- MIPS 24Kc
- MIPS 24Kf
- MIPS 24KEc
- MIPS 24KEf
- MIPS 34Kc
- MIPS 34Kf
- MIPS 74Kc
- MIPS 74Kf
- MIPS 1004Kc
- MIPS 1004Kf
- MIPS M14Kc
- MIPS M14Kf
- MIPS 1074Kc
- MIPS 1074Kf
- MIPS microAptiv
- MIPS interAptiv
- MIPS proAptiv
- MIPS64 architecture
- MIPS 5KEc
- MIPS 5KEf
- MIPS 5Kc
- MIPS 5Kf
- MIPS M5100
- MIPS M5150
- MIPS P5600

Renesas
- V850 ES
- V850 E1
- V850 E1F
- M16C

Contact Imperas
- RL78
- V850 E2
- V850 E2M
- V850 E2R
- V850 G3

ARC (Synopsys)
- ARC 605
- ARC 6xx
- ARC 7xx
- ARC EM

OpenCores
- OR1K

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PowerPC
- E200 core (MPC55xx)
- PowerPC 440
- PowerPC 460
- PowerPC 470
- PowerPC 476

Altera
- Nios II

Xilinx
- MicroBlaze

Available from other developers
- **MS 1750a**
- **SPARC** v8
- **Vinchip** VinRZ5110

OVP™ Fast Processor Models

To get the high speed required for real applications, processor hardware is modeled only to the minimum necessary level for *correct or plausible instruction behavior* so that software cannot tell it is not running on real hardware. Processor core models are instruction accurate. There is no timing information, no cycle approximation. These models are developed to simulate as fast as possible, enabling software engineers to use OVP for software development and test.

Wherever possible, processor core model functionality is verified either by the processor vendor themselves, or using technology and test suites provided by the processor vendor. This is the case for the vast majority of processor core models available from OVP.

Debugging and 3rd Party Tool Interfaces

OVPsim has interfaces to GDB for debugging, and can also be used in an Eclipse environment. In general, any debugger that utilizes the RSP socket for connecting to the processor can be used with an OVP simulation.

OVP virtual platforms can also be used with other tools for tasks such as hardware-software co-verification and system analysis. In addition to the native SystemC/TLM2.0 interfaces, OVP simulations have been integrated with various hardware design language (HDL) simulators, hardware emulators and FPGA prototype tools. Also, two different integrations with Simulink/Matlab have also been achieved.

Benefits of Virtual Platforms for Embedded Software Development

Virtual platforms lower software development costs, increase quality and reduce the risks involved with the software development side of delivering advanced electronic systems. This is accomplished by enabling:

- ✓ Ability to run the real hardware executables on the virtual platform
- ✓ Early start of software development and hardware-software integration
- ✓ Accessibility of the virtual platform for the entire development team, no matter the location
- ✓ Full visibility and controllability of the simulation environment for improved software testing
- ✓ Repeatable, deterministic simulation makes debugging easier