

Laboratorio di Sistemi Operativi
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Software Development with uMPS

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uMPS simulator and user interface

“Nothing is real”:

What is uMPS?

it is a computer system

it is a simulator (that is, a set of programs)

How to get it?

download from <http://mps.sourceforge.net>

compile and install (see INSTALL and README)

Suggested configuration on your own PC:

recent Linux distribution on x86 (Debian, Ubuntu, Fedora...)

release 1.23-RC2 (RC1 is identical, but is better suited for non-root installations)

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uMPS simulator main commands:

`umps`: the simulator itself

`umps-elf2umps`: to convert the output of the compiler to files the simulator will understand

`umps-objdump`: to analyze these files

`umps-mkdev`: to build disks and tapes for the simulator

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uMPS simulator-related files:

In the `support/` and `example*/` directory:

`*.rom.umps`: the ROM files

`*.core.umps`: the kernel to be loaded

`*.stab.umps`: the kernel *symbol table*

`*.aout.umps`: for programs other than kernel

other `*.umps` files (`term0.umps`, `printer0.umps`...): files associated to devices

`/etc/umpsrc` and `.umpsrc` (`ls -a` to see it): the simulator configuration file

`elf32*.x` files: configuration files for the cross-compiler

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uMPS other essential components:

some libraries (XForms, libelf) for building the simulator

libumps.e (and libumps.o) under support/: uMPS library for interfacing with ROM services, **CP0** registers and issue TLB-related and SYSCALL instructions

crtso.o and crti.o: kernel and program startup functions

const.h and types.h under support/h: some useful types and constants (eg. processor state definition)

a *cross-compiler* based on GNU gcc:

mipsel-linux-gcc for little-endian uMPS (on x86)

mips-linux-gcc for big-endian uMPS (on PPC)

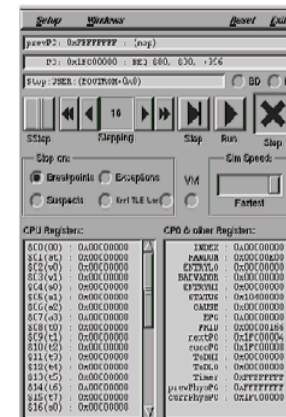
the make utility

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"Out of the Matrix": uMPS main window



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uMPS simulator and user interface

uMPS main window features:

a *menu bar* with *Setup*, *Windows*, *Reset*, and *Exit*

three *status lines* showing:

the last instruction executed

the instruction about to be executed

a *status line* with:

the current status of the simulator (running or stopped)

the reason the simulator stopped, if any (by user request or because some debugging event has happened)

the location of the instruction in a readable form

Load and Branch Delay status flags

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uMPS main window features (cont'd):

a series of buttons for controlling the simulation progression (*SingleStep*, *Stepping*, *Step*, *Run*, *Stop*)

a simulation speed slider (from *Slowest* to *Fastest*)

a *Virtual Memory* indicator

some *Stop on* buttons, to stop simulation on:

Exceptions

Breakpoints

Suspects

TLB-refill events in Kernel or User mode (requires also Exception to be selected)

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uMPS main window features (cont'd):

main CPU registers

CP0 registers

some useful “meta-registers”:

nextPC, succPC: next PC locations computed from the pipeline

prevPhysPC and currPhysPC: previous and current PC locations in physical memory (useful when VM is on)

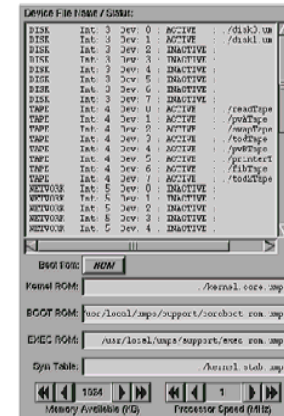
register values may be changed just by double-clicking on them

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uMPS Setup Window



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uMPS setup window features:

the file list of .umps files associated to various devices

the “Load core?” flag: to decide if the kernel file is loaded in RAM before the start of the simulation or not

the file list of .umps files used for:

ROMs (.rom.umps)

kernel (.core.umps and .stab.umps)

the RAM size selector (64KB – 2 MB)

the processor speed selector (1-99 MHz)

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uMPS setup menu contains:

the *Setup Window* option

the *Reset to Setup* option: to reset the simulator to the state described in the *Setup Window*, reloading all the files

the *Reset to Defaults* option: to reset the simulator to the state described in the .umpsrc file, reloading all the files

Some options may be configured only in the .umpsrc file:

TLB size

Expert Mode: no confirmation required for most operations

initial GUI setup (which buttons are on or off, etc.)

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uMPS Windows menu contains:

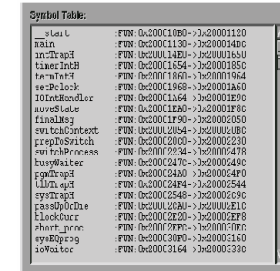
- the *Symbol Table* option: to show the kernel Symbol Table
- the *Memory Browser* option: to show memory contents, and to set Breakpoints and Suspects
- the *TLB Display* option: to show the TLB contents
- Int x Device Status* options: to show the devices' status
- the *Terminal x* options: to show the terminals

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uMPS Symbol Table Window



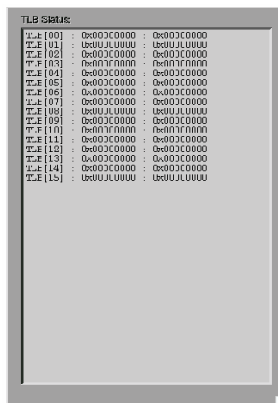
Symbol	Address
_start	0x20001000 -> 0x20001100
main	0x20001100 -> 0x20001400
initTraps	0x20001400 -> 0x20001800
timerIntH	0x20001854 -> 0x2000185C
hwTimeH	0x20001860 -> 0x20001964
secClock	0x20001968 -> 0x20001A60
IOirqHandler	0x20001A64 -> 0x20001E90
auv8Label	0x20001E90 -> 0x20001F80
findObj	0x20001F80 -> 0x20002050
switchContext	0x20002054 -> 0x20002080
pspInSwitch	0x20002080 -> 0x20002230
waitInProcess	0x20002234 -> 0x20002478
busyWaiter	0x2000247C -> 0x2000249C
ppmTraps	0x200024A0 -> 0x200024F0
LDLExp	0x200024F4 -> 0x20002544
sysTraps	0x20002548 -> 0x20002598
passUpOnDie	0x200025A0 -> 0x2000251C
lockUser	0x20002520 -> 0x200025F8
share_proc	0x200025FC -> 0x20002700
sysOpen	0x200026F0 -> 0x20002160
ioWaiter	0x20002164 -> 0x20002390

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uMPS TLB Display Window



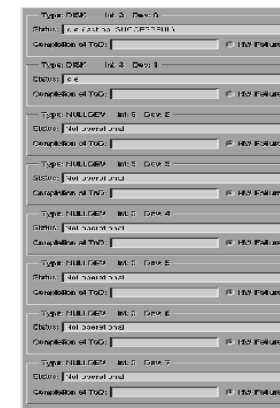
TLB Entry	Address	Value
TLB [00]	0x000C0000	0x000C0000
TLB [01]	0x000C0000	0x000C0000
TLB [02]	0x000C0000	0x000C0000
TLB [03]	0x000C0000	0x000C0000
TLB [04]	0x000C0000	0x000C0000
TLB [05]	0x000C0000	0x000C0000
TLB [06]	0x000C0000	0x000C0000
TLB [07]	0x000C0000	0x000C0000
TLB [08]	0x000C0000	0x000C0000
TLB [09]	0x000C0000	0x000C0000
TLB [10]	0x000C0000	0x000C0000
TLB [11]	0x000C0000	0x000C0000
TLB [12]	0x000C0000	0x000C0000
TLB [13]	0x000C0000	0x000C0000
TLB [14]	0x000C0000	0x000C0000
TLB [15]	0x000C0000	0x000C0000

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uMPS Device Status Window



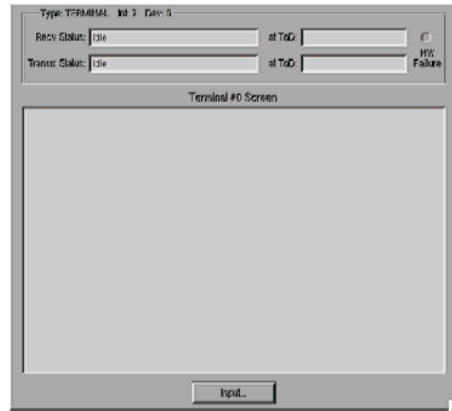
Type	Device	Value
TYPE: DEVICE	hd 0	Dev 0
Generation of TIO:		P 192 F VALUE
TYPE: DEVICE	hd 3	Dev 3
Generation of TIO:		P 192 F VALUE
TYPE: NULL DEV	hd 6	Dev 6
Generation of TIO:		P 192 F VALUE
TYPE: NULL DEV	hd 9	Dev 9
Generation of TIO:		P 192 F VALUE
TYPE: NULL DEV	hd 12	Dev 12
Generation of TIO:		P 192 F VALUE
TYPE: NULL DEV	hd 15	Dev 15
Generation of TIO:		P 192 F VALUE
TYPE: NULL DEV	hd 18	Dev 18
Generation of TIO:		P 192 F VALUE
TYPE: NULL DEV	hd 21	Dev 21
Generation of TIO:		P 192 F VALUE
TYPE: NULL DEV	hd 24	Dev 24
Generation of TIO:		P 192 F VALUE
TYPE: NULL DEV	hd 27	Dev 27
Generation of TIO:		P 192 F VALUE

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uMPS Terminal Status Window



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uMPS Device Status Window details:

for each device:

- a status line describes what the device is currently doing
- a TOD field tells when the current operation (if any) will end
- a *HW Failure* button allows to set the device as “faulty” (all operations will not be performed and will return an error status)

Terminal devices have also:

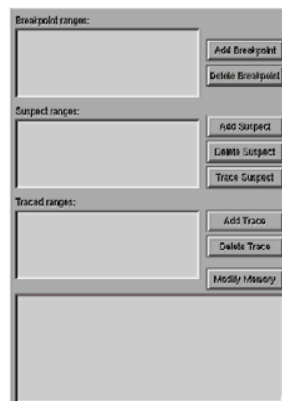
- two device status lines (one for receiver, one for transmitter)
- a screen to show the output
- an *Input* button to allow line input

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uMPS Memory Browser Window



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uMPS Memory Browser Window details:

Breakpoint list and *Add / Delete* buttons: to show, set and remove Breakpoints

Suspect list, and *Add / Delete / Trace* buttons: to show, set and remove *Suspect areas*

Trace list and *Add / Delete / Modify* buttons: to show, set and remove memory traced ranges and to modify RAM contents

memory content window: to show memory contents

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Breakpoint, Suspect and Trace: the debugger's tools of trade

Breakpoint: a position (an address) in the code; simulation stops when reaches it (may be referred to with a *symbol* + offset)

Suspect area: a memory range (a set of addresses) containing data (array, variables...) under exam; may be a *Read* suspect and/or a *Write* suspect (may be referred with a *symbol*)

Suspect: simulation stops when an access of the appropriate type (R, W) is made to the suspect area

Traced range: a range of memory addresses selected for showing

Addresses may be physical or virtual ones

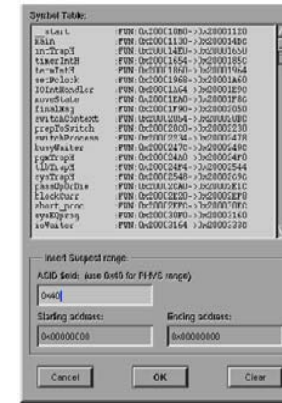
Only physical addresses may be traced

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uMPS: how to insert a Suspect range



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