Prise en main du système
Hello World

MI074 - 2

Objectif 1/2

L'objectif de cette séance est de présenter en détails la programmation de la première application sur la plateforme. Nous allons voir ainsi (pas forcément dans cet ordre) :

- le mapping mémoire
- le code de boot
- le makefile
- la synchronisation entre les processeurs
- la commande de périphérique
- les directives au compilateur en C
- l'allocation des piles de démarrage

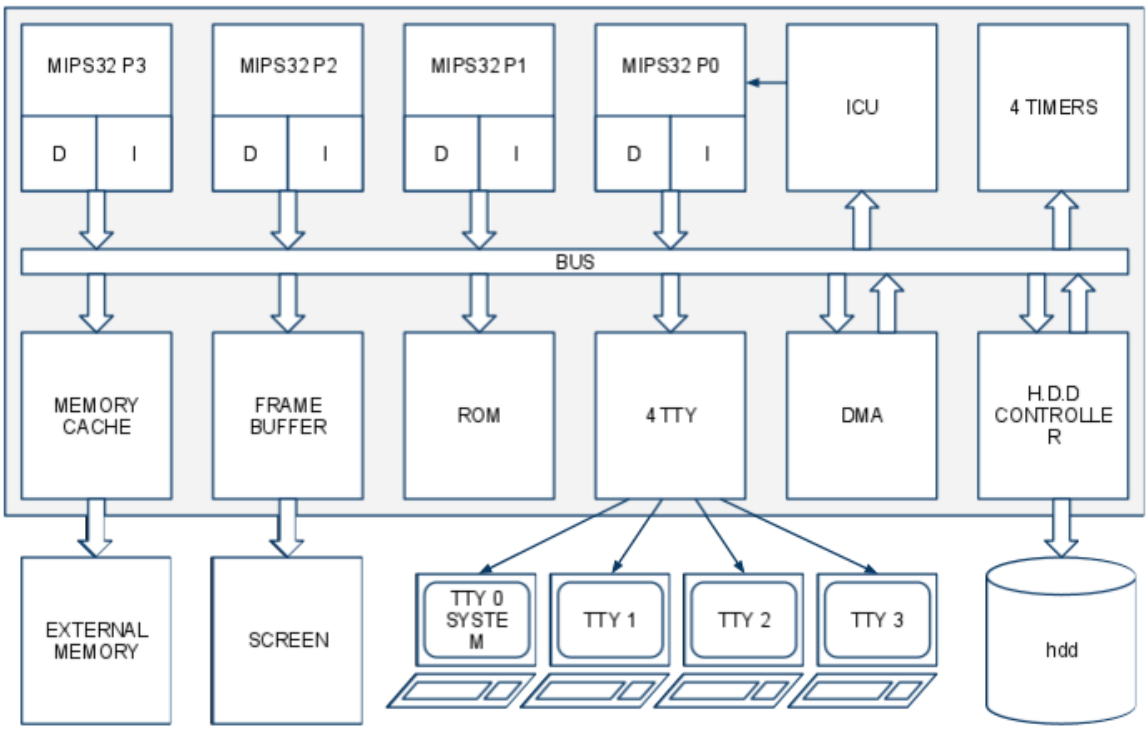
Ce séance est une préparation directe de la séance de TME

Objectif

Les programmes supports ne seront pas dans l'OS.
C'est seulement préparatoire.

Chaque processeur affiche "Hello World" sur "son" TTY
- entièrement en assembleur
- en assembleur et en C

La plateforme matérielle



description de la mémoire

fichier : segmentation.h

```
// ------- Devce  mapped segments

#define   TIMER_BASE  0xd3200000
#define   TIMER_SIZE   0x00000080

#define   ICU_BASE     0xd2200000
#define   ICU_SIZE     0x00000020

#define   DMA_BASE     0xd1200000
#define   DMA_SIZE     0x00000014

#define   TTY_BASE     0xd0200000
#define   TTY_SIZE     0x00000040

#define   BD_BASE      0xd5200000
#define   BD_SIZE      0x20

#define   FB_XSIZE     512
#define   FB_YSIZE     512
#define   FB_BASE      0x52200000
#define   FB_SIZE      FB_XSIZE*FB_YSIZE*2
```

```
// ------- ROM mapped segments

#define   KTEXT_LMA_BASE 0xbf800000
#define   KTEXT_LMA_SIZE  0x00020000

#define   KDATA_LMA_BASE  0xbf820000
#define   KDATA_LMA_SIZE   0x00020000

#define   BOOT_BASE        0xbfc00000
#define   BOOT_SIZE        0x00001000

// ------- RAM

#define   RAM_BASE         0x7F400000
#define   RAM_SIZE         0x01000000

// ------- Application mapped segments

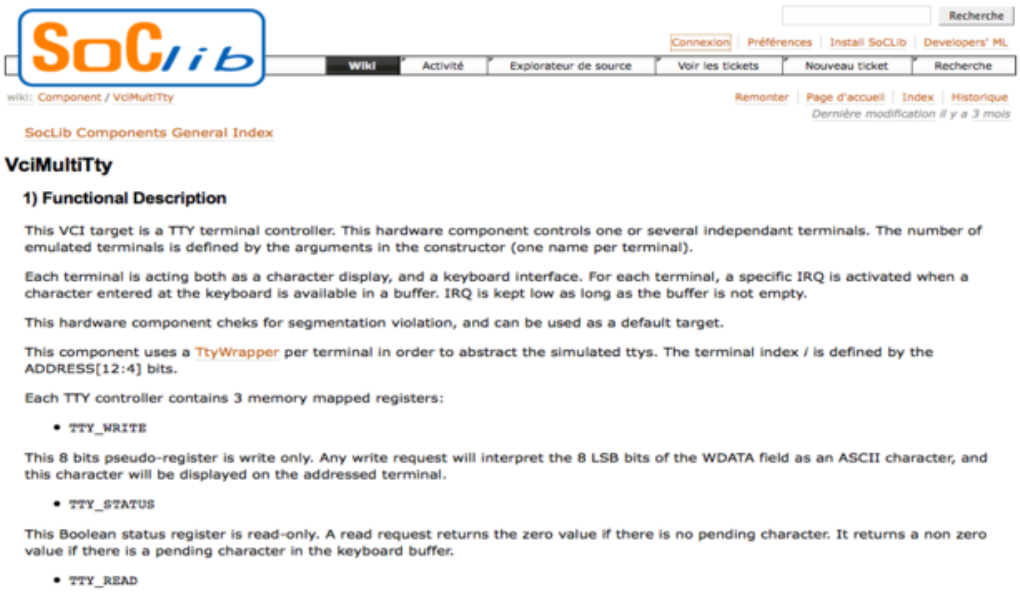
#define   KTEXT_BASE       0x80000000
#define   KDATA_BASE       0x80020000
#define   KDATA_SIZE       0x003E0000

#define   USR_TEXT_BASE   RAM_BASE
#define   USR_TEXT_SIZE    0x00060000
#define   USR_DATA_BASE   \
          USR_TEXT_BASE + USR_TEXT_SIZE
#define   USR_DATA_SIZE    0x00B9F000
```

Description des périphériques

https://www.soclib.fr/trac/dev/wiki/Component

pour le TTY :
https://www.soclib.fr/trac/dev/wiki/Component/VciMultiTty



SoCLib

Recherche

Connexion | Préférences | Install SoCLib | Developers' ML

wiki | Activité | Explorateur de source | Voir les tickets | Nouveau ticket | Recherche

wiki: Component / VciMultiTty

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Dernière modification il y a 3 mois

SocLib Components General Index

VciMultiTty

1) Functional Description

This VCI target is a TTY terminal controller. This hardware component controls one or several independant terminals. The number of emulated terminals is defined by the arguments in the constructor (one name per terminal).

Each terminal is acting both as a character display, and a keyboard interface. For each terminal, a specific IRQ is activated when a character entered at the keyboard is available in a buffer. IRQ is kept low as long as the buffer is not empty.

This hardware component cheks for segmentation violation, and can be used as a default target.

This component uses a TtyWrapper per terminal in order to abstract the simulated ttys. The terminal index / is defined by the ADDRESS[12:4] bits.

Each TTY controller contains 3 memory mapped registers:

- `TTY_WRITE`

This 8 bits pseudo-register is write only. Any write request will interpret the 8 LSB bits of the WDATA field as an ASCII character, and this character will be displayed on the addressed terminal.

- `TTY_STATUS`

This Boolean status register is read-only. A read request returns the zero value if there is no pending character. It returns a non zero value if there is a pending character in the keyboard buffer.

- `TTY_READ`

Description des périphériques

Sur la page de description du périphérique on trouve :

The file source:trunk/soclib/soclib/module/connectivity_component/vci_multi_tty/include/soclib/tty.h defines `TTY_WRITE`, `TTY_STATUS`, `TTY_READ` and `TTY_SPAN`.

fichier : devices.h

```
#ifndef _DEVICES_H_
#define _DEVICES_H_

/* TTY mapped registers offset */
#define TTY_SPAN        4
#define TTY_WRITE_REG   0
#define TTY_STATUS_REG  1
#define TTY_READ_REG    2

#endif
```

Description de la mémoire pour le linker

fichier kldscript.h

```
#include "segmentation.h"

MEMORY
{
  boot : ORIGIN = BOOT_BASE, LENGTH = BOOT_SIZE
}

SECTIONS
{
 .boot : { *(.boot) } > boot
}
```

Description de la mémoire pour le linker

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MEMORY
{
  boot : ORIGIN = BOOT_BASE, LENGTH = BOOT_SIZE
}
SECTIONS
{
 .boot : { *(.boot) } > boot
}
```

```
#include "segmentation.h"
MEMORY
{
  boot   : ORIGIN = BOOT_BASE, LENGTH = BOOT_SIZE
}
SECTIONS
{
 .boot : { *(.boot) *(.text) *(.boot.*) *(.data) *(.rodata*)  } > boot
}
```

le code de boot

fichier : boot.S

```
#include <devices.h>
#include <segmentation.h>

.section .boot ,"ax",@progbits
.ent    boot
.align  2

boot:
    li      $26,    0
    mtc0    $26,    $12     # Status Register
    mfc0    $4,     $0
    la      $5,     str
    j       tty_puts
```

```
//  Function name : fputs
//  Arguments     : $4 <-> processor id, $5 <-> @str
//  Description   : print charecters of string str
//  ------------------------------------------------------------------
tty_puts:
    la      $26,    TTY_BASE
    li      $27,    TTY_SPAN * 4
    multu   $4,     $27
    mflo    $27
    addu    $26,    $26,    $27
loop:
    lbu     $27,    0($5)
    beqz    $27,    deadLoop
    sw      $27,    (TTY_WRITE_REG)($26)
    addiu   $5,     $5,     1
    j       loop
deadLoop:
    j       deadLoop

str:    .asciiz "hello world"

.end boot
```

Signification des drapeaux

Section Flag Characters	
Flag Characters	**Description**
`w`	Write access allowed.
`a`	Section is allocated in memory.
`x`	Section contains executable instructions.
`s`	Section contains "short" data.
`o`	Section adds ordering requirement. The 'o' flag is only for `ELF` (Unix*) files.

Section Types	
Section Type	**Description**
`"progbits"`	Sections with initialized data or code.
`"nobits"`	Sections with uninitialized data (`bss`).
`"comdat"`	`COMDAT` sections, Windows NT specific. See Windows NT (COFF32) Specific Section Flag Operands.
`"note"`	Note sections.

registre status

dans MIPS_vol3 p. 53

contenu des 16 bits de poids faible du registre **SR**:

IM[7:0]	0	0	0	UM	0	ERL	EXL	IE

Cette version du processeur MIP32 n'utilise que 12 bits du registre SR :

IE : Interrupt Enable
EXL : Exception Level
ERL : Reset Level
UM : User Mode
IM[7:0] : Masques individuels pour les six ligne d'nterruption matérielles
(bits IM[7:2]) et pour les 2 interruptions logicielles (bits IM[1:0])

registre status

IM[7:0]	0	0	0	UM	0	ERL	EXL	IE

- Le processeur a le droit d'accéder aux ressources protégées (registres du CP0, et adresses mémoires > 0x7FFFFFFF) si et seulement si le bit UM vaut 0, ou si l'un des deux bits ERL et EXL vaut 1.

- Les interruptions sont autorisées si et seulement si le bit IE vaut 1, et si les deux bits ERL et EXL valent 00, et si le bit correspondant de IM vaut 1.

- Les trois types d'événements qui déclenchent le branchement au GIET (interruptions, exceptions et appels système) forcent le bit EXL à 1, ce qui masque les interruptions et autorise l'accès aux ressources protégées.

- L'activation du signal RESET qui force le branchement au Boot-Loader force le bit ERL à 1, ce qui masque les interruptions et autorise l'accès aux ressources protégées.

- L'instruction ERET force le bit EXL à 0.

Makefile

```
INCLUDES    = segmentation.h
KERNEL      = kernel-soclib.bin
CSRC        =
SSRC        = boot.S
KOBJS       = $(SSRC:%.S=%.o) $(CSRC:%.c=%.o)

.PHONY: clean realclean

# CC tools and parameters
#-------------------------------------------------------------------------------
BUILD_DIR   :=$(shell pwd)
CCTOOLS     ?=
CPU         = mipsel
CC          = $(CCTOOLS)/bin/$(CPU)-unknown-elf-gcc
LD          = $(CCTOOLS)/bin/$(CPU)-unknown-elf-ld
OD          = $(CCTOOLS)/bin/$(CPU)-unknown-elf-objdump
SIMUL       = ../../bin/simulation.x

CFLAGS      = -fno-builtin -I. -fomit-frame-pointer -O3 -G0 -Wall -Werror -mips32r2
LDFLAGS     =
TRASH       = /dev/null||true

# Kernel building rules
#-------------------------------------------------------------------------------
all: depend $(KERNEL)
```

Makefile

```
$(KERNEL): $(KOBJS) kldscript
	$(LD) -o $@ $(KOBJS) $(LDFLAGS) -T$(BUILD_DIR)/kldscript
	$(OD) $@ -D > $@.dump

kldscript : kldscript.h segmentation.h
	cpp $< | egrep -v "#|//" | grep . > $@

clean:
	$(RM) vcitty* *.bak *.o *.pdf *~ kldscript *.dump $(KERNEL) 2> $(TRASH)

simul: $(KERNEL)
	$(SIMUL)

pdf:
	a2ps -1 --medium=A4 --file-align=fill -o - -l100 \
		Readme.txt Makefile *.h $(SSRC) $(CSRC) |\
	ps2pdf -sPAPERSIZE=a4 - `basename $$PWD`.pdf

#- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
%.o: %.c
	$(CC) $(CFLAGS) -c $< -o $@
%.o: %.S
	$(CC) $(CFLAGS) -c $< -o $@

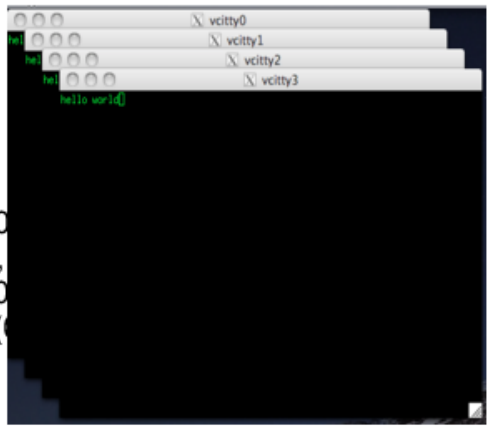
depend: ; makedepend -I. $(CSRC)
```

Compilation & Exécution

```
> make
makedepend -I.
/usr/local/cctools/bin/mipsel-unknown-elf-gcc -fno-builtin -I. -fomit-frame-pointer -O3 -G0 -
Wall -Werror -mips32r2 -c boot.S -o boot.o
cpp kldscript.h | egrep -v "#|//" | grep . > kldscript
/usr/local/cctools/bin/mipsel-unknown-elf-ld -o kernel-soclib.bin boot.o   -
T/Users/franck/Enseig/uem1_os/ose/tp1/e0/kldscript
/usr/local/cctools/bin/mipsel-unknown-elf-objdump kernel-soclib.bin -D > kernel-soclib.bin.
dump

> make simul
../../bin/simulation.x

            SystemC 2.2.0 --- Nov  9 2009 17:32:16
        Copyright (c) 1996-2006 by all Contributors
                    ALL RIGHTS RESERVED
Mapping table: ad:(8) id:(8) cacheability mask: 0xf000000
 <Segment "boot": @0x0xbfc00000, 0x0x1000 bytes, (0),
 <Segment "ktext": @0x0xbf800000, 0x0x20000 bytes, (0
 <Segment "kdata": @0x0xbf820000, 0x0x20000 bytes, (
 ....
```



Ajout de code C / boot

La différence est qu'il va falloir réserver une pile pour chaque processeur

```
#include <segmentation.h>
#include <config.h>

#define STACK_SIZE  CONFIG_BOOT_STACK_SIZE

.section  .boot ,"ax",@progbits
.extern   __do_init
.ent      boot
.align    2

boot:
   li       $26,   0
   mtc0     $26,   $12                      # Status Register
   mfc0     $4,    $0                       # CPU_ID
   la       $27,   RAM_BASE+RAM_SIZE        # top memory
   li       $26,   (STACK_SIZE)
   mult     $4,    $26
   mflo     $29
   subu     $29,   $29,   $27               # $29 <= TOP - procid * STACK_SIZE
   addiu    $29,   $29,   -1*4              # for __do_init argument
   la       $26,   __do_init
   jr       $26

.end boot
```

Ajout de code C / __do_init

que se passerait-il si on n'utilisait pas de pile séparée ?

```
#include <segmentation.h>
#include <config.h>
#include <devices.h>

void tty_puts(unsigned tty_id, char *buffer)
{
   unsigned volatile *tty_base = (unsigned *) TTY_BASE + (tty_id * TTY_SPAN);
   while (*buffer)
      tty_base[TTY_WRITE_REG] = *buffer++;
}

void __do_init(unsigned cpu_id)
{
   tty_puts(cpu_id, "Hello World!\n");
   while (1);
}
```

Ajout de code C / kldscript

code objet issu du code C

```
Disassembly of section .text:

00000000 <tty_puts>:
  0:   80a20000    lb    v0,0(a1)
  4:   00042100    sll   a0,a0,0x4
  8:   3c03d020    lui   v1,0xd020
  c:   10400006    beqz  v0,28 <tty_puts+0x28>
...
 28:   03e00008    jr    ra
 2c:   00000000    nop

00000030 <__do_init>:
 30:   3c02d020    lui   v0,0xd020
 34:   00042100    sll   a0,a0,0x4
 38:   3c030000    lui   v1,0x0
...
 5c:   08000017    j     5c <__do_init+0x2c>
 60:   00000000    nop

Disassembly of section .reginfo:

00000000 <.reginfo>:
  0:   8000003c    lb    zero,60(zero)
   ...
```

```
Disassembly of section .pdr:

00000000 <.pdr>:
   ...
 18:   0000001d    0x1d
 1c:   0000001f    0x1f
   ...
 38:   0000001d    0x1d
 3c:   0000001f    0x1f

Disassembly of section .rodata.str1.4:

00000000 <$LC0>:
  0:   6c6c6548    0x6c6c6548
  4:   6f57206f    0x6f57206f
  8:   21646c72    addi  a0,t3,27762
  c:   0000000a    movz  zero,zero,zero
```

Ajout de code C / kldscript

que se passerait-il si on n'utilisait pas de pile séparée ?

```
#include "segmentation.h"

MEMORY
{
  boot   : ORIGIN = BOOT_BASE, LENGTH = BOOT_SIZE
}

SECTIONS
{
  .boot : { *(.boot) *(.text) *(.boot.*) *(.data) *(.rodata*)  } > boot
}
```