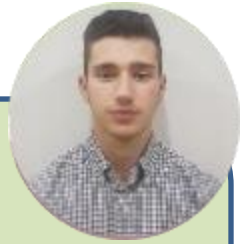
CENTRALE NANTES

MERE PROJECT : Implementation of ED-H on Xenomai

DEBUS ALEXY
RAYELLA NIRANJAN

12/11/2021

Our team



Debus Alexy

C dev.

Rayella Niranjan

C dev.

Table of contents

1. Context

Meeting with the professor (M.Queudet) on october the 15th :

The interest here is to put into applications a dynamic-priority energy aware scheduling strategie ED-H through the use of a Real-time kernel.

We will use Xenomai, I mean a dual kernel configurations : a Linux kernel (using Ubuntu distributions) supplementing by a RT co-kernel (Cobalt)

A Master student recently integrated EDF into Xenomai…

2. Key question

We need to have ED-H working without affecting integrity of other scheduling policies (fixed priority, EDF).

How could we manage to integrate/validate ED-H on Xenomai ?

3. Approach

1) Learn about Xenomai
2) Validate/Assert EDF implementation on Xenomai
3) Understand EDF implementation
4) Learn about ED-H
5) Implement ED-H In Xenomai
6) Validate/Assert ED-H implementation on Xenomai

The project will be split into sprints (1 sprint = 3-4 weeks)

4. Primary objectives

Primary objectives are established at the beginning of the project

1) Installation of modified Xenomai and validation for EDF integration
Metric : report for modifications added to have a functional installation + tests to validate xenomai-EDF (report + source code)
Estimated time : 10h

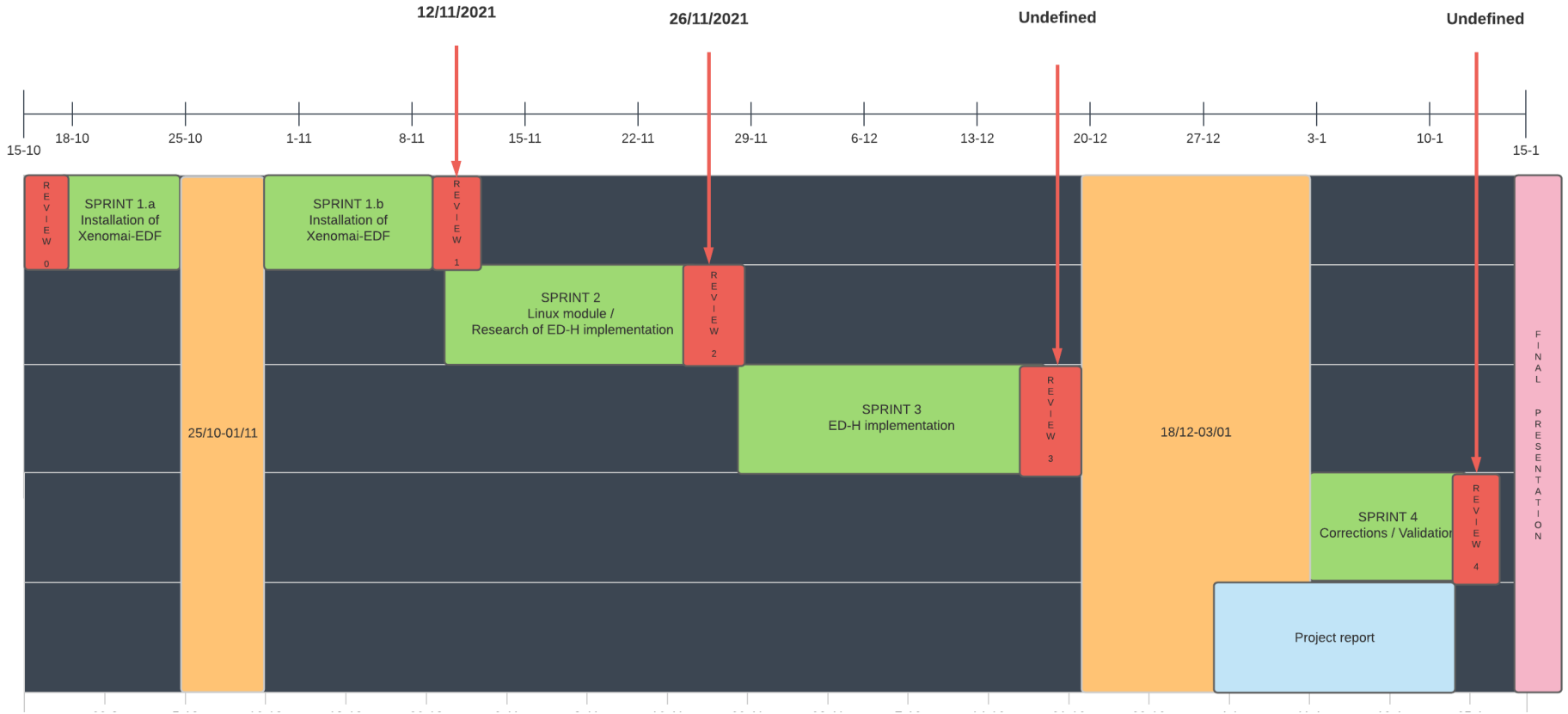
2) Development of a linux module to grab battery information and transfer to Cobalt
Metric : guideline for the creation/usee of the linux module + source code for the linux module
Estimated time : 25h

3) ED-H implementation and validation on Xenomai
Metric : guideline for the creation/usee of the linux module + source code for the linux module
Estimated time : 50h

Remaining time : 15h (Redaction of the final report, PWP presentation, handle git repo.)

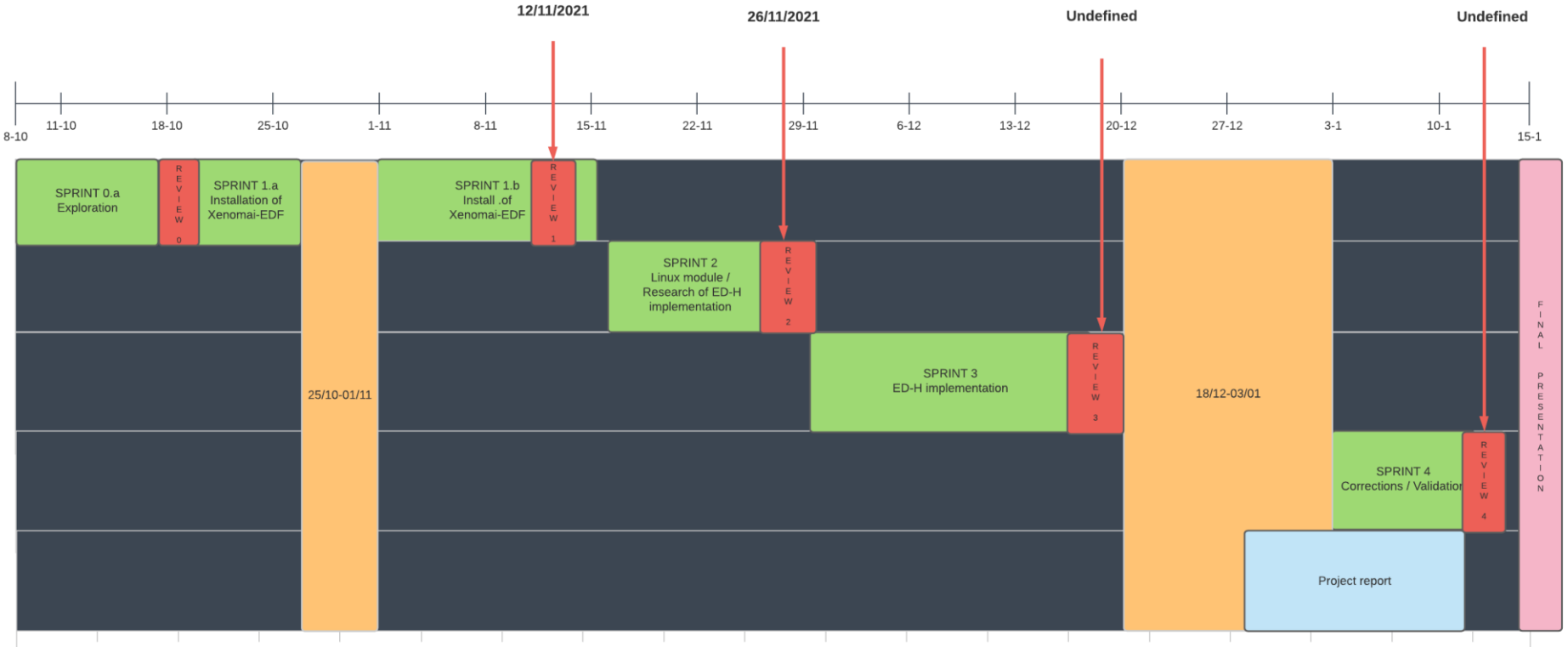
5. Planning

Provisional planning:



5. Planning

Effective planning :



6. Progress

0) Development of linux module to grab battery information

Results: Start implementation of a simple linux module (using kernel header file linux/power_supply)

2 weeks (08/10 - 17/10)

- In charge : Debus Alexy

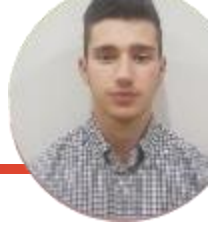
1) Installation of Xenomai EDF and validation of EDF alg.

Results: Successfully installed Xenomai and validate EDF for no-premption test cases

3 weeks (18/10 - 11/11

- In charge : Debus Alexy & Rayella Niranjan

7. Project evolution



Actual :

1. Working on linux module - 8h
2. Installation of Standard Xenomai - 2h
3. Resolved problems for install. of EDF-Xenomai -20h
4. Source code to validate EDF implementation -6h

Future (11/11 - 26/11) : Linux module + Read EDF source files

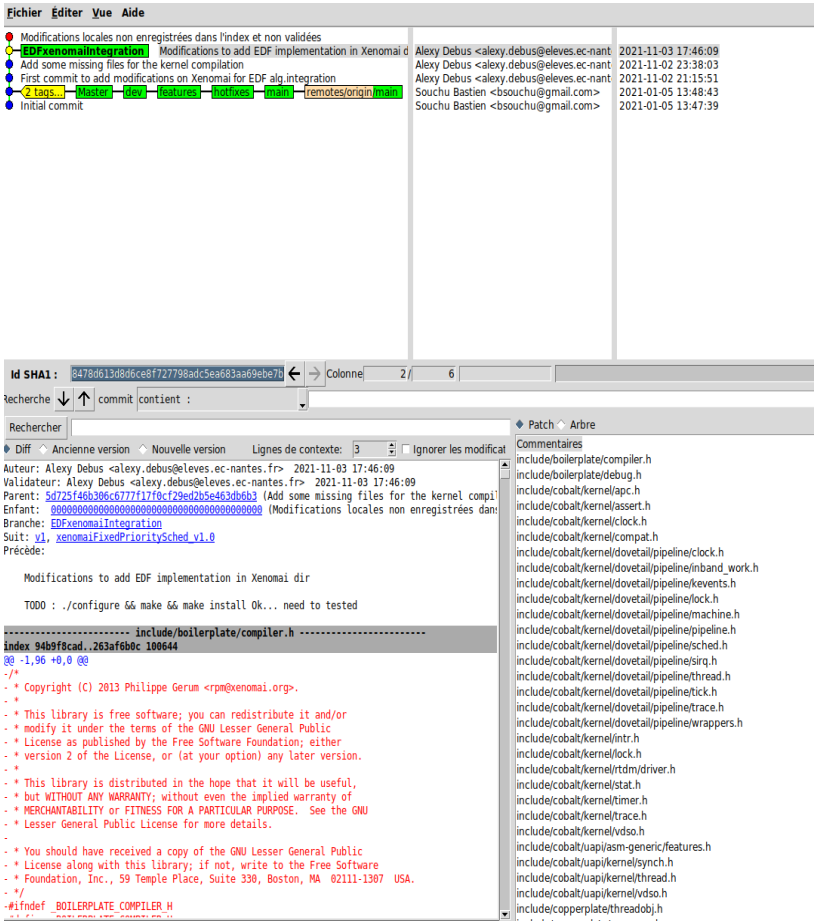
7. Project evolution

Actual : installation of xenomai and EDF-Xenomai.

1. Installation of Linux Kernel - 1h
2. Installation of Xenomai - 6h
3. Installation of Xenomai-EDF Installation, meeting with Alexy (compilation problems) - 10h

Future (11/11 - 26/11) : ED-H Implementation

8. Presentation of sprint 1




```
---------- include/copperplate/threadobj.h ----------
index c0e2b7d96..3a26598d0 100644
@@ -27,7 +27,7 @@
 #include <boilerplate/list.h>
 #include <boilerplate/lock.h>
 #include <boilerplate/sched.h>
-#include <cobalt/kernel/sched.h>
+
 #include <copperplate/clockobj.h>
 #include <copperplate/heapobj.h>
 #include <sched.h>
---------- lib/copperplate/internal.c ----------
index da6f387e8..9240246c8 100644
@@ -70,7 +70,7 @@ int copperplate_create_thread(struct corethread_attributes *cta,
         return __bt(thread_spawn_epilogue(cta));
 }

-int copperplate_roll_dynamic_priority(pthread_t ptid, xnticks_t deadline)
+//int copperplate_roll_dynamic_priority(pthread_t ptid, xnticks_t deadline)


 int copperplate_renice_local_thread(pthread_t ptid, int policy,
---------- lib/copperplate/threadobj.c ----------
index 858f8867f..1f35adfec 100644
@@ -29,6 +29,7 @@
 #include <fcntl.h>
 #include <assert.h>
 #include <limits.h>
+#include <sched.h>
 #include "boilerplate/signal.h"
 #include "boilerplate/atomic.h"
 #include "boilerplate/lock.h"
@@ -1664,16 +1665,21 @@ int threadobj_wait_period(unsigned long *overruns_r)
         struct threadobj *current = threadobj_current();
         siginfo_t si;
         int sig;
-        struct xnsched *sched;
-
+
+        #if 0
+          struct xnsched *sched;
+        #endif
+
         if (!(current->status & __THREAD_S_PERIODIC))
                 return -EWOULDBLOCK;

         for (;;) {
                 current->run_state = __THREAD_S_DELAYED;
                 sig = __RT(sigwaitinfo(&sigperiod_set, &si));
-                if(current->schedparam.sched_u.deadline.sched_relative_deadline != 0)//We have to requeue the xnthread
+
+                /*if(current->schedparam.sched_u.deadline.sched_relative_deadline != 0)//We have to requeue the xnthread
                         sched = xnsched_struct(cpumask_first(CPU_MASK_ALL));
+                */
                 current->run_state = __THREAD_S_RUNNING;
                 if (sig == SIGPERIOD)
                         break;
```

8. Presentation of sprint 1

Simple example without preemption

```
metadata::gedit-spell-language n'est pas prise en charge

** (gedit:7730): WARNING **: 21:28:40.860: Set document metadata failed: La définition de l'attribut
metadata::gedit-encoding n'est pas prise en charge
^C
root@xenomai-Predator-PH317-52:/home/xenomai/Documents/tests/loopTask# make
gcc -o loop_task loop_task.c -I/usr/xenomai/include/cobalt -I/usr/xenomai/include -D_GNU_SOURCE -D_RE
ENTRANT -fasynchronous-unwind-tables -D__COBALT__ -I/usr/xenomai/include/alchemy -lm -Wl,--no-as-need
ed -Wl,@/usr/xenomai/lib/modechk.wrappers -lalchemy -lcopperplate /usr/xenomai/lib/xenomai/bootstrap.
o -Wl,--wrap=main -Wl,--dynamic-list=/usr/xenomai/lib/dynlist.ld -L/usr/xenomai/lib -lcobalt -lmodech
k -lpthread -lrt
root@xenomai-Predator-PH317-52:/home/xenomai/Documents/tests/loopTask# ./loop_task
policy in attr.c : 0
policy in attr.c : 0
policy in attr.c : 0
policy in attr.c : 0
Creating prio and non-prio tasks (3 tasks)...
   0"002.814| WARNING: [loop_task_1] cannot renice core thread, EINVAL
   0"003.099| WARNING: [loop_task_2] cannot renice core thread, EINVAL
   0"003.287| WARNING: [loop_task_3] cannot renice core thread, EINVAL
Starting task loop_task_1 with period/deadline of 400000000 ....
Task name:loop_task_1, Loop count: 0, Loop time: 0.00047 ms
Starting task loop_task_2 with period/deadline of 600000000 ....
Task name:loop_task_2, Loop count: 0, Loop time: 0.00001 ms
Starting task loop_task_3 with period/deadline of 800000000 ....


Task name:loop_task_3, Loop count: 0, Loop time: 0.00033 ms
Task name:loop_task_1, Loop count: 1, Loop time: 400.01644 ms
Task name:loop_task_2, Loop count: 1, Loop time: 600.01534 ms
Task name:loop_task_1, Loop count: 2, Loop time: 800.00531 ms
Task name:loop_task_3, Loop count: 1, Loop time: 800.00251 ms
Task name:loop_task_1, Loop count: 3, Loop time: 1200.02047 ms
Task name:loop_task_2, Loop count: 2, Loop time: 1200.00250 ms
Task name:loop_task_1, Loop count: 4, Loop time: 1600.01484 ms
Task name:loop_task_3, Loop count: 2, Loop time: 1600.00598 ms
Task name:loop_task_2, Loop count: 3, Loop time: 1800.02042 ms
Task name:loop_task_1, Loop count: 5, Loop time: 2000.00876 ms
Task name:loop_task_1, Loop count: 6, Loop time: 2400.00699 ms
Task name:loop_task_2, Loop count: 4, Loop time: 2400.00094 ms
Task name:loop_task_3, Loop count: 3, Loop time: 2400.00014 ms
Task name:loop_task_1, Loop count: 7, Loop time: 2800.00778 ms
Task name:loop_task_2, Loop count: 5, Loop time: 3000.02075 ms
Task name:loop_task_1, Loop count: 8, Loop time: 3200.00633 ms
Task name:loop_task_3, Loop count: 4, Loop time: 3200.00073 ms
Task name:loop_task_1, Loop count: 9, Loop time: 3600.00731 ms
Task name:loop_task_2, Loop count: 6, Loop time: 3600.00101 ms
Task name:loop_task_1, Loop count: 10, Loop time: 4000.00842 ms
Task name:loop_task_3, Loop count: 5, Loop time: 4000.00075 ms
Task name:loop_task_2, Loop count: 7, Loop time: 4200.01677 ms
Task name:loop_task_1, Loop count: 11, Loop time: 4400.00665 ms
^C
root@xenomai-Predator-PH317-52:/home/xenomai/Documents/tests/loopTask#
```

Task	Release time(ri)	Execution Time(Ci)	Deadline (Di)	Time Period(Ti)
T1	0	1	4	4
T2	0	2	6	6
T3	0	3	8	8

8. Presentation of sprint 1

Example with preemption

Demonstration

CENTRALE NANTES

Thanks for your attention.

Do you have any questions ?