ContikiOS na TI CC2650

Bežične mreže osjetila, ak. god. 2018/2019
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Ciljevi

Pružiti upute za instalaciju i postavljanje razvojnog okruženja

Pružiti uvod u princip razvoja programa za Contiki

Demonstracija Ping-Pong algoritma na Texas Instruments CC2650

Uputstva za instalaciju i postavljanje razvojnog okruženja

Najjednostavnije - Instant Contiki 3.0 virtualna mašina

- Sadrži unaprijed postavljeno razvojno okruženje
- Izbor virtualizacijskog softvera (VMWare player, VirtualBox...)
- Jednostavno korištenje bez obzira na host OS

Uputstva za instalaciju i postavljanje razvojnog okruženja

```
$ sudo apt install build-essential doxygen git curl wireshark
python-serial srecord rlwrap gcc-arm-eabi-none

$ git clone https://github.com/contiki-os/contiki
$ cd contiki
$ git submodule update --init --recursive
```

Test:

```
$ cd <contiki-path>/examples/hello-world
$ make
```

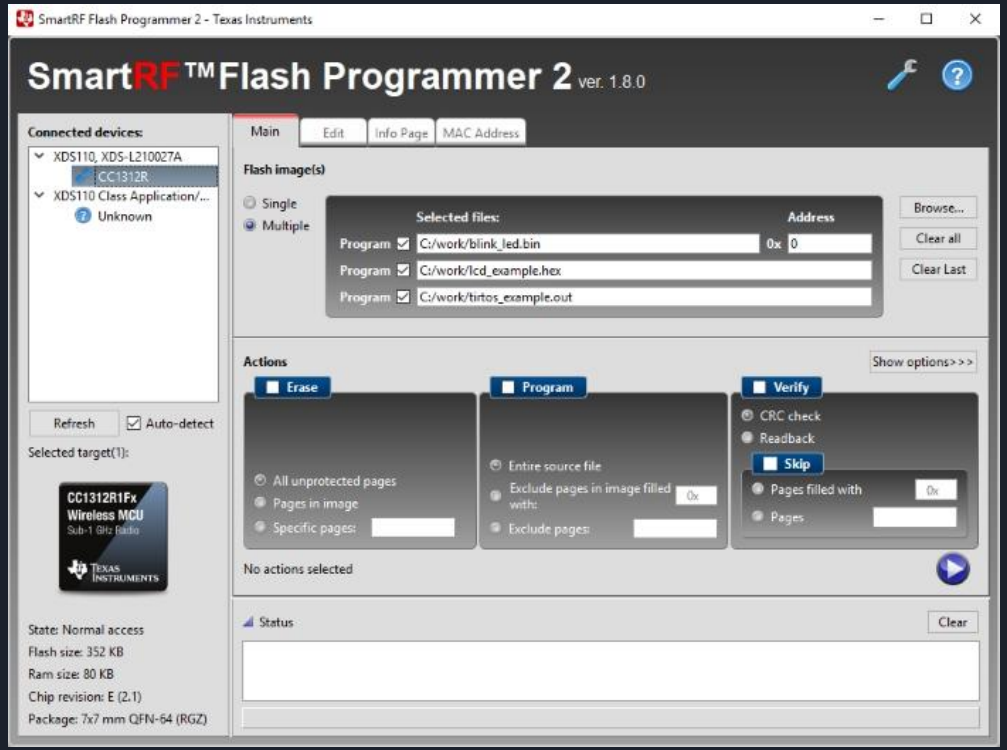
Izrada slike

C program, proj-conf.h datoteka, Makefile

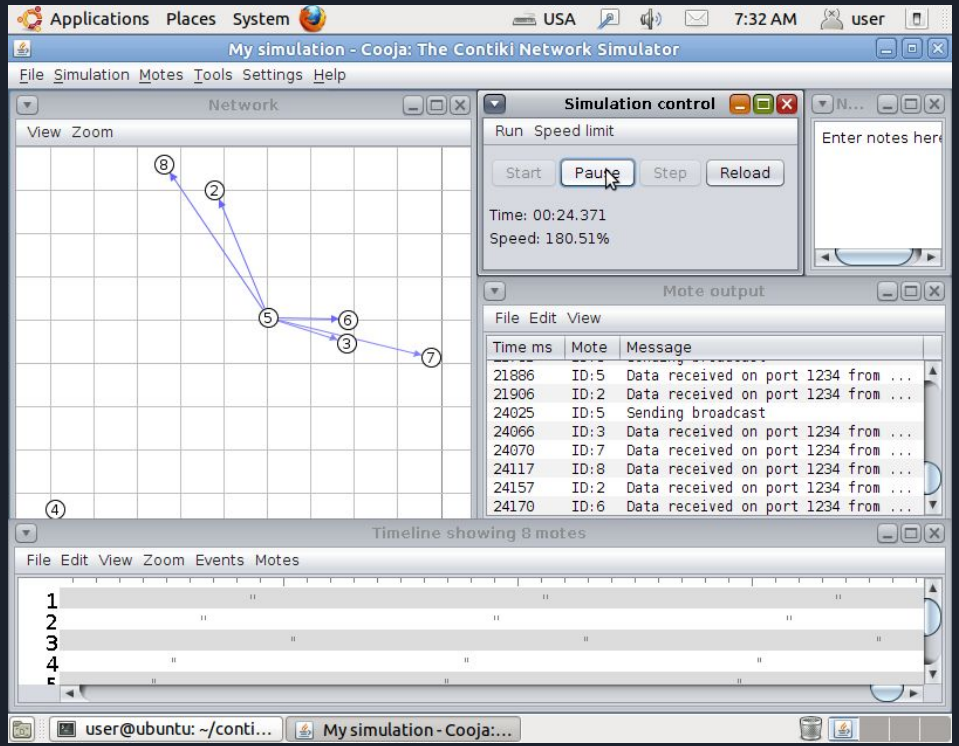
```
$ make TARGET=srf06-cc26xx BOARD=srf06/cc2650 clean
$ make TARGET=srf06-cc26xx BOARD=srf06/cc2650
```

Kreira image u ELF, BIN i HEX formatima

Postavljanje slike na sustav



Cooja


Applications Places System
USA
7:32 AM
user
My simulation - Cooja: The Contiki Network Simulator
File Simulation Motes Tools Settings Help
Network
View Zoom
Simulation control
Run Speed limit
Start Pause Step Reload
Time: 00:24.371
Speed: 180.51%
Enter notes here
Mote output
File Edit View
Time ms Mote Message
21886 ID:5 Data received on port 1234 from ...
21906 ID:2 Data received on port 1234 from ...
24025 ID:5 Sending broadcast
24066 ID:3 Data received on port 1234 from ...
24070 ID:7 Data received on port 1234 from ...
24117 ID:8 Data received on port 1234 from ...
24157 ID:2 Data received on port 1234 from ...
24170 ID:6 Data received on port 1234 from ...
Timeline showing 8 motes
File Edit View Zoom Events Motes
user@ubuntu: ~/conti...
My simulation - Cooja:...

Cooja - instalacija i pokretanje

```
$ sudo apt install default-jdk ant

$ echo 'export JAVA_HOME="/usr/lib/jvm/default-java"' >>
~/.profile


/path/to/contiki/tools/cooja$ ant run
```

Uvod u programiranje aplikacija za ContikiOS

Uvod u programiranje aplikacija za ContikiOS

Osnovni primjer

Objašnjenje koncepta programiranja

- Širi pregled osnova - izbjegavanje objašnjavanja pojedinačnih funkcija

Osnovni primjer - Hello World!

```
/*---------------------------------------------------*/
PROCESS(hello_world_process, "Hello world process");
AUTOSTART_PROCESSES(&hello_world_process);
/*---------------------------------------------------*/

PROCESS_THREAD(hello_world_process, ev, data) {
    PROCESS_BEGIN();
    printf("Hello World!\n");
    while(1){
        led_toggle(LEDS_RED)
    }
    PROCESS_END();
}
```

Osnovni primjer - Hello World! (Makefile)

```
CONTIKI_PROJECT = hello-world
all: $(CONTIKI_PROJECT)
DEFINES+=PROJECT_CONF_H=\"project-conf.h\"
CONTIKI = ../..
include $(CONTIKI)/Makefile.include
```

Principi programiranja Contiki Procesi (1)

Kontrolni blok

Procesni Thread

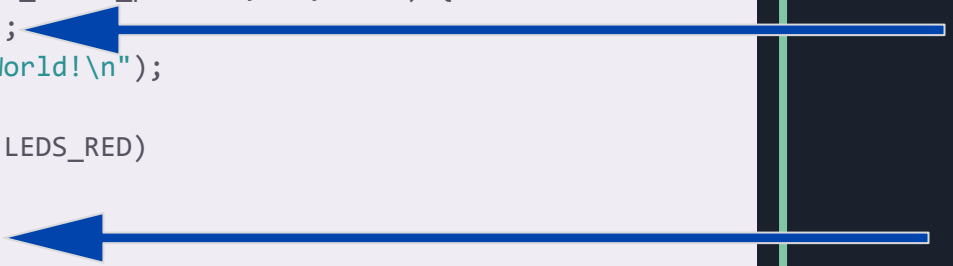
Protothread

```
PROCESS_BEGIN();
PROCESS_END();
PROCESS_EXIT();
PROCESS_WAIT_EVENT();
PROCESS_WAIT_EVENT_UNTIL();
PROCESS_YIELD();
PROCESS_WAIT_UNTIL();
PROCESS_PAUSE();
```

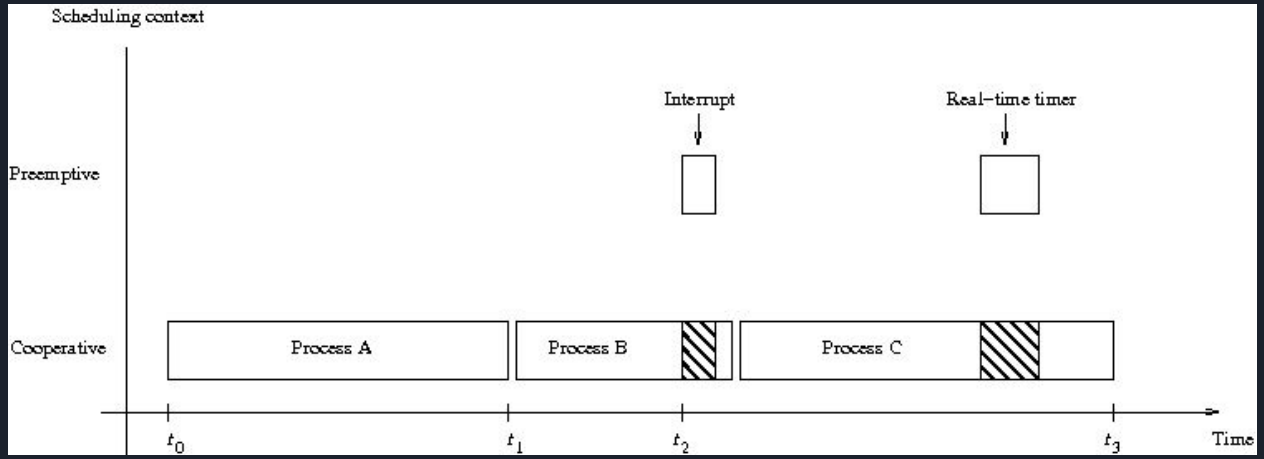
Osnovni primjer - Hello World! Sada sa procesima!

```
/*---------------------------------------------------*/
PROCESS(hello_world_process, "Hello world process");
AUTOSTART_PROCESSES(&hello_world_process);
/*---------------------------------------------------*/
```

```
PROCESS_THREAD(hello_world_process, ev, data) {
    PROCESS_BEGIN();
    printf("Hello World!\n");
    while(1){
        led_toggle(LEDS_RED)
    }
    PROCESS_END();
}
```



Principi programiranja Contiki
Procesi (2)



Slika 1. Preemptivni i kooperativni procesi.

Principi programiranja Contiki Eventi (1)

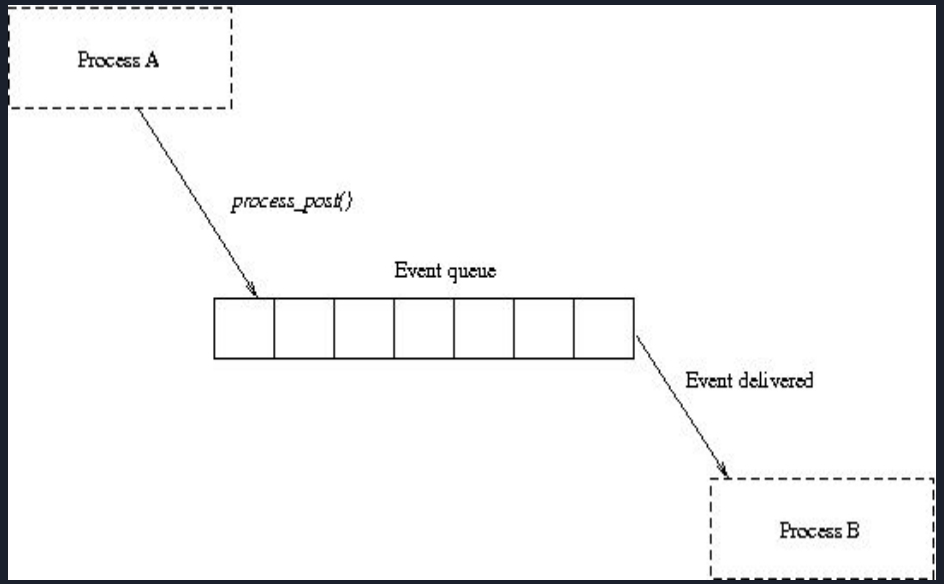
Procesi se pokreću kada prime događaj

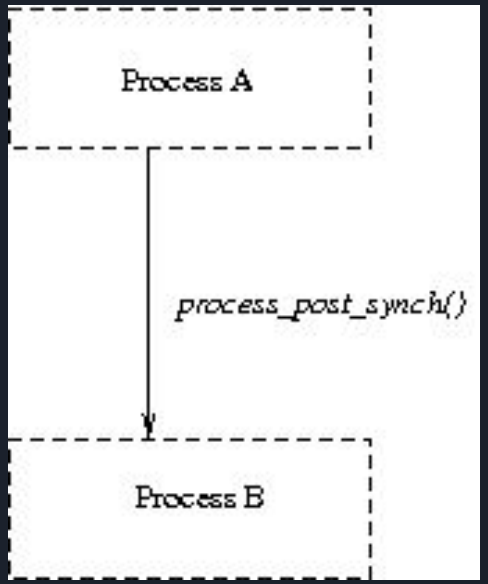
`process_post()`

```
PROCESS_THREAD(hello_world_process, ev, data)
```

```
#define PROCESS_EVENT_NONE              128
#define PROCESS_EVENT_INIT              129
#define PROCESS_EVENT_POLL              130
#define PROCESS_EVENT_EXIT              131
#define PROCESS_EVENT_CONTINUE          133
#define PROCESS_EVENT_MSG               134
#define PROCESS_EVENT_EXITED            135
#define PROCESS_EVENT_TIMER             136
```

Principi programiranja Contiki
Eventi (1) - Asinkroni i sinkroni





ContikiOS za distribuirane algoritme

Entitet - memorija, **statusni registar**, alarm, komunikacija

Implementacija statusa

- Na razini procesa
- Proces kao status

Problemi

Rad sa virtualnim strojem

Loša podrška za postavljanje slike, Host↔Guest

CC2650, postavljanje slike, očitavanje izlaza...

Timeri, eventi, procesi...

Primjer ping-pong - live demo!

6LoWPAN

Algoritam - kada primiš poruku, vrati je pošiljatelju

Hvala na pažnji!