IoT Security – Autumn 2023
Lab 4: Connecting IoT network to the internet

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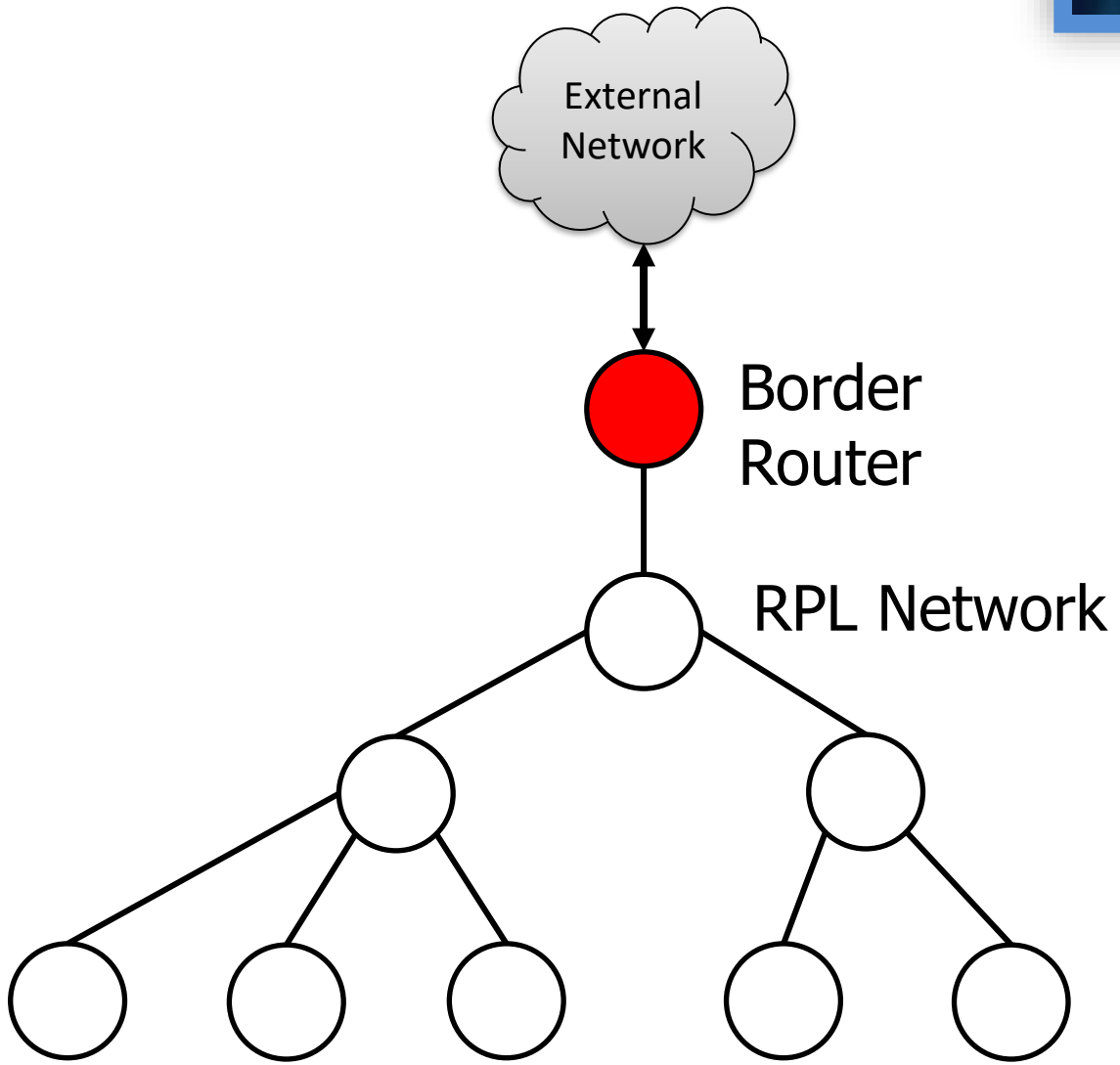
RPL Border Router

- Border routers are routers that can be found at the edge of a network.
- To connect one network to another.
- RPL Border Router is used to connect a regular IP network with a RPL 6LoWPan network.



RPL Border Router

RPL

- The border router is the DAG root
- Build a DAG for the network.
- Make sure that every nodes can communicate with the router

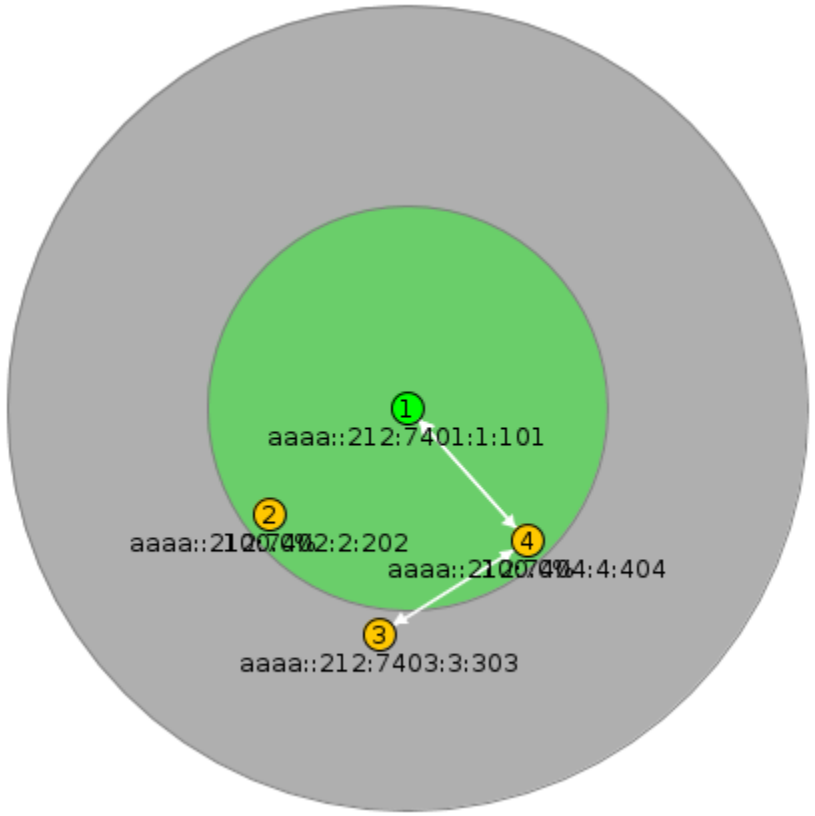
HTTPD

- Apache HyperText Transfer Protocol (HTTP) server program
- To build a simple webserver that allows client request the network's information.

SLIP

- Serial Line Internet Protocol.
- A TCP/IP protocol to transmit IP packet over serial lines.
- In cooja, slip is used to connect the border router with the local machine.

RPL Border Router



ContikiRPL - Mozilla Firefox

File Edit View History Bookmarks Tools Help

ContikiRPL

[aaaa::212:7401:1:101]

Neighbors

fe80::212:7404:4:404
fe80::212:7402:2:202

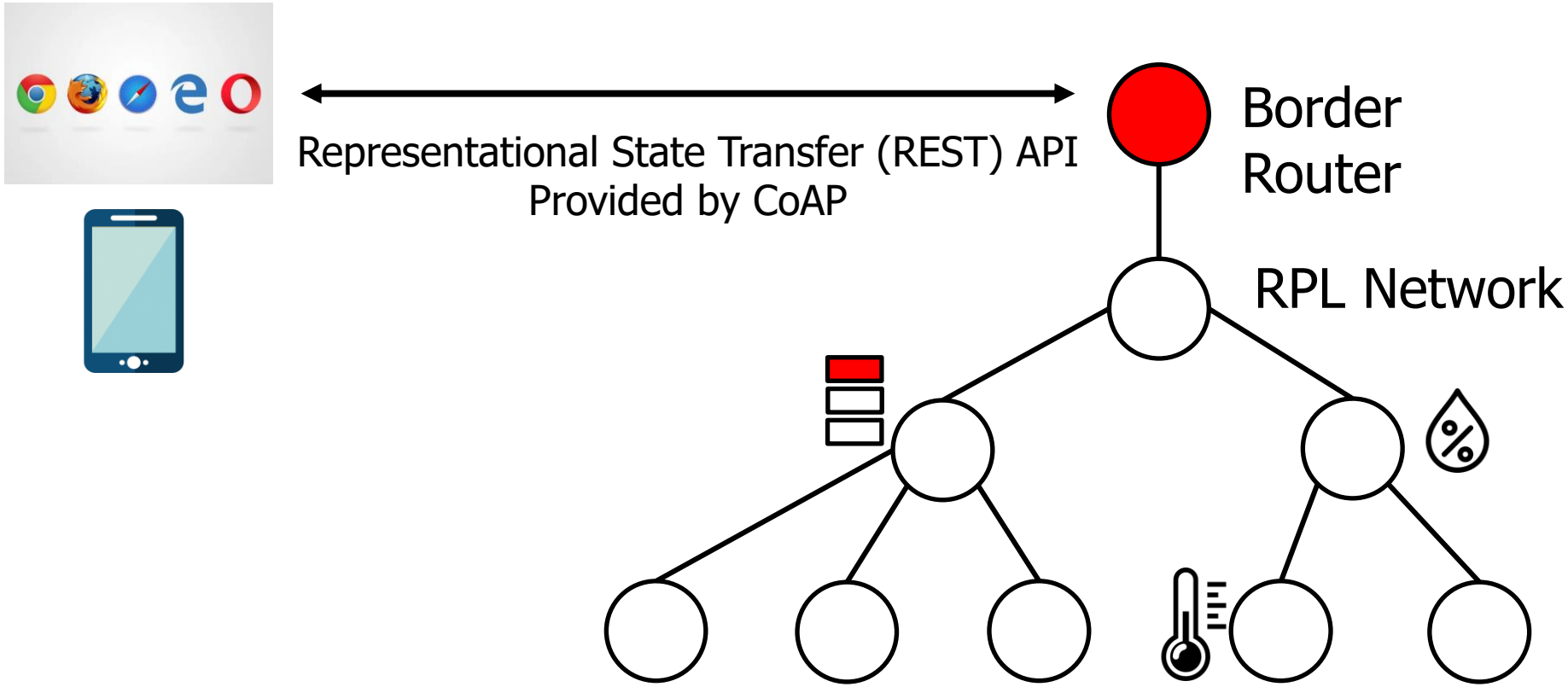
Link-local address

Routes

aaaa::212:7404:4:404/128 (via fe80::212:7404:4:404) 16711225s
aaaa::212:7403:3:303/128 (via fe80::212:7404:4:404) 16711318s
aaaa::212:7402:2:202/128 (via fe80::212:7402:2:202) 16711221s

CoAP in Contiki

Can we control the IoT network over the Internet?



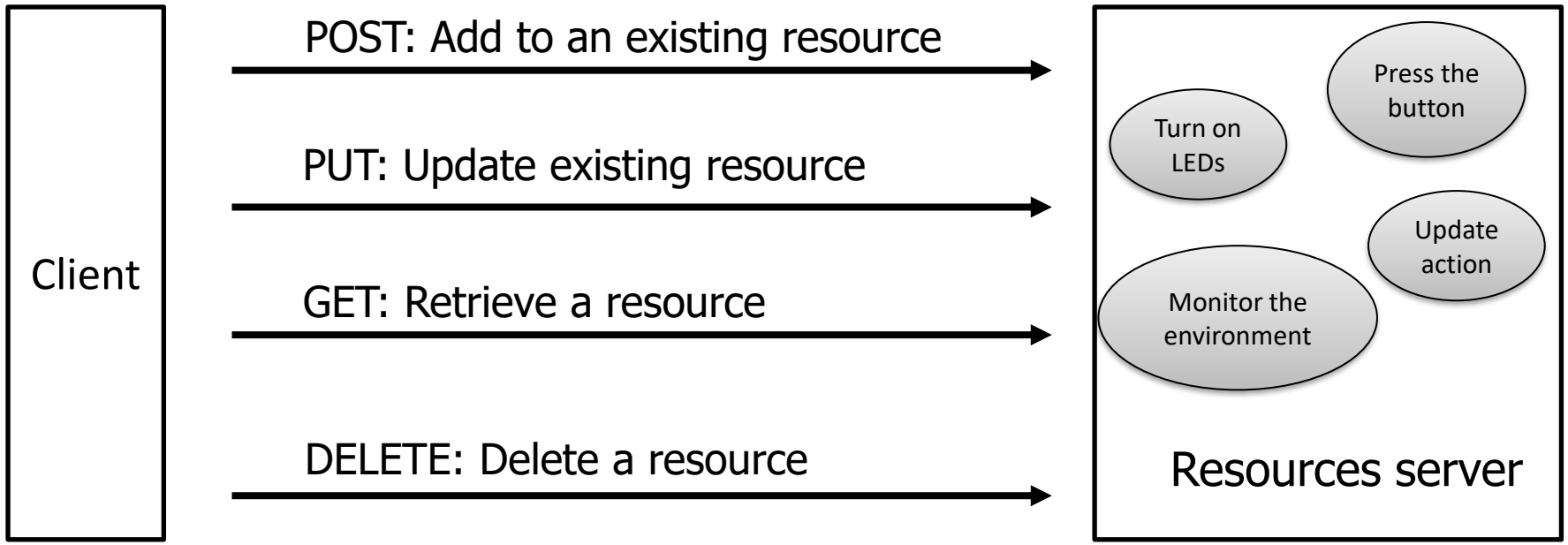
CoAP in Contiki

- Constrained Application Protocol (CoAP) is a specialized **Internet Application Protocol** for **constrained devices**
- CoAP is designed to easily translate to HTTP for simplified integration with the web, while also meeting specialised requirements such as **multicast support**, **very low overhead**, and **simplicity**.
- CoAP provides several **REST APIs** which are similar to the HTTP protocol: get, post, put, delete, observe, discover.

CoAP in Contiki

What is REST?

REpresentational State Transfer is an architecture style that is based on web standards and the HTTP or CoAP protocol.
In a REST-based architecture everything is a Resource



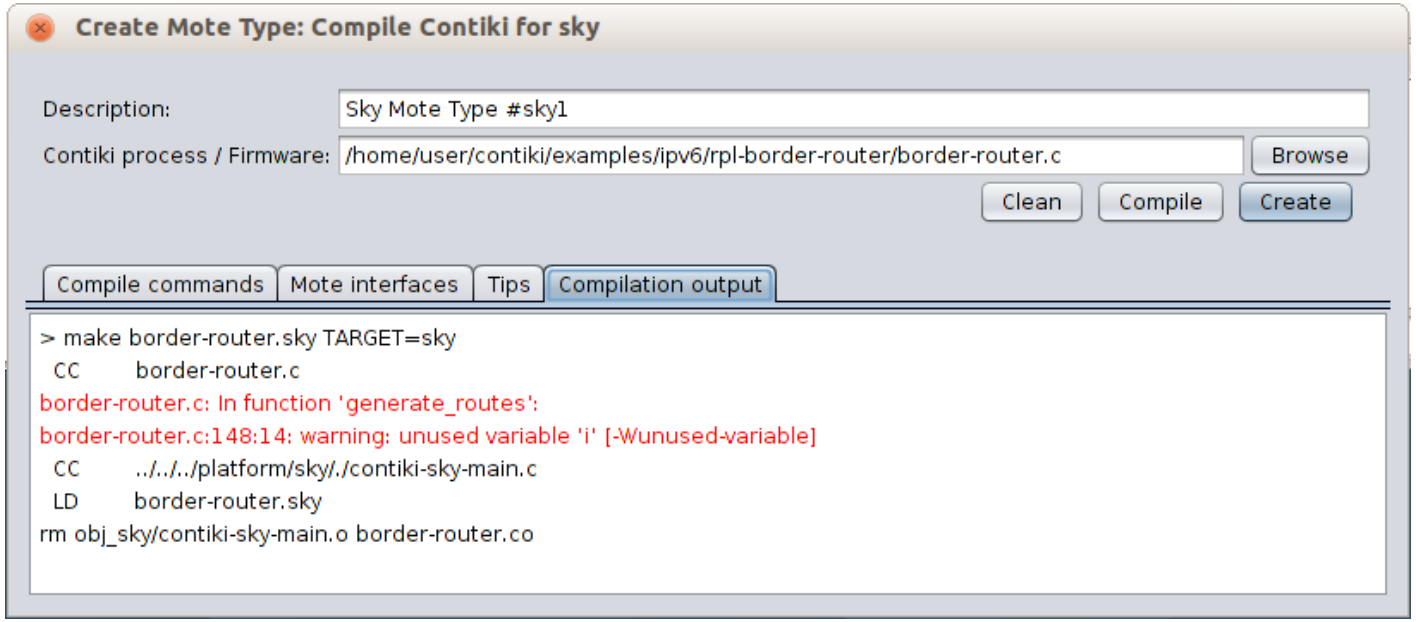
Control IoT networks with RPL border router and CoAP

Create a IoT network with: a RPL border router and 2 CoAP server.

- Connect the network with the Internet by using border-router.c in contiki/examples/ipv6/rpl-border-router.
- Turn on and off the LEDs on the CoAP servers by using er-example-server.c in contiki/examples/er-rest-example.

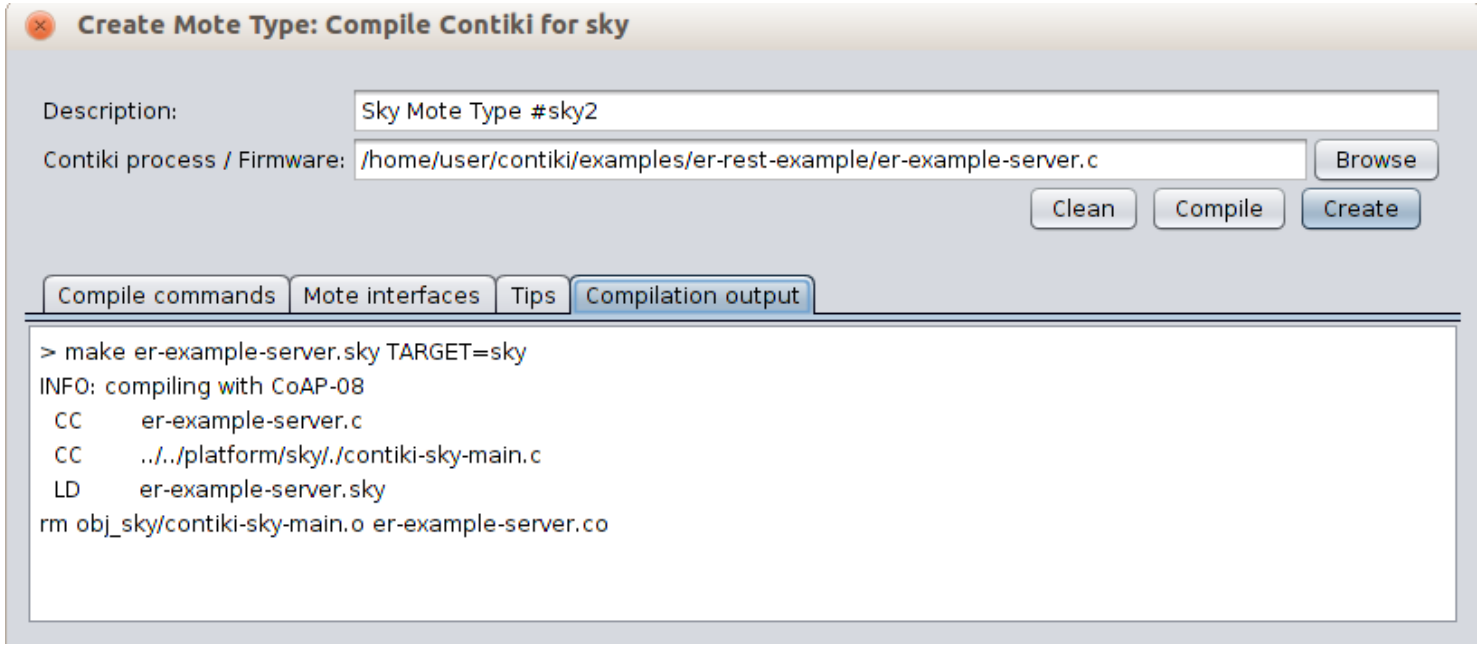
Control IoT networks with RPL border router and CoAP

- Open Cooja Simulator
- Create a new simulation
- Create a RPL border router by using the firmware contiki/examples/ipv6/rpl-border-router/border-router.c



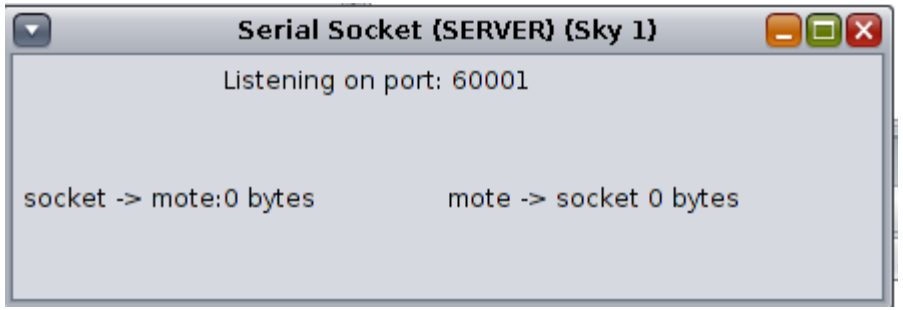
Control IoT networks with RPL border router and CoAP

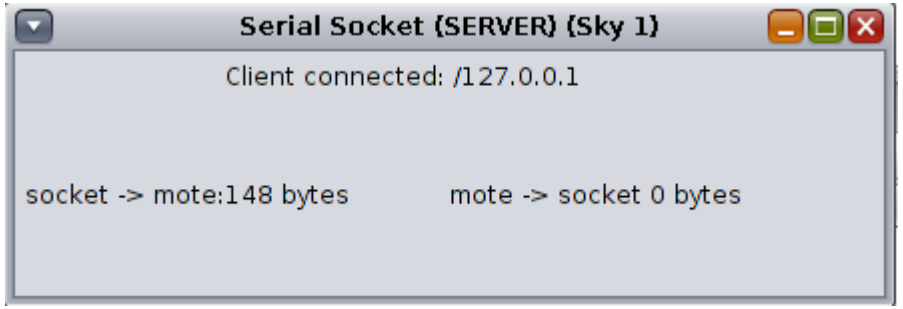
- Create 2 CoAP servers by using the firmware contiki/examples/er-rest-example/er-example-server.c
- Change version of CoAP protocol in the makefile at: contiki/examples/er-rest-example/Makefile by changing WITH_COAP=13 to WITH_COAP=7 (as the current version of Firefox on the virtual machine support CoAP version 7/8)



Control IoT networks with RPL border router and CoAP

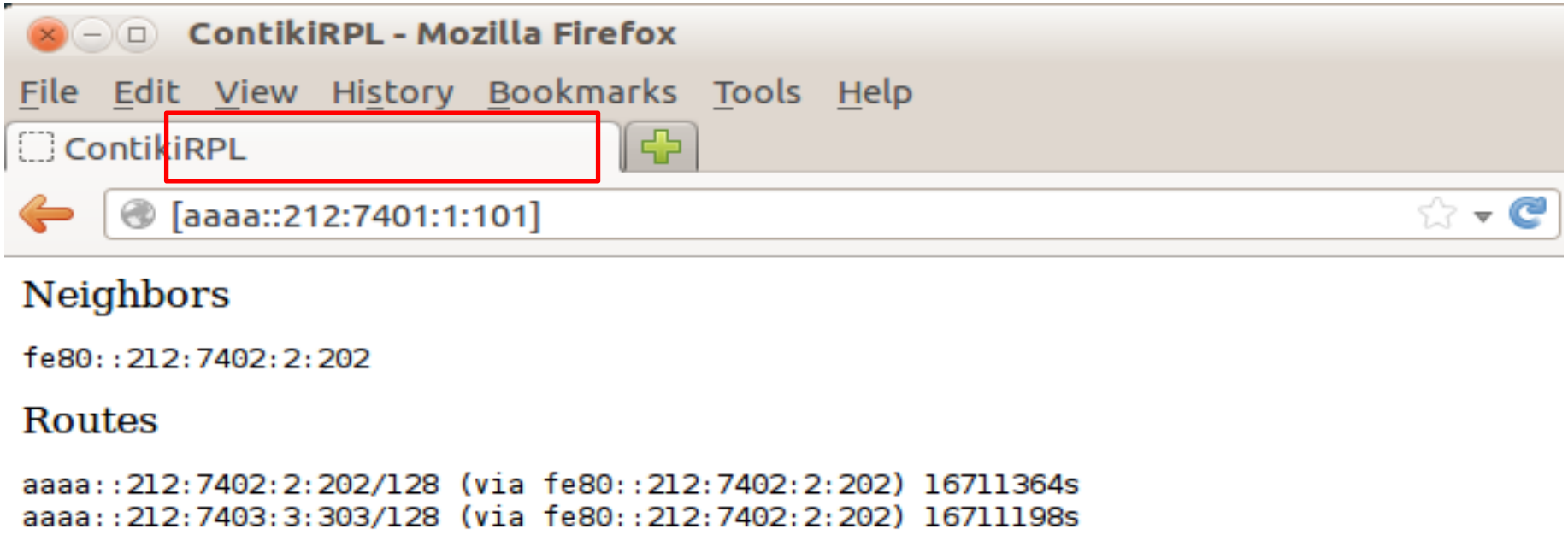
- Create a bridge between the rpl border router and the local machine
  - Right-click on the rpl border router (mote 1), choose Mote tools for Sky 1 -> Serial Socket (Server)
  - Open a new Terminal and run:
    - cd contiki/examples/ipv6/rpl-border-router/
    - make connect-router-cooja





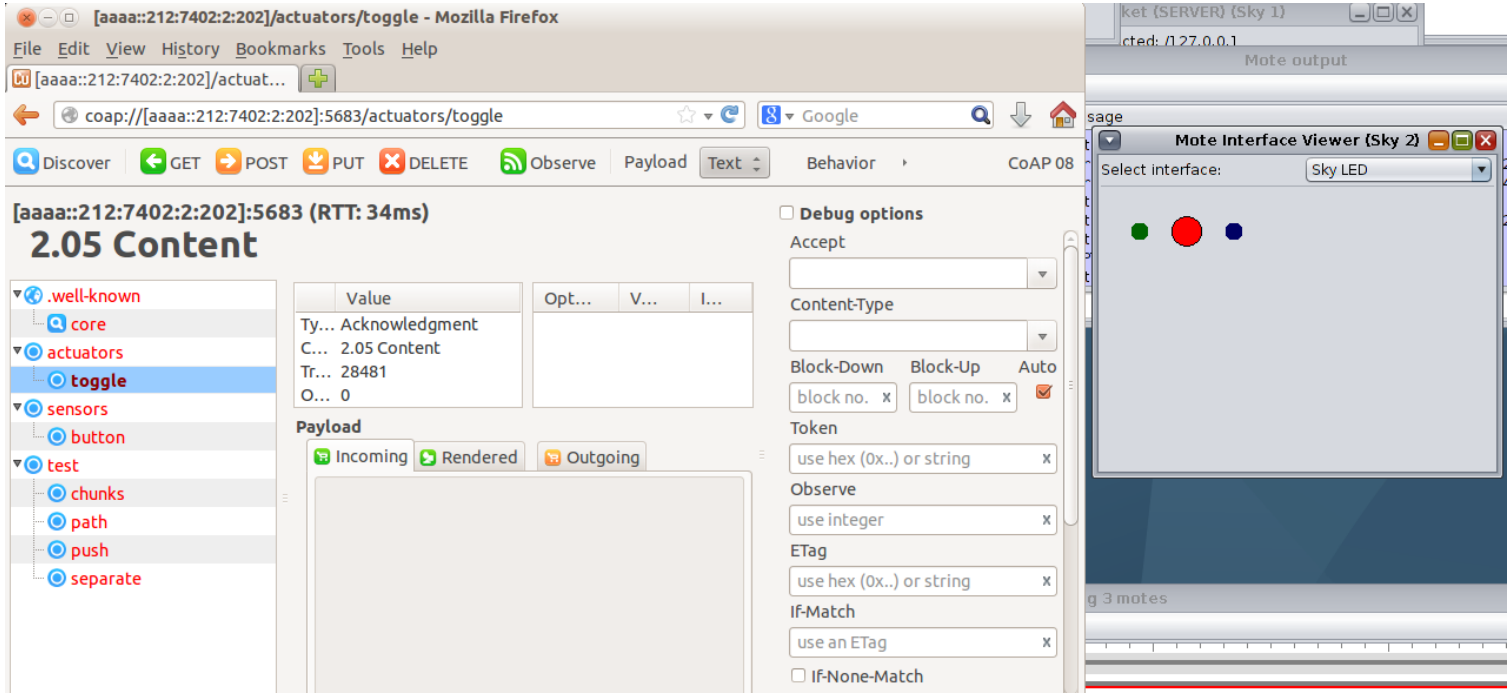
Control IoT networks with RPL border router and CoAP

- Run the simulation
- Open Firefox and connect to the border router by typing the Ipv6 address of the border router [aaaa::212:7401:1:101]



Control IoT networks with RPL border router and CoAP

- Turn on LED on mote 2 through CoAP
  - Open Firefox and type the Ipv6 address of mote 2: coap://[aaaa::212:7402:2:202]/
  - Click on Discover to explore the neighbours
  - Click on actuators->toggle and click on the POST command to turn on/off LED RED on mote 2



Exercises

1. Create a new simulation with a RPL border router and 5 UDP client and see the topology's information on Firefox.
2. Change the code in `contiki/examples/er-rest-example/er-example-server.c` to turn on LED GREEN and LED BLUE when using the POST command on Firefox.

References

1. Get Started with Contiki: http://www.contiki-os.org/start.html
2. Contiki Tutorial: http://anrg.usc.edu/contiki/index.php/Contiki_tutorials
3. https://anrg.usc.edu/contiki/index.php/RPL_Border_Router
4. https://github.com/contiki-ng/contiki-ng/wiki/Documentation:-CoAP
5. A. L. Colina, A. Vives, A. Bagula, M. Zennaro, and E. Pietrosemoli, "IoT in 5 days" [Online]. Available: http://www.iet.unipi.it/c.vallati/files/IoTinfivedays-v1.1.pdf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You
Grazas
Danke
Merci
Maake
Biyan
Arigato
Gracias
Juspaxar
Dank Je
Dziekuje
Mauruuru
Dhanyavadagalu
Asante
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