FLUKSO

community metering

bart.vandermeerssche@flukso.net
• MSc. Electrical Engineering
• Alcatel-Lucent Antwerp ’99 - ’07
• ADSL R&D ’99 - ’04
• Bell Labs ReNA ’04 - ’07
• Co-founder Jokamajo Institute ’07 - present
• Founder Flukso ’07 - present
INDUSTRIA URUGUAYA.

1 FASE  2 HILOS  1kWh.  450

220V  10A  50Hz  I_max. 6

IPÓ  M6S1Z  AÑO 1988  CLASE
REDUCE!

* close feedback loop
* visualize energy streams
* benchmark against peers

Help people in reducing resource consumption:

* Visualize energy streams
* Close feedback loop
* Benchmark against peers
select time scale
dynamically (un)subscribe to other Fluksonians' data streams
change the chart’s y-axis unit
min/max/avg/last statistics
Flukso’s first steps!

- ethernet-enabled Arduino
- hacked commercial energy meter
- energy meter dev board
Fonera 2200 wireless router

8-pin female header sensor input

power loss detection circuitry

ATmega168v

Fonera 2200 wireless router
INSTALL

current clamp

Fluksometer
Why two platforms?

• ATmega48v is an 8 bit AVR uc
• Loads of GPIOs
• 10 bit ADC / analog comparator
• UART / SPI / 2-wire
• Multiple timers / PWM
• A great platform for hooking up any sensor or actuator!
• BUT: Limited network connectivity
Why two platforms? cont.

- Atheros AR2317 is an 802.11b/g SoC
- Integrated 32 bit MIPS R4Kc proc
- Flash with OpenWRT and you get an embedded Linux box
- Eth, Wifi, DHCP, NTP, PPP, PPTP, PPPoE, SSL, [your favorite acronym here]
- BUT: Only 8 GPIO pins. Poor physical computing platform.
OpenWRT Buildroot

- set of Makefiles and patches
- x-compilation toolchain based on Linux kernel / uClibc and Busybox
- generates target firmware images and additional selected packages
- includes opkg package manager on target
What if the connection drops?

- Log \{Timestamp, Counter\} tuples
- Allows for ‘gaps’ in logging
- Never lose track of Counter! Use power loss detection circuitry in uc to trigger EEPROM write of Counter
- Buffer tuples in Fluksometer RAM
- Age tuples in the daemon so that RAM increases logarithmically in time
- Dynamically typed and garbage collected
- Primary and only data structuring mechanism: the ubiquitous table `{}`
- First-class functions, closures, proper tail calls
- Coroutines for non-preemptive multithreading
- Dynamic module loading
- Extensible through C API
- All these goodies on a 150KB footprint, incl luac!

_L_EMBEDDED LUA_
**ARCHITECTURE RECAP**

```
Fluksometer
  Fluksos daemon
    OpenWRT kamikaze
      Atheros AR2317
        802.11b/g + MIPS
          ATmega48v uc
            UART

sensor
sensor
    ...    
sensor

sensor

Webmachine HTTP/REST API
  Nginx
    PHP-FPM*  Django GUI
      MySQL
        RRDTool
          Webmachine HTTP/REST API

* FastCGI Process Manager
```
Data storage?

• Log time series data in RRDs
• Data set will not grow in size!
• It will simply age the data, reducing resolution
• Graphing layer included
• 1.4 introduces a caching daemon for improved performance
Show me the API!

- Webmachine / Mochiweb based
- JSON HTTP/REST API
- GET http://api.flukso.net/sensor/d8a8ab8893ea73f768b66b45234b5c3a/hour/watt
• Introduce a broader range of current sensors [50A, 100A, 250A, 500A]

• Measure multiple electricity flows: aggregate consumption & PV or wind generation

• Monitor other resources: water, heating?

• Monitor environmental parameters: temp, humidity?

• Add RS-485 communication to the Fluksometer: mySmartGrid project
Vince Alongi, kWh
www.flickr.com/photos/vincealongi/2927254475

Macarena C., ?
www.flickr.com/photos/room_onfire/403830495/

Join us at www.flukso.net/forum
HW and SW repository at dev.jokamajo.org