

Citysniff

An experiment in collective
urban sensing

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Outline

- Background and prevalent model of sensor networks.
- A new modus operandi.
- System overview
- Datapath from sensor to browser
- Project status
- Some early data
- Conclusions and Outlook

Premise

What happens when a pollution sensing kit is

- Affordable,
- Easy to set up,
- Available to anybody (who is interested), and
- Able to publish data on the web for all to see?

Project goal is to **explore** one possible system architecture motivated by this question.

PS: The real question is of course “What happens when a phd student looks for excuses not to work on his dissertation...?”

Prevailing Architecture

Majority of sensornet deployments (effective or envisioned):

- **Technical**

- Local-area coverage (1 hop = 100m)
- Multi-hop wireless data transport
- Existing pipes (Internet, Wifi, GPRS not at center of picture)

- **Social**

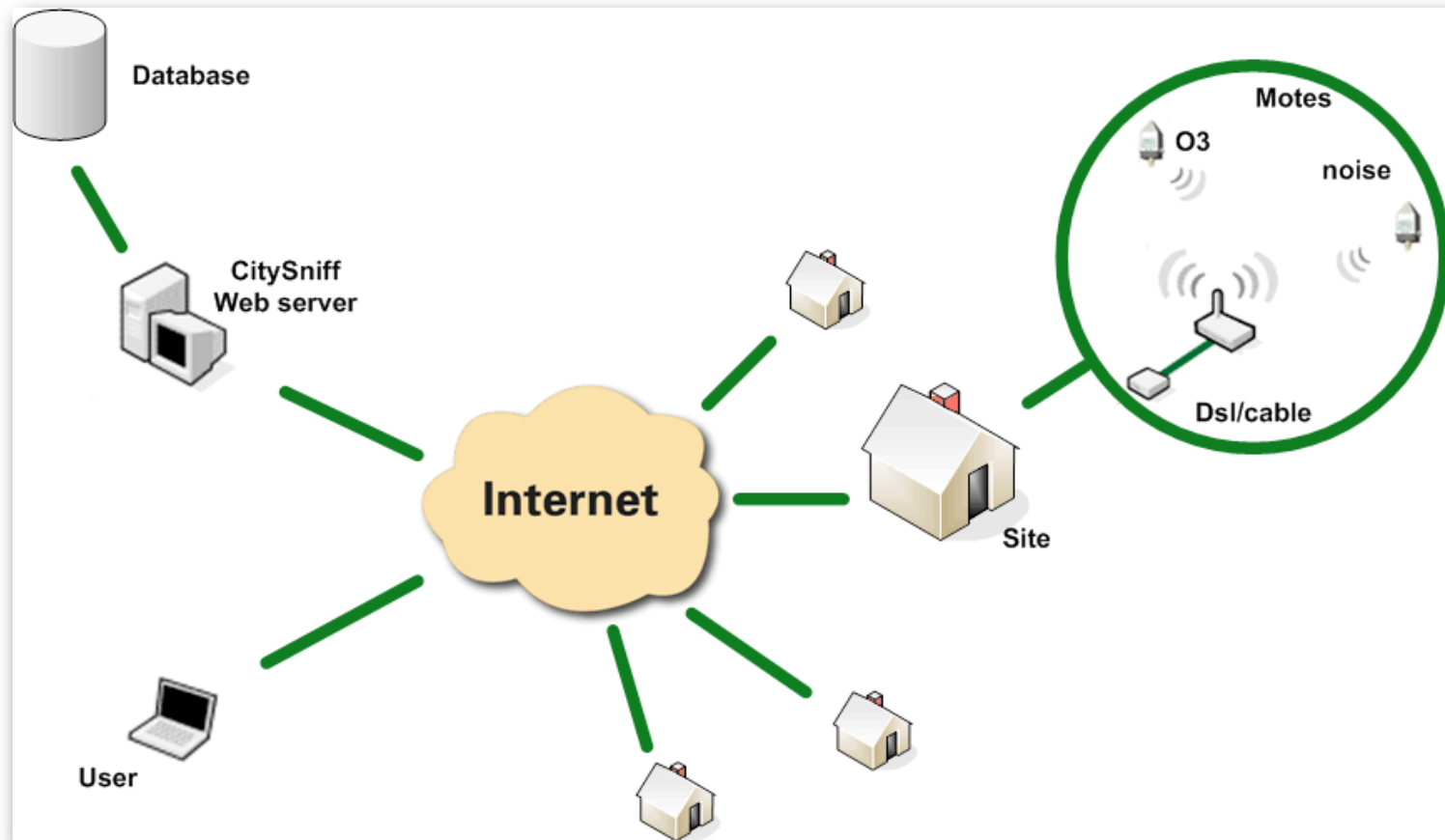
- Central ownership of infrastructure
- Central ownership of data
- Designed and run by a single entity (e.g research institution or public authorities)

Differences

More specifically, explore new technical and social models for environmental monitoring:

- **Technical**
 - Wide-area coverage (e.g., city, country, or even continent)
 - Internet as primary transport pipe
 - Tiny sensor patches (1-2 nodes)
- **Social**
 - Anyone can install a sensor and contribute data
 - Distributed ownership of infrastructure
 - “By the people, for the people” (e.g., wifi communities, FON)

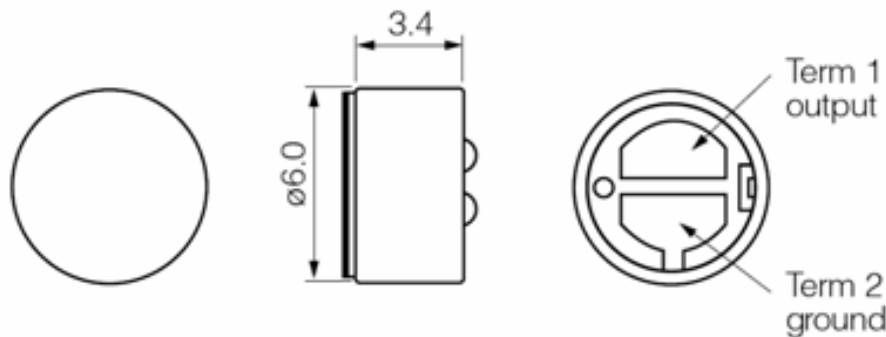
Corollary: Not really for scientists!!



Bird's eye view

What are we sensing?

- **Noise:** Panasonic WM61
 - Omnidirectional electret condenser
 - Microphone is cheap (1-2 CHF)
 - Quite low-power (0.5mA @ 3V)
 - Interpretation and calibration are easy
 - Planned on all stations (locality!)



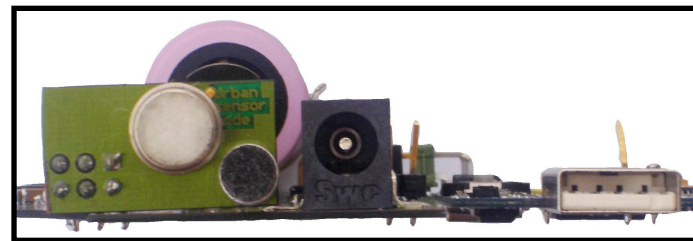
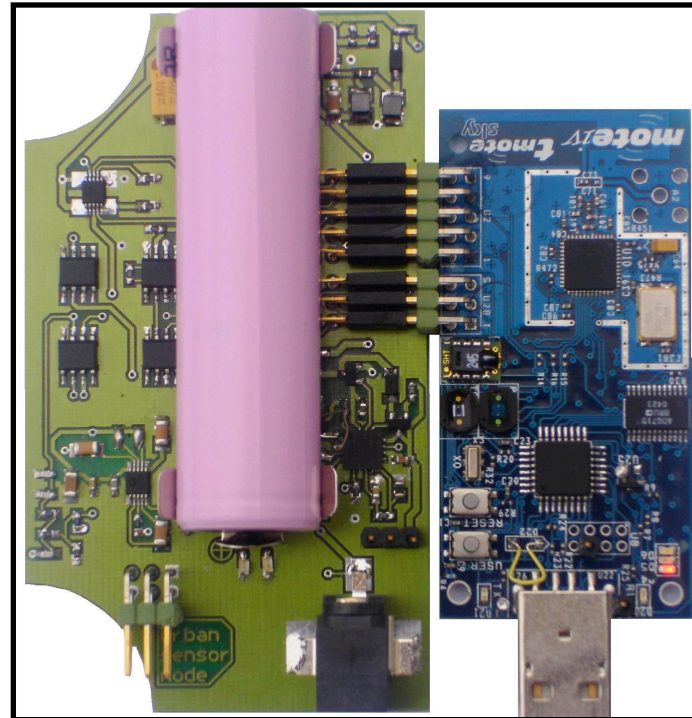
Small (6mm diam)
surface-mount
package

What are we sensing?

- **Ozone:** MSGS-3003 (Silsens, Neuchâtel)
 - Semiconductor gas sensor
 - Less cheap (approx. 100 CHF)
 - Power (25 mA, but 4-5 minute warmup!)
 - Sensitivity 0-200ppb (CH legal limit 80ppb)
 - Operation quite “opaque” (to be diplomatic)
 - Only on a small number of stations (3!!)

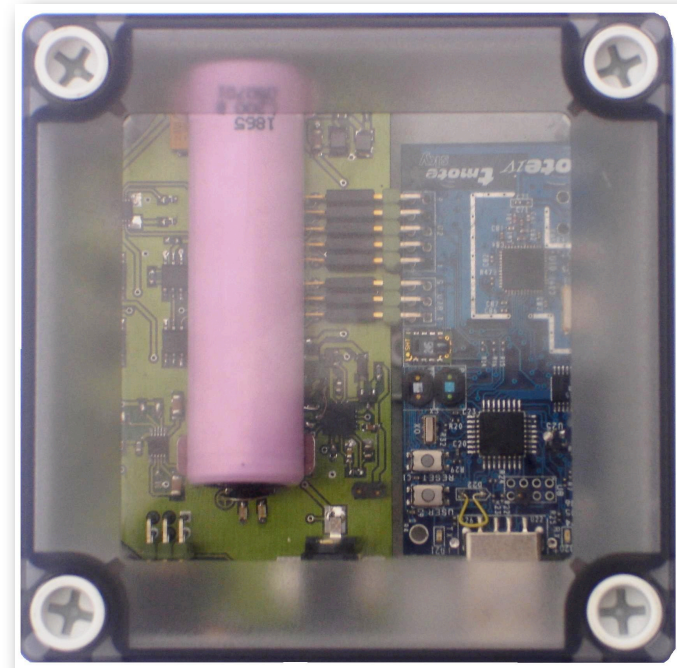
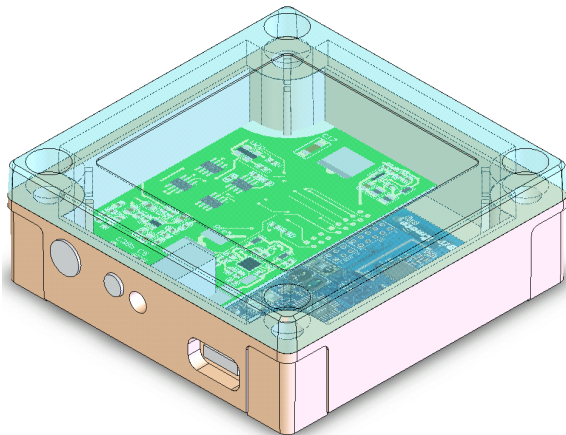
Sensorboard overview

- Connects to TmoteSky wireless node
- Interfaces to mic & ozone sensors, some analog circuitry
- Host Li-Ion battery (1500mAh) and charging circuitry
- BOM cost approx. 25 CHF



Packaging

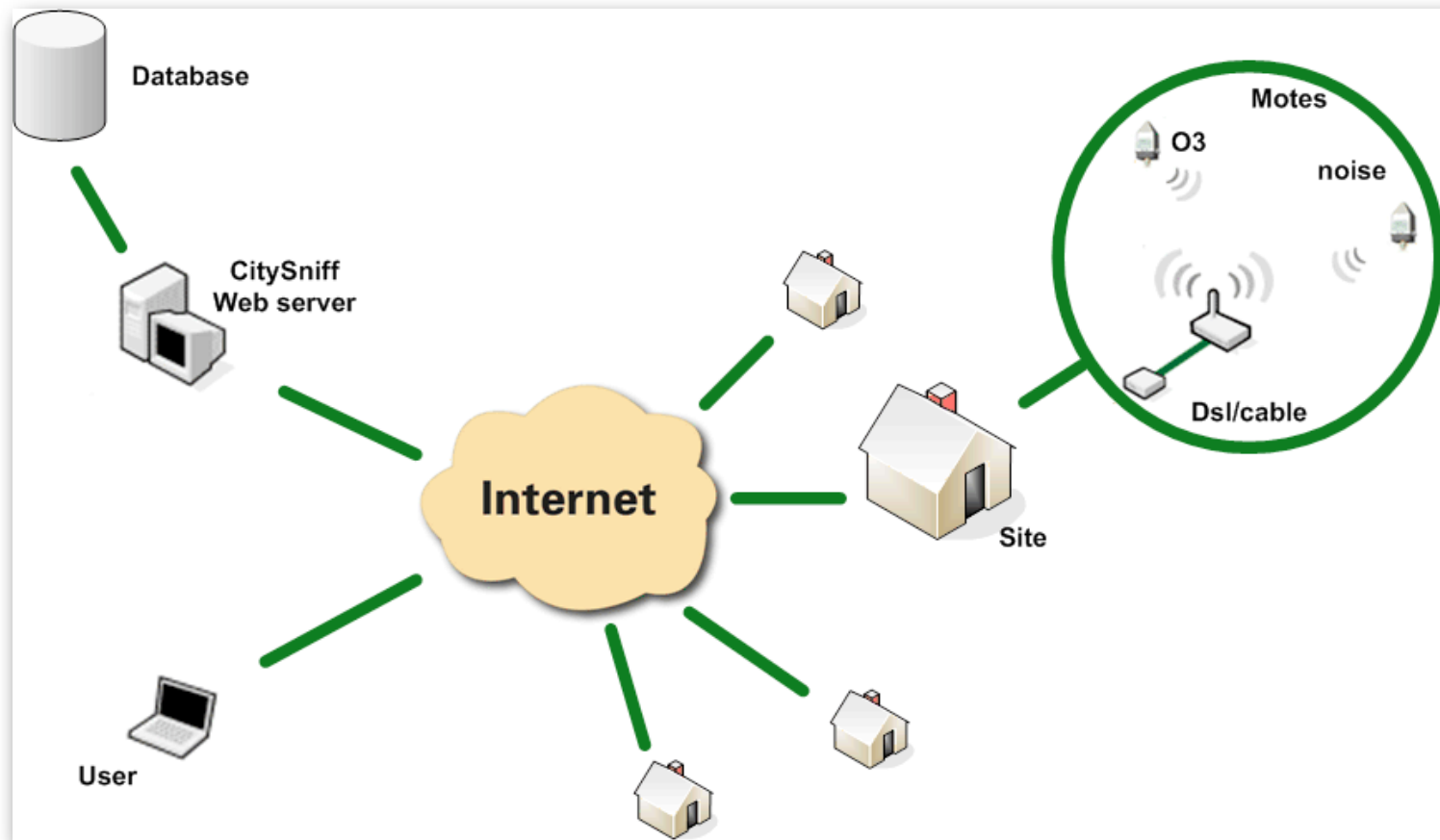
- Seamlessly closing box would be extremely hard given sensors and connectors.
- So, went for breathable solution. Device must not be exposed to direct rain.



Power: rough numbers

Component	Consumption	Duty Cycle	Effective Cons.
Radio+Mcu	20 + 8 mA	1%	0.28mA
Mic	0.5 mA	10%	0.05mA
O3	25mA	10%	2.5mA

- User must recharge node every N days (via USB or power supply)
- With O3 sensor: N=25
- Without: N=189 (or run Mic at 100% and N=60)
- Of course in practice we should be happy if we get half of that!



Bird's eye view

Remote gateway

We have a wireless node on a balcony.
How does its data “get into” the internet?

- Solution: Embedded linux gateway with:
 - Basestation (BS) tmote connected via USB to gateway.
 - BS talks to balcony node.
 - Gateway is connected to home router/hub.
 - Talks HTTP (or could use other standard protocols) to web server over DSL internet connection.

Remote gateway (II)

By luck (and browsing moteiv's page..), came upon a suitable low-cost device:

- Linksys NSLU2 storage mini-appliance:
 - Original purpose is to place USB drives on a LAN (low-cost file server).
 - 267Mhz Xscale CPU, 8MB flash, 32MB Ram.
 - Can be re-flashed, thriving hacker community and different distros available (e.g., unslung, openslug.).
 - A full linux machine for the price of a mote (!!).



2.1 cm x 9.1 cm x 13 cm

NSLU2 functions

- Initial “bring-up” of a site:
 - Runs embedded web server.
 - User enters coordinates, email, info.
 - NSLU2 registers with central citysniff server.
- Data flow:
 - Balcony mote sends to BS.
 - POSTs sensor data via HTTP to server.

Web Interface

W3C XHTML 1.0 CitySniff web interface

noise min 0 max 50 O3 min 0 max 50 location search time date today

sites favorites

site1 lausanne

site details		notes (2)		
ID:	owner:	ID	last heard	status
1	own1first own1last	1	11:17 AM 09-Apr-06	good
	email: own1@epfl.ch	2	11:18 AM 09-Apr-06	inactive
location: lausanne				
zip code: 1007				
last heard: Sun 09-Apr-06 11:19				

view map view noise view o3

site2 geneve
site3 nyon
site1 lausanne
site1 lausanne

Yverdon-les-Bains
Plan/ Carte Satellite Mixte
info 0 1
details of site: 1
Orbe
Crissier
Morges
Pully
Lausanne
A1 E23 E62 A12 A9
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15/02/05	सल्फर डाई ऑक्साइड	SO ₂	30
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Ok, this has already been done....