

Privacy-Preserving Energy-Reading for Smart Meter

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Outline

- **Smart Meters**
 - Benefits
 - Current Deployment
 - Security and Privacy issues
- **Building Your Own Smart Meter**
 - Architecture
 - Privacy-Study
 - Privacy-Solution
- **Conclusion**

Smart Meters

- Smart meters are a **new kind of energy meter** and are a replacement of your existing meters;
- **Accurate bills** — Customers pay what they consumed;
- No one has to go to customers' home to read the meter;
- **Customers do not have to submit** meter readings;
- **Better oversight and management** of your energy use;

Smart Meters - Situation

**DIRECTIVE 2009/72/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 13 July 2009**

concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC

Brussels 9 March 2012

Energy: Commission paves the way for massive roll-out of smart metering systems

UK Smart Meters Delayed. Again.

November 24th, 2014

Smart Meters - Security and Privacy Issues

16 October 2014



Smart meters can be hacked to cut power bills



Smart Meters - Italy



Telegestore

- Over last ten years, Italy has maintained the electric meter leadership
- It **communicates** with the energy provider through narrow-band Power Line Communication (PLC)
- **Is it** a Smart Meter?



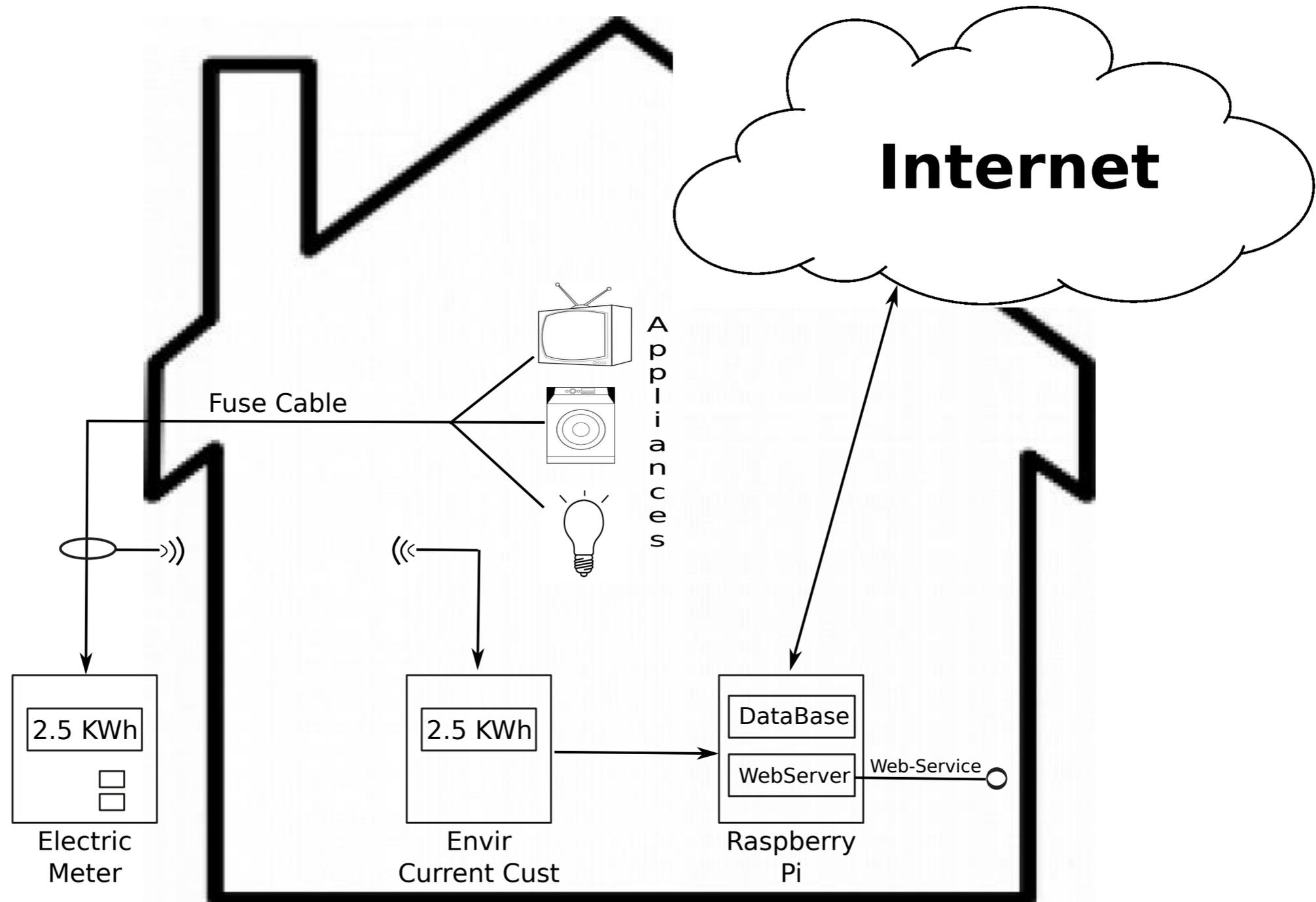
Smart Meters - Build Your Own



Envir Current Cost

- It is an energy meter
- Indoor display
- Serial Cable
- One or more sensor jaw
- It costs about 100€

Smart Meters - Architecture



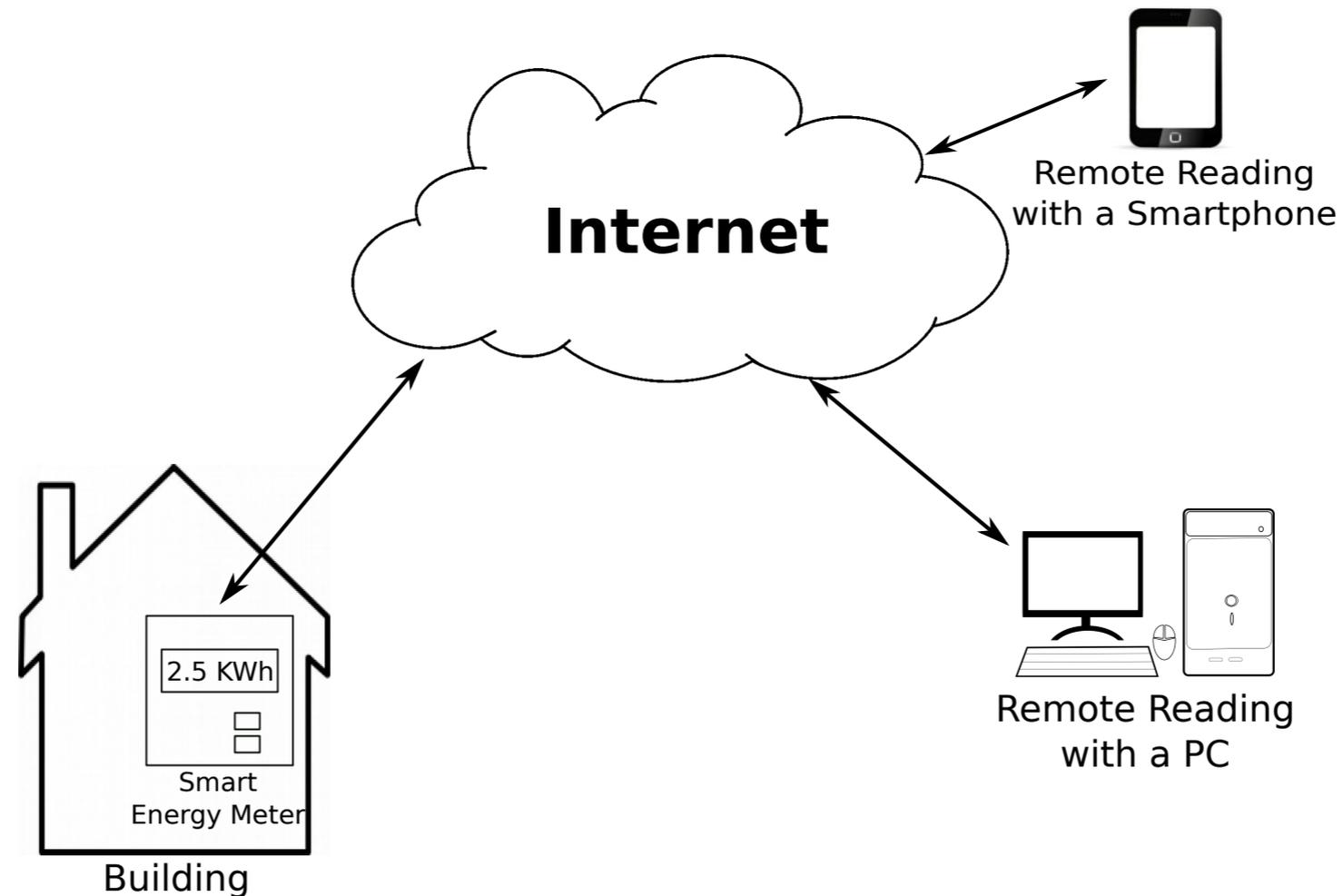
Smart Meters - Recording Energy consumes



```
...  
port = '/dev/ttyUSB0'  
baud = 57600  
timeout = 10  
  
meter = serial.Serial(port, baud, timeout=  
    timeout)  
...
```

Python Code

Smart Meters - Remote Reading



- RESTfull Services
- Username / Password Authentication

Smart Meters - Pros and Cons

Pros

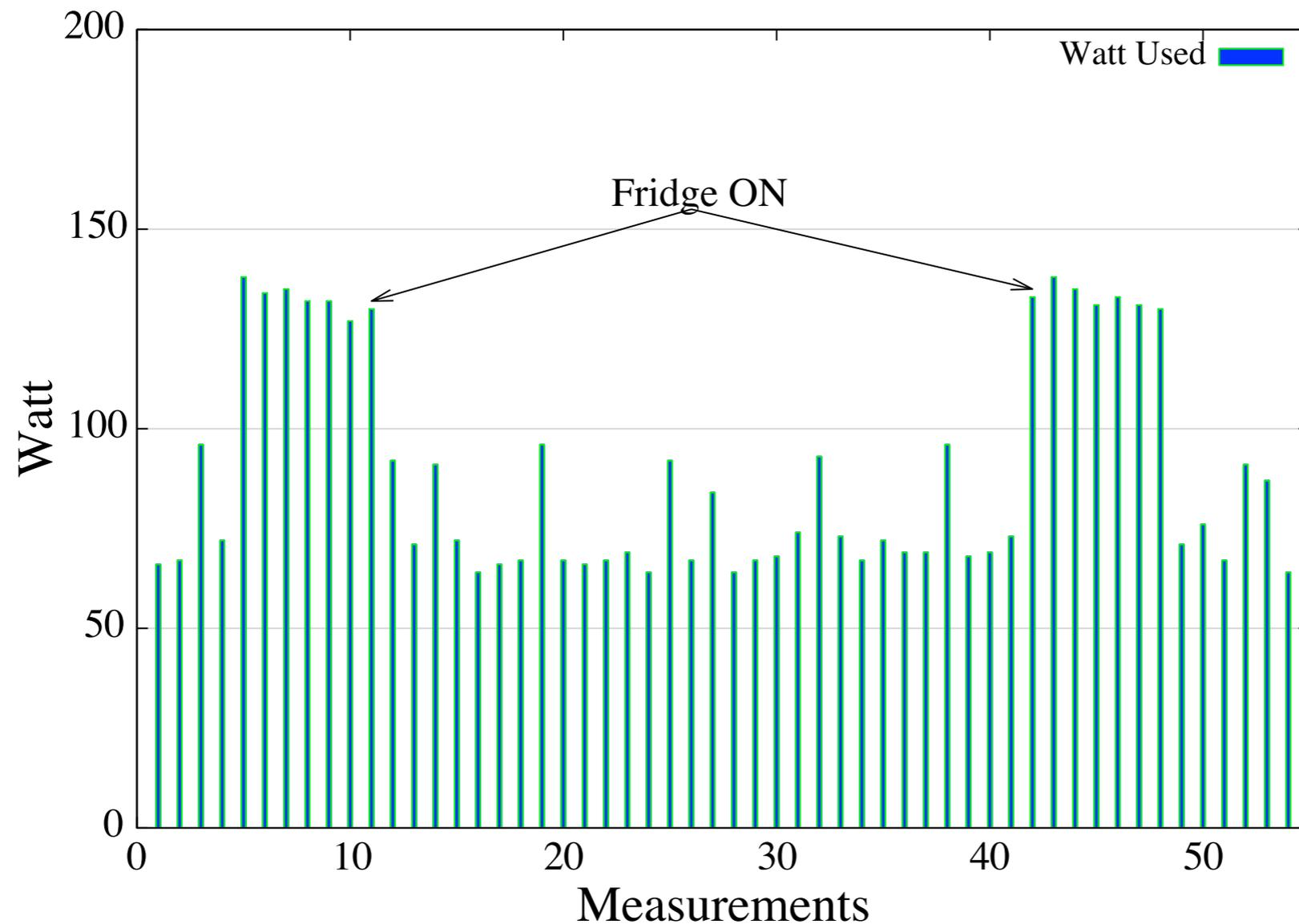
- Your Meter becomes Smart.
- You know in real-time your consumes.
- You could forecast your bill amount.
- You can save energy.
- It is quite cheap.

Cons

- Read-Only

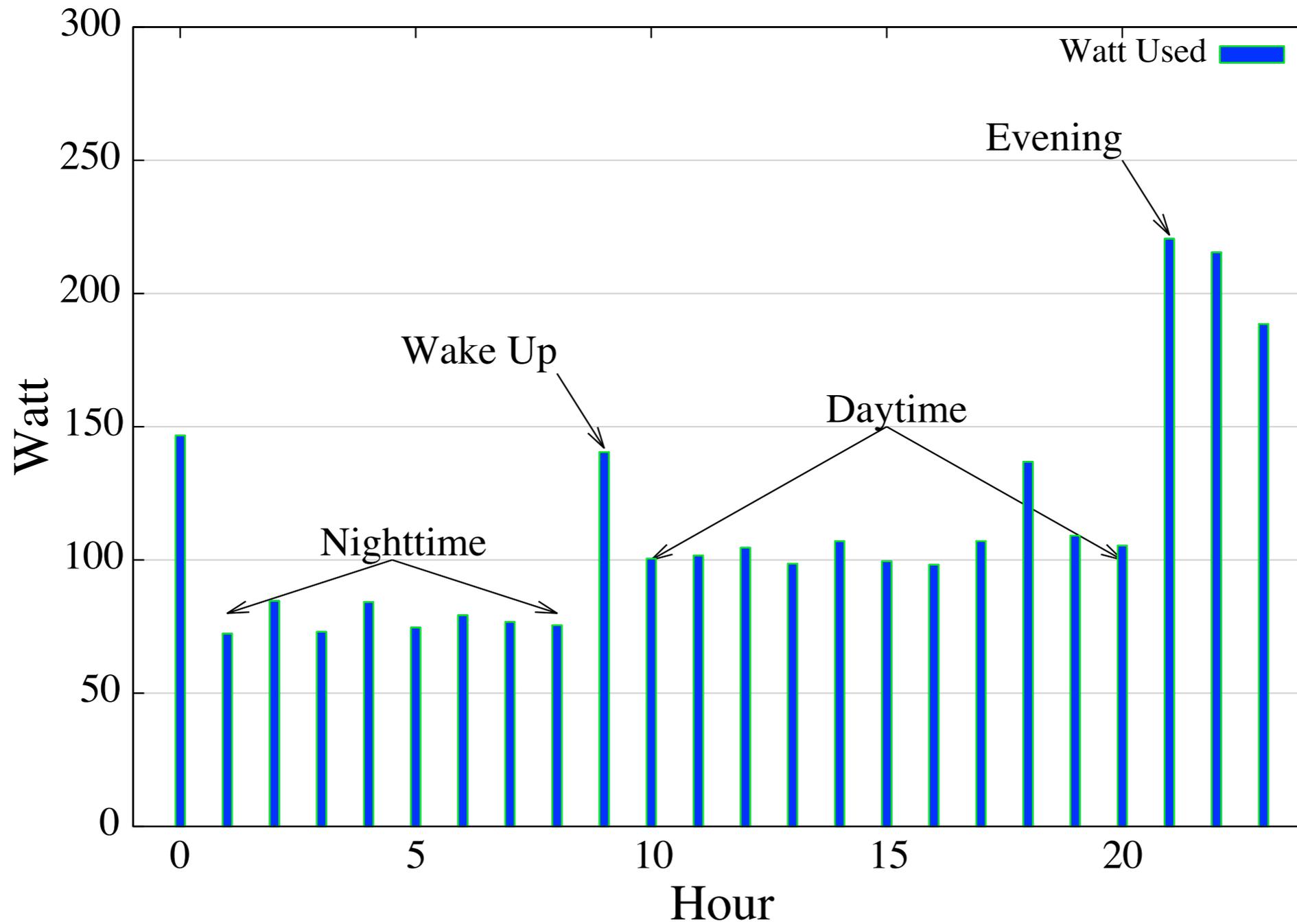
Smart Meters - Privacy Study

- Data-set of two months.
- We monitored my flat consumes



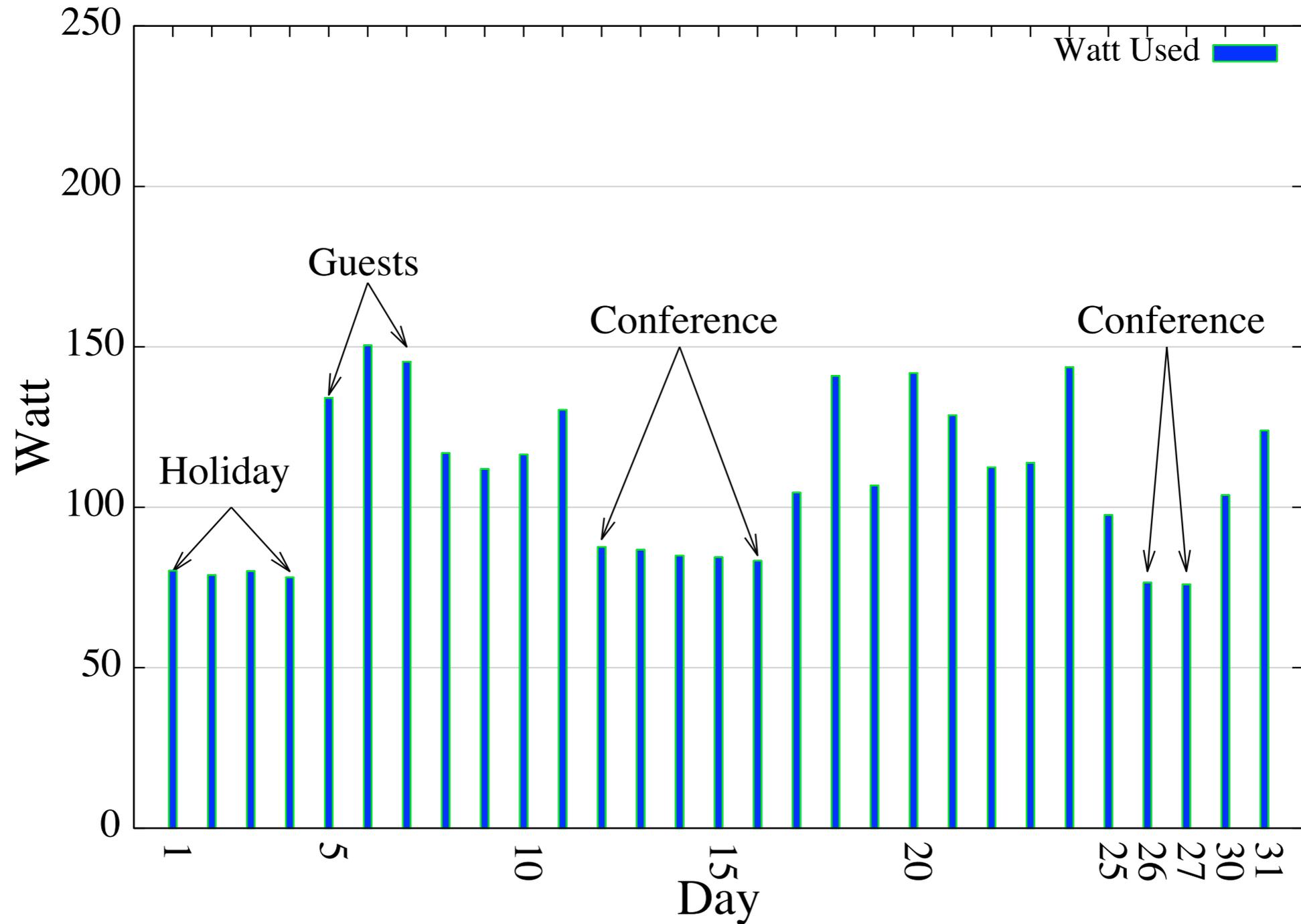
**One-Hour
Monitoring**

Smart Meters - Privacy Study



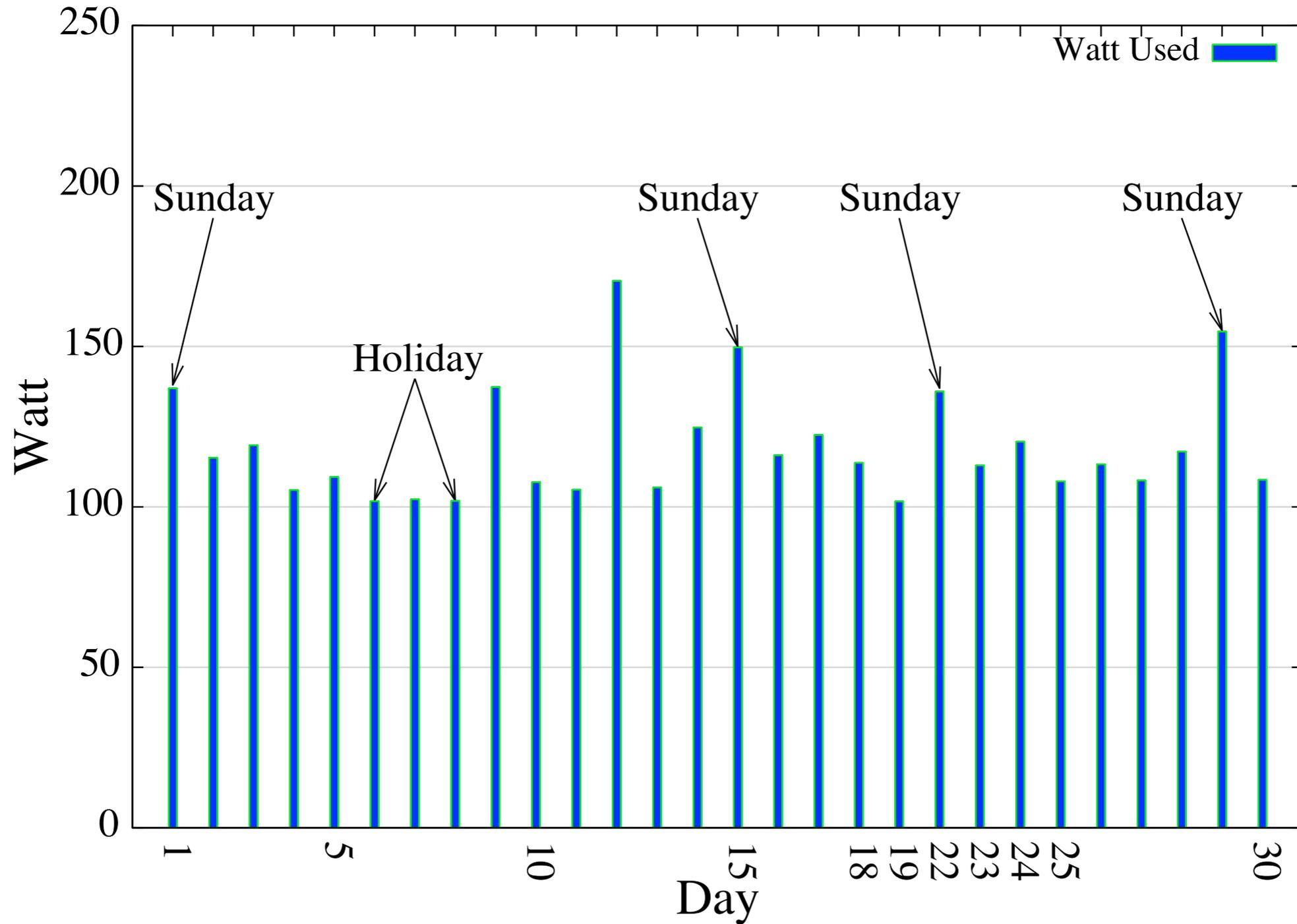
One-day Monitoring

Smart Meters - Privacy Study



Flat consumes in May

Smart Meters - Privacy Study



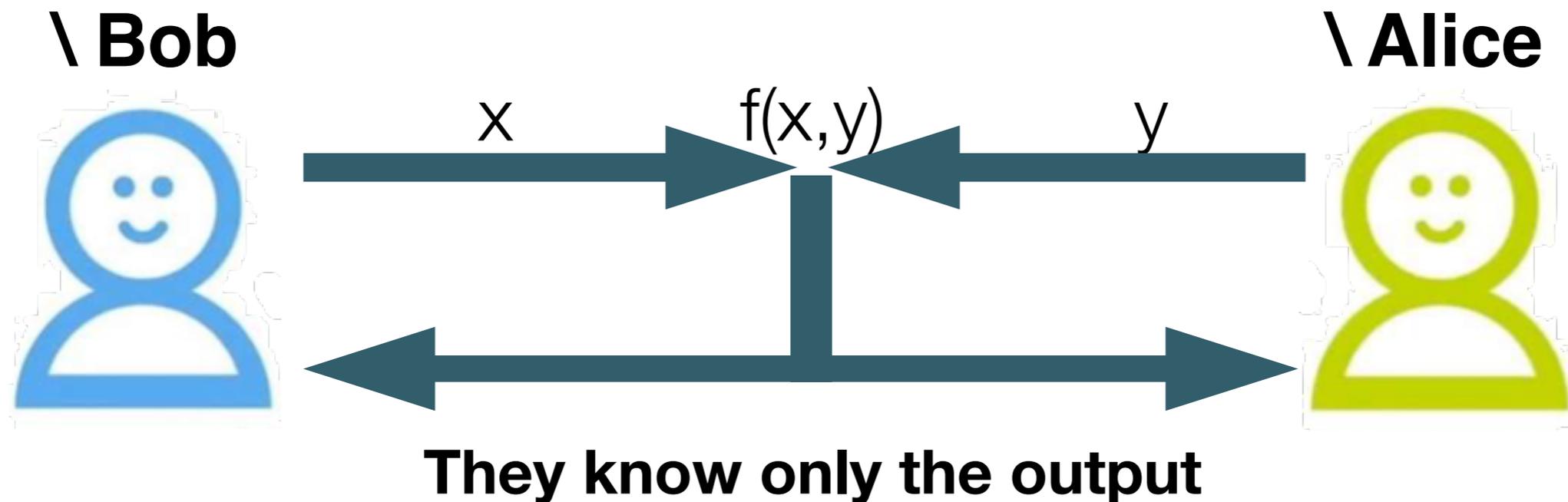
Flat consumes in June

Smart Meters - Privacy Issue

- An Energy provider is able **to profile its customers**
- It may know when people are **in** or **out**, and what they are doing?
 - Watching TV
 - Using Hairdryer
 - ...
- And if your **Smart Meter is hacked?**
 - Same things above but much bigger problems

Smart Meters - Privacy Solution

- We use Secure-Two party Computation (STC) to mitigate the privacy issue
- STC in brief...



Smart Meters - Privacy Solution Implementation

\ Energy
Provider

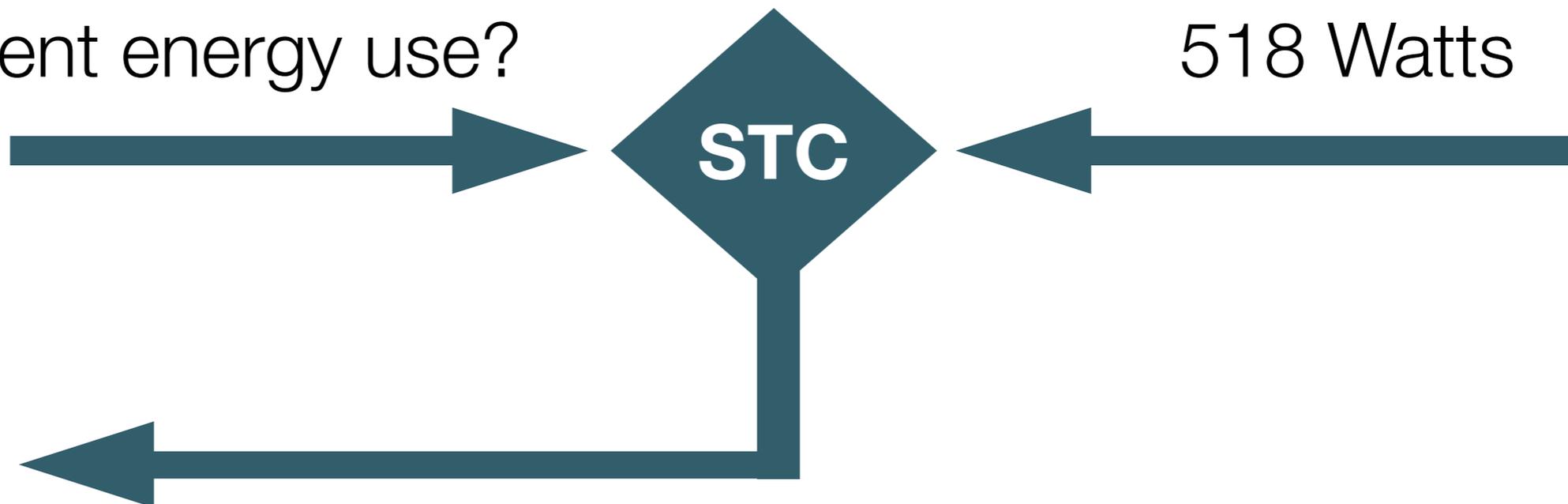


\ Customer



Your current energy use?

518 Watts



$0 < \text{Energy Used} < 1000$

Smart Meters - Privacy Solution

\ Customer



- CBMC-GC as STC framework
- Installed Both on Raspberry Pi and Energy Provider (simulated with a Virtual Machine)
- **Running Time**: 40sec.

```
int range(int x, int y, int z, int t)
{
    int output = 0;
    if ((x >= 0) && (x <= y))
        output = 1;
    else if ((x > y) && (x <= z))
        output = 2;
    else if ((x > z) && (x <= t))
        output = 3;
    return output;
}

void meterCheck(int INPUT_A_x, int
    INPUT_B_int1, int INPUT_B_int2, int
    INPUT_B_int3)
{
    int OUTPUT_meterCheck = range(INPUT_A_x,
    INPUT_B_int1, INPUT_B_int2,
    INPUT_B_int3);
}
```

STC function written in C

Conclusion

- In **theory** Smart Meters have more than 5 years. In **practice**, we will have Smart Meters installed at home by 2020 (maybe...)
- In this talk, we have seen a way to turn our meter into a Smart one.
- Moreover, we have focused this talk on a **privacy issue** that may hit customers.
- Finally, we have developed a solution **to mitigate** the privacy issue using STC.