

Using Zabbix in an IoT Architecture

...with the right hardware

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Presentation

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GRUPPO FINMATICA



Systematica is the tech subsidiary of **Gruppo Finmatica**

Developing and supporting software for Government and Healthcare organizations.

Zabbix is used since 2009 to monitor systems and applications deployed on our customers.

ZABBIX 2017
Conference



What is IoT ?

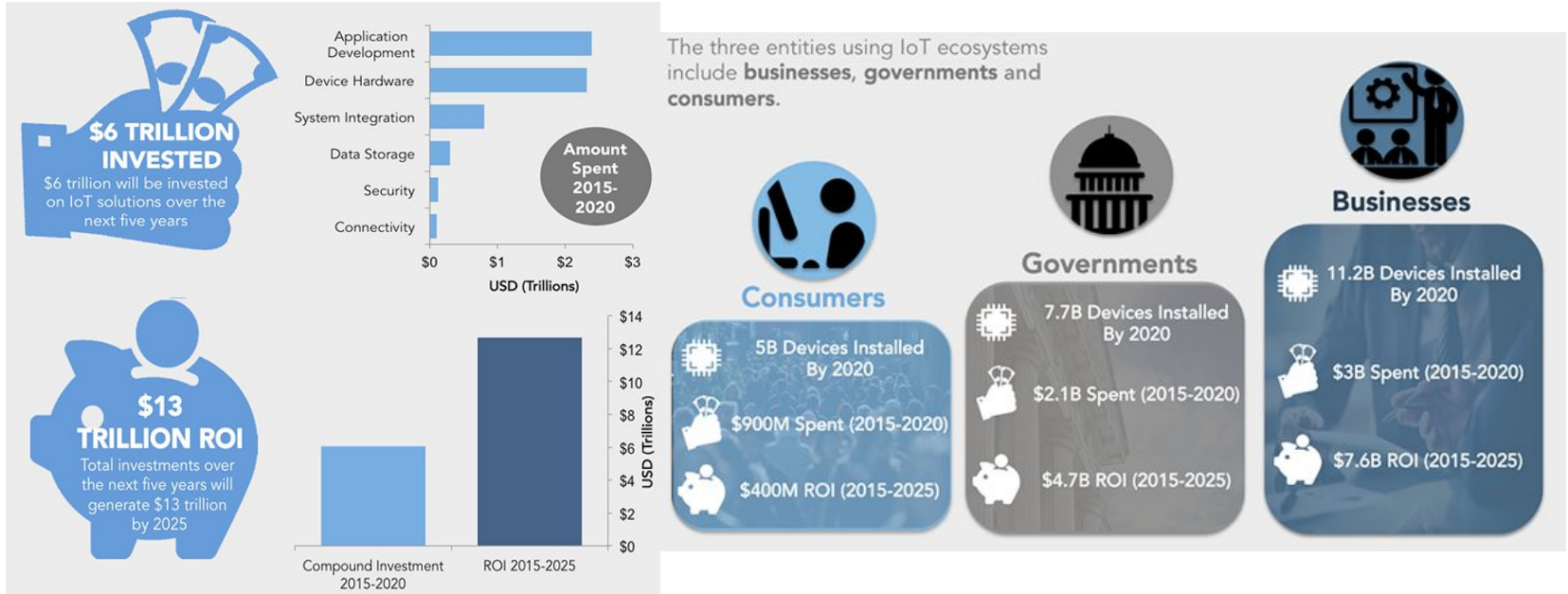
(Internet of Things)

IoT describe a new way to interact with things around us.

IoT is a “revolutionary evolution” beyond machine-to-machine communications (M2M): it permits high connectivity of sensors, devices and systems.

IoT is DATA, a huge amount of **Data** that can be use to take decisions.

Is IoT the future?





Different type of IoT

IoT is a technology used in two different ways

- **IoT in Consumer marketplace**
Mobile Phones, Bracelets, GPS, home automation etc...
- **IoT in Industry and SmartCities**
Energy Management, Industry Automation, Environment monitoring

Two different ways to use the same
technology, with **different goals**



IoT in Consumer MarketPlace

Many vendors in an extreme competitive market.

Lack of standards, every vendor has its technology and way to use and analyze data.

A **LOT** of data to collect and analyze, a job for Big Data Analysts and Data Scientists.



IoT for Industry and SmartCities

Mostly based on legacy and custom applications, it's the new hot trend nowadays¹, especially focused on Energy Management and Environment Monitor.

The technology chosen must be simple to install and integrate well with existing devices.

One of the application of IoT in industry and SmartCities is to analyze where energy is wasted to reduce cost and pollution.

1. https://en.wikipedia.org/wiki/Smart_city
https://en.wikipedia.org/wiki/Industry_4.0



The way we have chosen: **Industry and SmartCities**

Consumer IoT is for big players who start from creating the device to the data analysis (Google, Fitbit, Neuroio, etc...).

People expect a simple way to interact with a device, don't ask for customization but choose the device by cost or fashion.

Industry and SmartCities want custom project, designed and ready to be modified to satisfy new needs.

Data must be always available (OpenData) and exportable (Cost analysis, accounting, etc...).



What **Industry** wants

It is preferable to be able to use existing sensors

Hardware used must work in a noisy and dusty environment (no fan)

Is better if hardware can be fixed in a DIN slide inside a box (no PC or caseless device)

The solution must work with minimal maintenance

Collected data may be available to be used for internal analysis





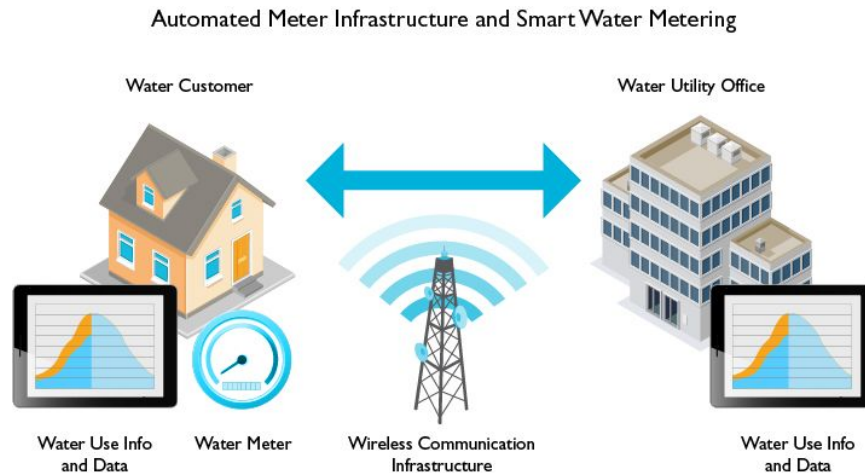
What SmartCities wants

Project must be modular, start small and grow over time

The technology used is preferably to be Open Source

Data must be readable and reusable (OpenData)

The software must be simple to use and supported for a long time



Sensors in industry and SmartCities

The big part of sensors used in industry automation or environment monitoring use a communication protocol called MODBUS.

Some sensor are based on SNMP, via ethernet or WiFi.

Other have proprietary way to collect data and a set of API to retrieve those.

A IoT gateway must be able to collect data in different ways.



Can Zabbix be use for it

YES

Can Zabbix be use for it

YES

But with the right hardware



Pros of Zabbix

- **Distributed monitoring by proxy**
To be able to create a network of (proxy) gateways and collect data in a safe place.
- **Custom items**
To pull data in different ways from different sensors (SNMP, MODBUS, scripts)
- **Open Database schema**
To extract data with common reports utility
- **API**
Integrate with other portal (ex: Grafana) and automatic configuration of hosts/items
- **Low footprint for proxy and agent**
Can be installed on small appliance
- **Proxy run on Linux and require minimal configuration**



Three challenges

1. ModBus protocol, what is it and how can I retrieve data?
2. Remote and easy configuration when sensors are added/removed
3. Hardware of gateway must be usable in an industry environment (*no fan, protected case, ability to fix in a box*)



ModBus

the standard of industry communication

<https://it.wikipedia.org/wiki/Modbus>

Used in many sensors, using only 2 or 4 wires (on RS485) and can be extend up to 1,2 Km.

From 1 up to 247 devices can be in a single cable line, every device can be polled for a lot of numeric and string data.

Supported in zabbix by a loadable module: <https://github.com/v-zhuravlev/libzbxmodbus>



Remote configuration of gateway

A gateway is a embedded hardware who have **Zabbix Proxy** installed.

Using Zabbix Proxy on a gateway device allow to change configuration from **Zabbix Server** when a new sensor is installed. No need to operate on gateway.

The configuration is stored on Zabbix Server. This enables us to simply change gateway if it breaks.

Zabbix Proxy can cache data in case of communication problem.



Hardware used for gateway device

To be compliant with the needs of an industrial environment we choose a modular product engineered and made in Italy:

The Gropius Multiutility Concentrator

Crafted by **SinTau**
<http://www.sintau.it>

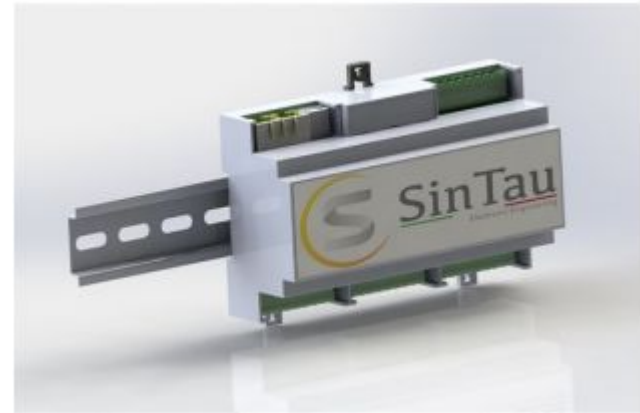




Gateway Hardware description

The Gropius MUC is a MultiUtility Concentrator performing the following features:

- very high performances
- Linux based system
- Gigabit Ethernet
- Flash base Storage
- GPRS\3G\4G
- WiFi IEEE 802.11 g\n
- RS485\CAN\SPI
- PLC HomePlugAV, HomeGreenPHY,G3



Hardware is modular and expandable and compatible with Zabbix Proxy and Agent 3.0.

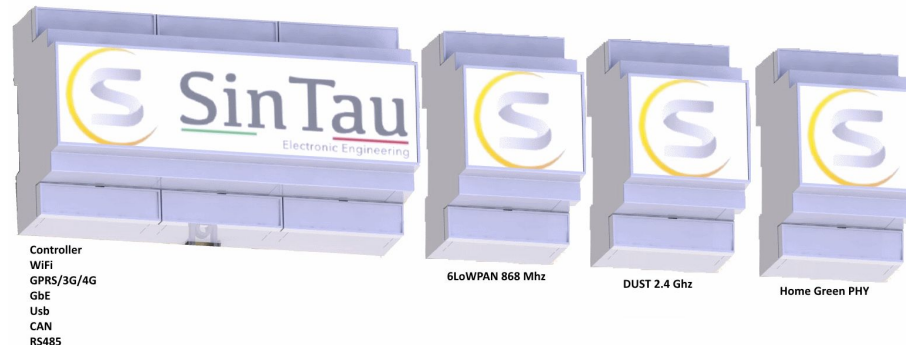
Gateway Hardware description

The main controller is based on an ARM processor running Linux Debian Embedded or OpenWRT. The system is provided with 2 Gigabit Ethernet, RS485, CAN bus, USB.

A number of communication modules are available in order to increase the interface capability and communication technologies.

6LoWPAN @868 Mhz and DUST @2.4 Ghz are already available.

HGP and WMBUS #169/868 Mhz are under development.





Use case for **Energy Management**

A company wants to measure and analyze energy consumption of the headquarter, distributed in two floors on the same building.

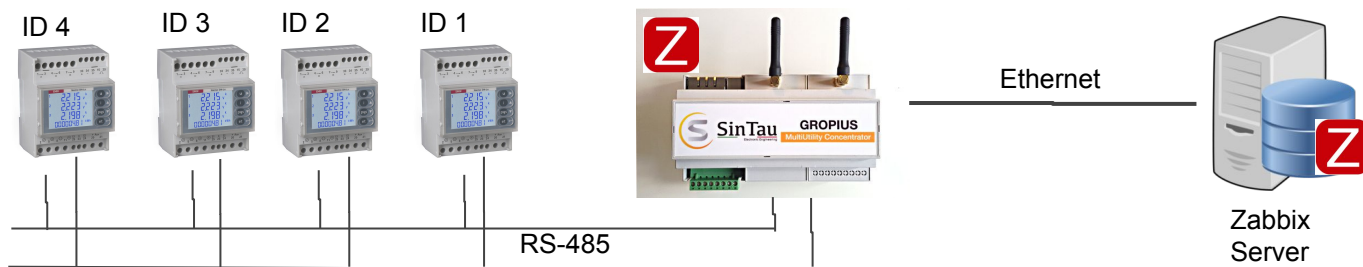
The building is separated in 9 different zones by electric fuse boxes.

Every fuse box has a **Nemo D4-Le Multifunction Indicator**, with Modbus output.

Using the ethernet cabling already present all the Multifunction Indicators was joined in a single bus and connected to the Gropius Gateway, on the modbus RS-485 port.



Logic Schema



Every multimeters is connected on the same bus and configured with a different ModBus ID

The Gropius Gateway has the ModBus hardware module installed and Modbus Zabbix loadable module compiled.

It's configured as Zabbix Proxy on Zabbix Server



Configuration on Zabbix Server

For every sensor an host is created and put under Gropius Proxy monitoring

A template is linked to the host with a **UserMacro** identifying the ModBus ID

The screenshot shows the Zabbix web interface for configuring a host. The 'Host' tab is active, showing the host name 'Quadro P1 PAL'. Under 'Groups', the 'IoT' group is selected. The 'Agent interfaces' section shows an interface with IP address '127.0.0.1' and port '10050'. Below this, the 'Host macros' section is visible, showing a macro definition: `{${MODBUS_ID}}` with a value of `2`. The 'Add' button is highlighted.



Configuration on Zabbix Server

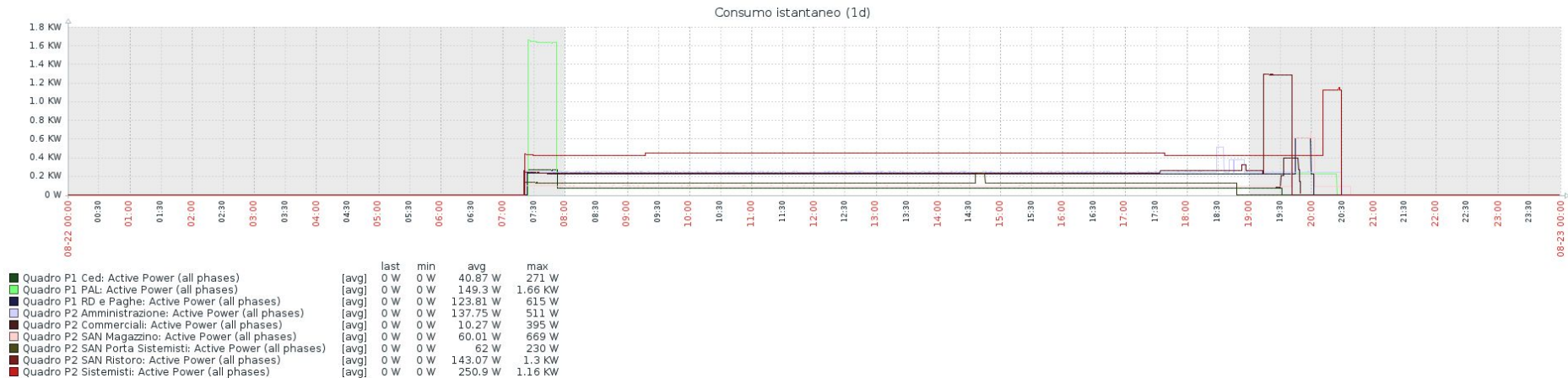
Items read the modbus registry of the measure*

Name	Active Power (all phases)
Type	Simple check ▼
Key	modbus_read_registers["/dev/ttyS1 9600 N",{\$MODBUS_ID}0x1518,3,I,1,0]
Host interface	127.0.0.1 : 10050 ▼
User name	
Password	
Type of information	Numeric (float) ▼
Units	W
Use custom multiplier	<input type="checkbox"/> 1
Update interval (in sec)	60

*Look at the modbus module ReadMe for the items key syntax.

Load modbus module on zabbix agent to test with zabbix_get utility:

```
root@gropius:~# zabbix_get -s localhost -kmodbus_read_registers["/dev/ttyS1 9600 N",9,0x1518,3,I,1,0]
```



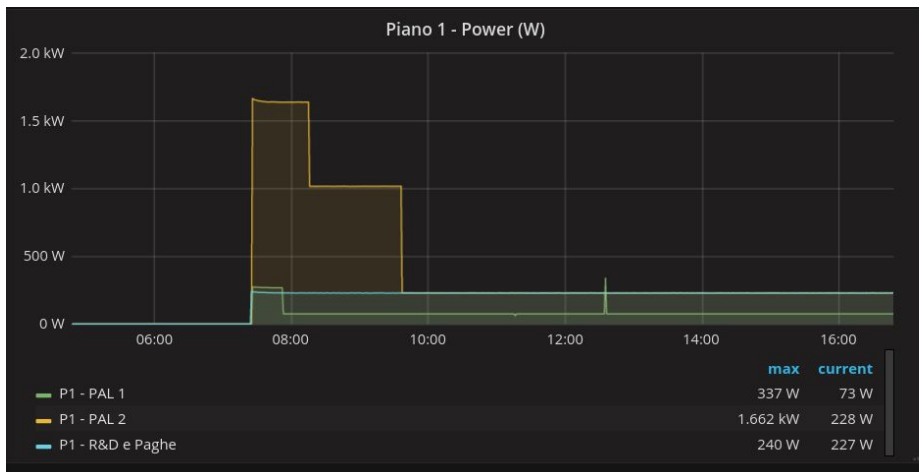
Example of **only lighting system** power consumption (all fuse box).

As you can see the office opens at 7:30 and close at 20:30 after cleaning. It seems that at 19:30 people need more artificial light.



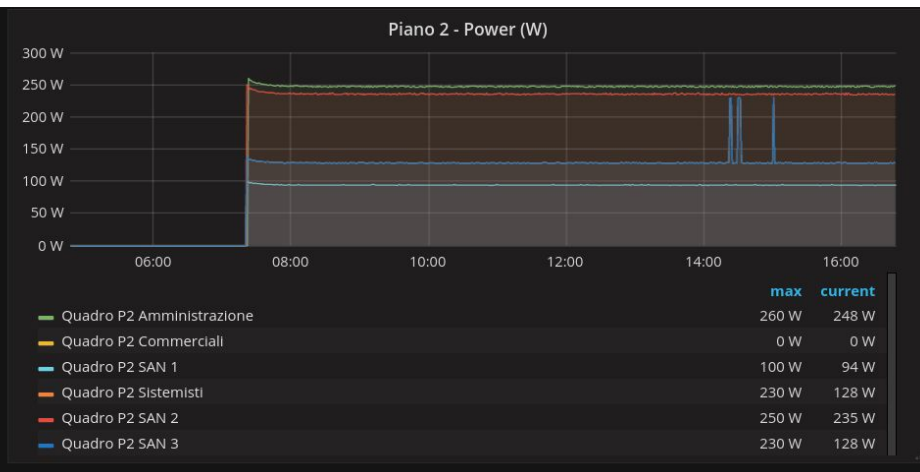
Latest Data

<input type="checkbox"/> Name ▲	Last check	Last value	Change	
▼ Power Measurement (7 Items)				
<input type="checkbox"/> Active Power (all phases)	2017-08-23 16:51:02	73 W	-1 W	Graph
<input type="checkbox"/> Ampere (phase 1)	2017-08-23 16:50:08	0.393 A		Graph
<input type="checkbox"/> Ampere (phase 2)	2017-08-23 16:50:12	0 A		Graph
<input type="checkbox"/> Ampere (phase 3)	2017-08-23 16:50:16	0 A		Graph
<input type="checkbox"/> Total Ampere (media 3 fasi)	2017-08-23 16:50:00	0.131 A		Graph
<input type="checkbox"/> Total Ampere (sum of Phases)	2017-08-23 16:50:21	0.393 A		Graph
<input type="checkbox"/> Total power used	2017-08-23 16:49:43	156.4 KWh		Graph



Consumo Attuale

1.66 kW



Totale Consumato

3.81 MWh

Same Data but with Grafana



Faced Challenge

Choosing the right sensor for the desired measures can be hard

Understand how to pull data from Modbus is another challenge, especially for people like us who are used to work with snmp, agent or databases.

Connecting sensors to gateway is a problem, it needs wiring work and that is not always feasible. Some new technology are out but need testing:

- **6LoWPAN**
- **DUST/WMBUS**



What we learned

Zabbix is not only a great server and network monitoring solution, but it can be used effectively in an IoT scenario.

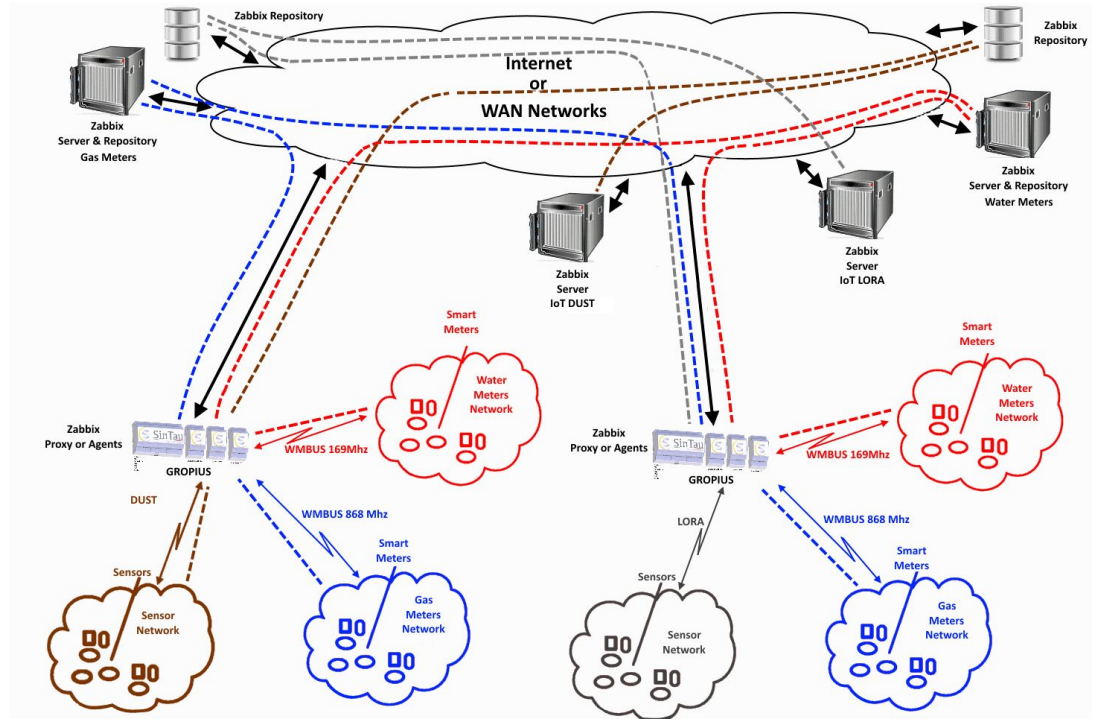
The architecture of Zabbix let us use it in embedded devices and in distributed monitoring simplifying a lot the deployment and configuration.

The API, the loadable modules and external check let us monitor everything and show data in different ways.

Future project

The chosen technology is ready to be use in any place where we need to read remote measurements and put in a single repository, ex. for billing purpose.

- Water meter
- Gas meter
- Any meter



Thank you!

support.zabbix@ads.it / www.systematicasrl.it

www.sintau.it

