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# Data Visualization for IoT Measurements without Third Party Involvement

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Zürich<sup>UZH</sup>**

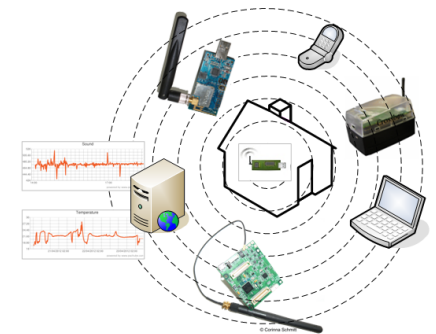


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[http://www.csg.uzh.ch/  
research/  
SecureWSN.html](http://www.csg.uzh.ch/research/SecureWSN.html)



# Motivation and Goal

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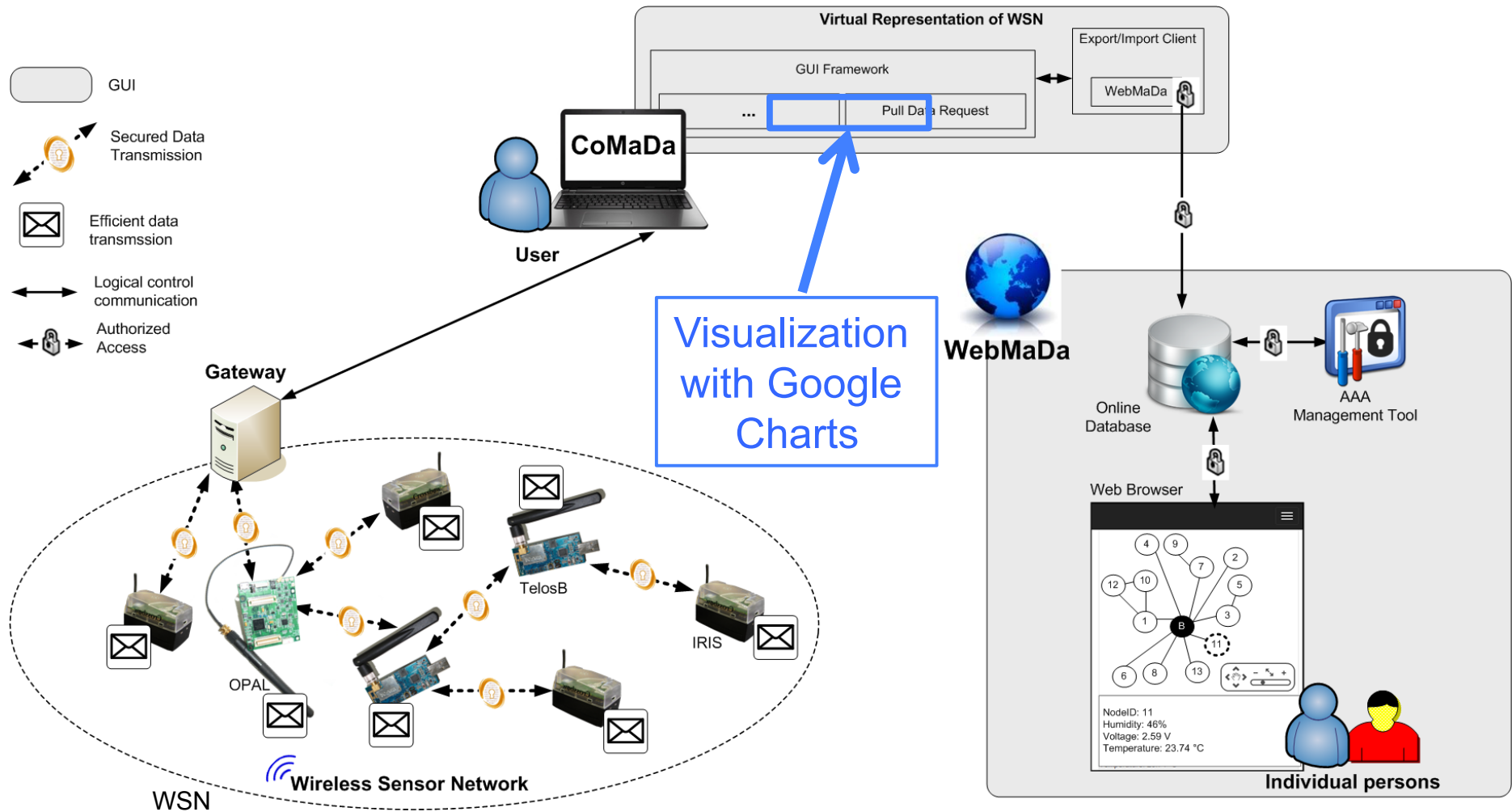
## □ **Motivation:**

- Number of IoT devices grow including Wireless Sensor Networks (WSN)
- Automatic measurements (PUSH) in pre-defined intervals
- Visualization in graphs preferred
- Flexibility in time-range specification

## □ **Goal:** Visualization without third party involvement

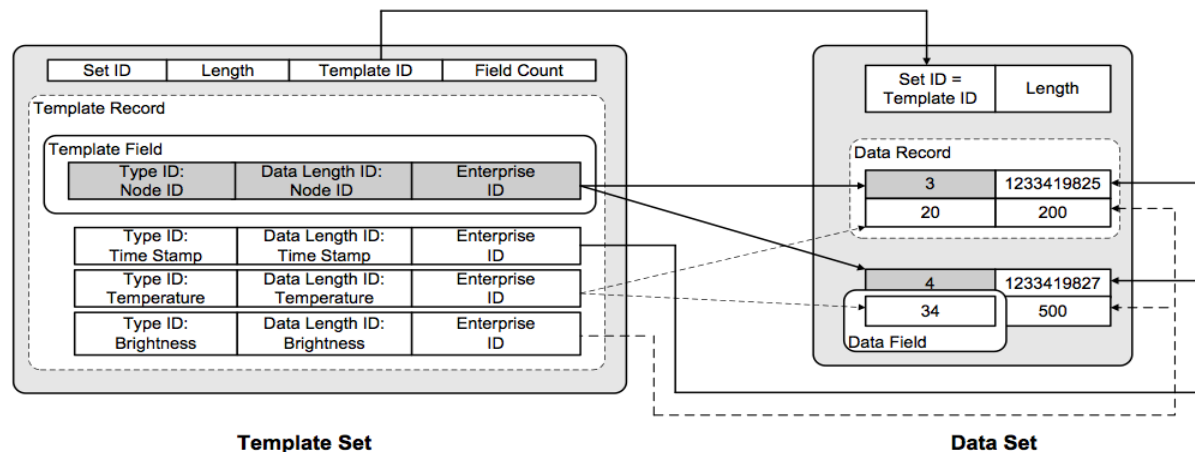
- Extend SecureWSN
- Exchange currently used third party Xively
- Support same functionality as Xively

# SecureWSN Architecture



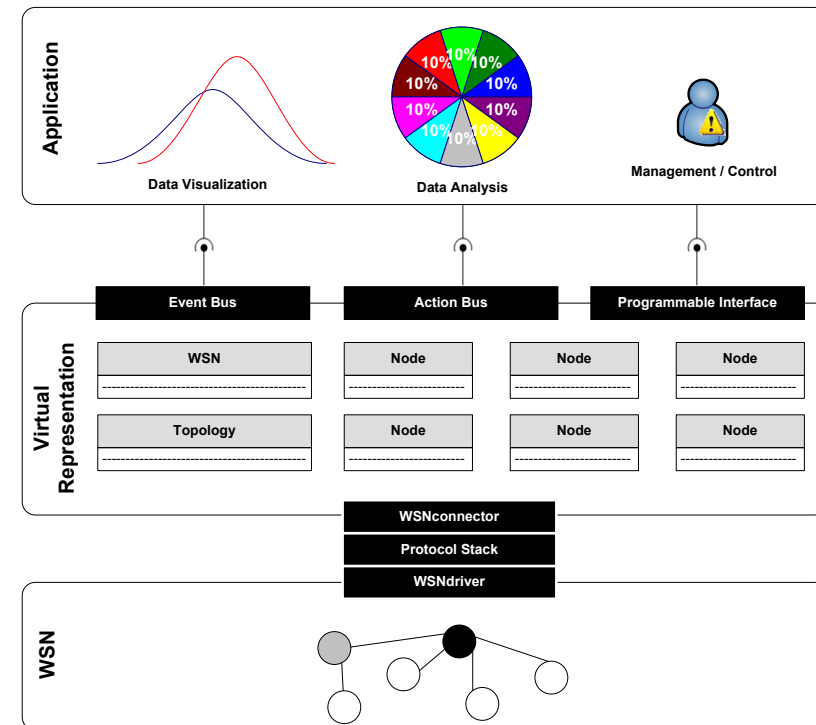
# TinyIPFIX Data Format in WSN

- ❑ Inspired by IP Flow Information Export (IPFIX) protocol (RFC 5101)
  - Push based
  - Template-based design → Separation of meta information and data
- ❑ Header compression to match constrained device's message size
- ❑ Aggregation support



# CoMaDa (Version 1.1)

- **C**onfiguration, **M**anagement, and **D**ata Handling
  - Virtual representation → Separation of program logic from drivers
  - Each WSN is linked to one CoMaDa component
  - Configuration of WSN components
  - Managing deployed network receiving network information
  - Stores and visualize data with third Party



# Visualization with Third Party Xively (1)

- ❑ Cloud Service
- ❑ IoT PaaS (Platform as a Service)
- ❑ 1 Device = 1 Feed
- ❑ API Endpoint for Feed

The screenshot displays the 'Development Devices' section of the Xively platform. At the top, there are three device cards: '2015-03-02-telos-55', 'noack-telos-01', and 'noack-telos-02'. The first device is selected, showing its details: 'Private Device', 'Product ID', 'Product Secret', 'Serial Number', and 'Activation Code'. It is 'Activated' at 05-03-2015 12:01:06. A 'Deploy' button is visible. Below the device details, a 'Channels' section lists 'Humidity', 'NodeID', 'NodeTime', 'Temperature', 'Type', and 'Voltage'. A callout box highlights the 'Feed ID', 'Feed URL', and 'API Endpoint' for the selected device. The 'API Keys' section shows an auto-generated key for the feed.

| Device              | Feed ID    | Feed URL                                     | API Endpoint                               |
|---------------------|------------|--|--|
| 2015-03-02-telos-55 | 1914010350 | https://personal.xively.com/feeds/1914010350 | https://api.xively.com/v2/feeds/1914010350 |

| Channel     | Value     |
|-------------|-----------|
| Humidity    |           |
| NodeID      | 16.0      |
| NodeTime    | 714.0 sec |
| Temperature | 33.84 C   |
| Type        | 0.0       |
| Voltage     | 2.92 V    |

| API Key   |
|---|
| Auto-generated 2015-03-02-telos-99 device key for feed 1914010350 |
| llyISPCmsemjMYhOKKC3lqTnopoPiozLxlyIDFawnrvrVAVb                  |
| permissions READ,UPDATE,CREATE,DELETE                             |
| private access  |

# Visualization with Third Party Xively (2)

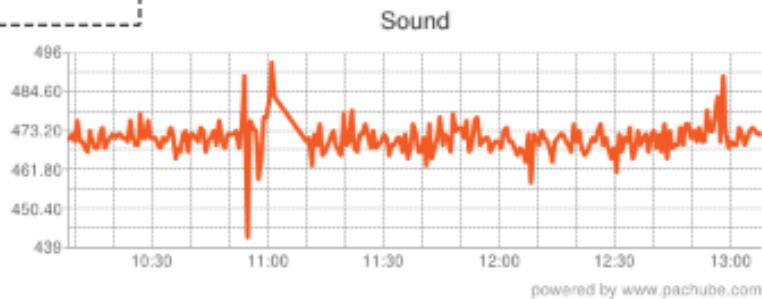
120508-1106 (Public)

Node: 1106

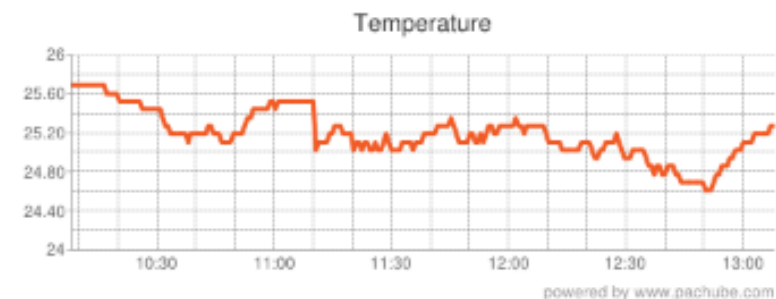
NodeID 1106  
Sound (MTS300) 464  
Temperature 25.19 °C  
NodeTime 14283 sec

Information:

Cosm-Uploads: 565



X 3 hours image link



X 3 hours image link

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# Visualization with Third Party Xively (3)

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## □ Features

- Visualize data of an (old) feed with a line chart
- Add/Remove nodes
- Add/Remove fields/channels
  - Humidity
  - Temperature
- Filter
  - Show last 5 minutes
  - Show 30 minutes
  - Show 1 hour
  - Etc.
- Download charts

## □ Drawbacks

- Fast-changing API
- Need for internet connection/ Network overhead
- Privacy issues (Third party)
- Authentication/ Storing Credentials
- Only Static PNGs

Visualization without third party involvement!

Google Charts

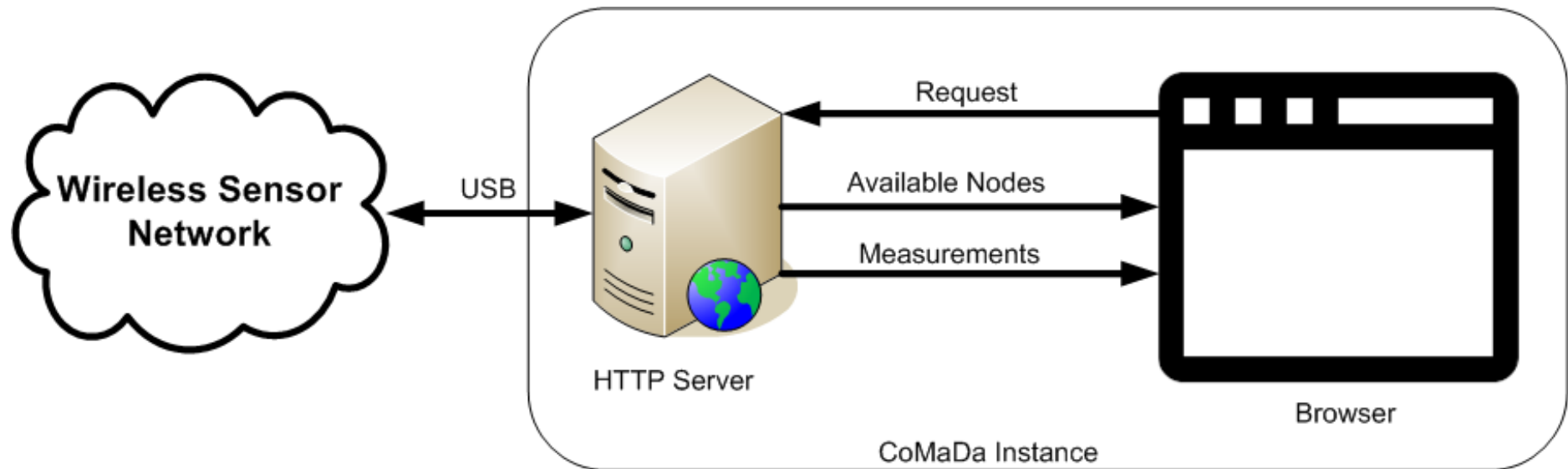
# Google Charts

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- ❑ It's Free!
- ❑ No REST-API
- ❑ JavaScript library
- ❑ SVG, HTML5 or VML (Vector Markup Language)
- ❑ Interactive charts
- ❑ Real-time data visualization
- ❑ Highly modifiable charts
- ❑ Based on data tables
- ❑ Generate static PNGs
- ❑ Simple Filters
- ❑ Extensive Documentation
- ❑ Popular

# Integration into CoMaDa

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# Visualization of Data (1)

Available Nodes (last updated at 21:45:25): [Update](#)

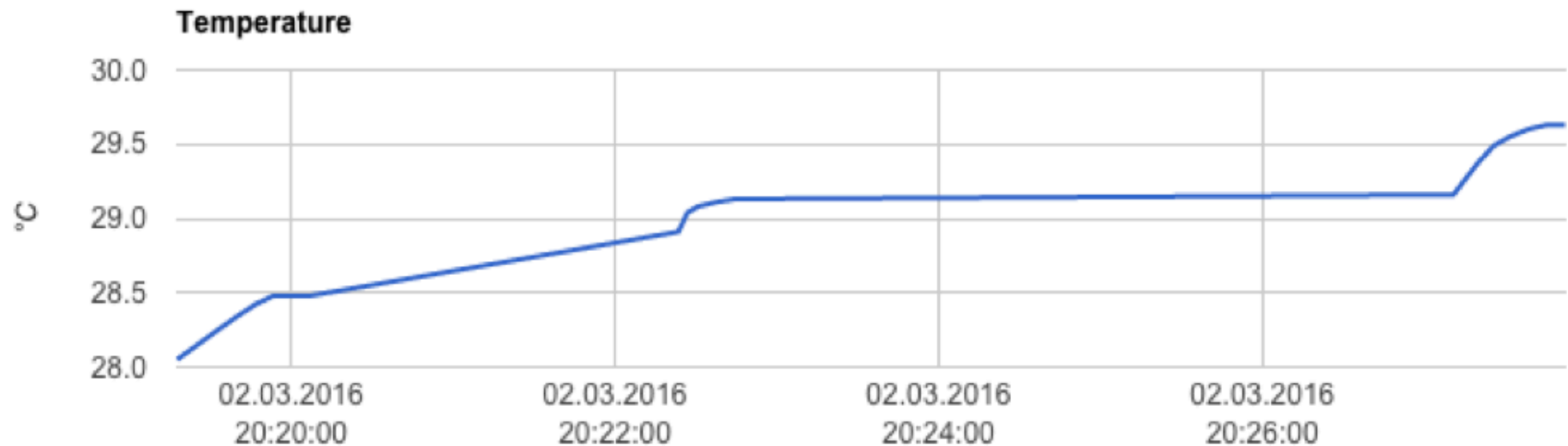
12 + 55 +

Node 66

x



# Visualization of Data (2)



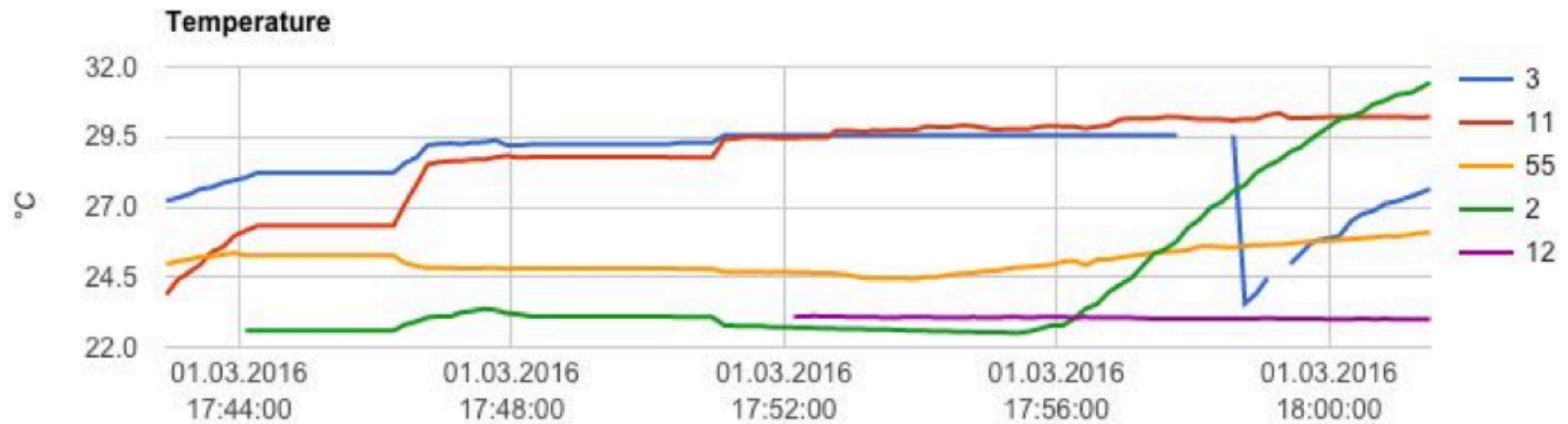
Time **02.03.2016 20:00:00**   **02.03.2016 20:35:00**

First data point received at: 23.02.2016 21:45:14

Show data from:  to:

# Visualization of Data (3)

x



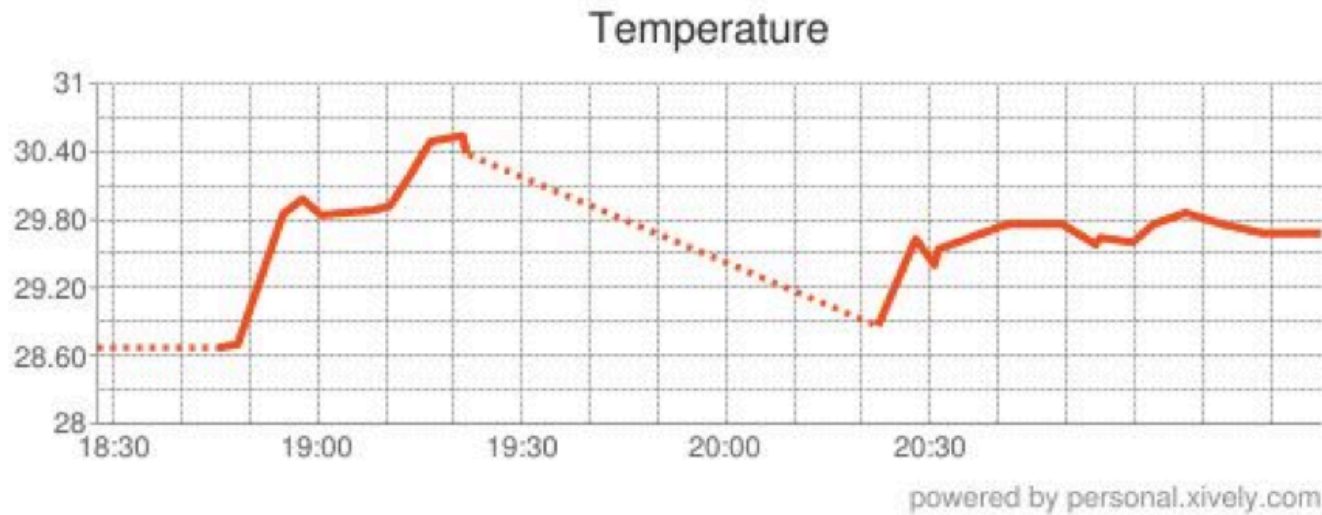
Time **01.03.2016 17:42:56**  **01.03.2016 18:01:30**

Show data from:  to:

[Reset filter](#)

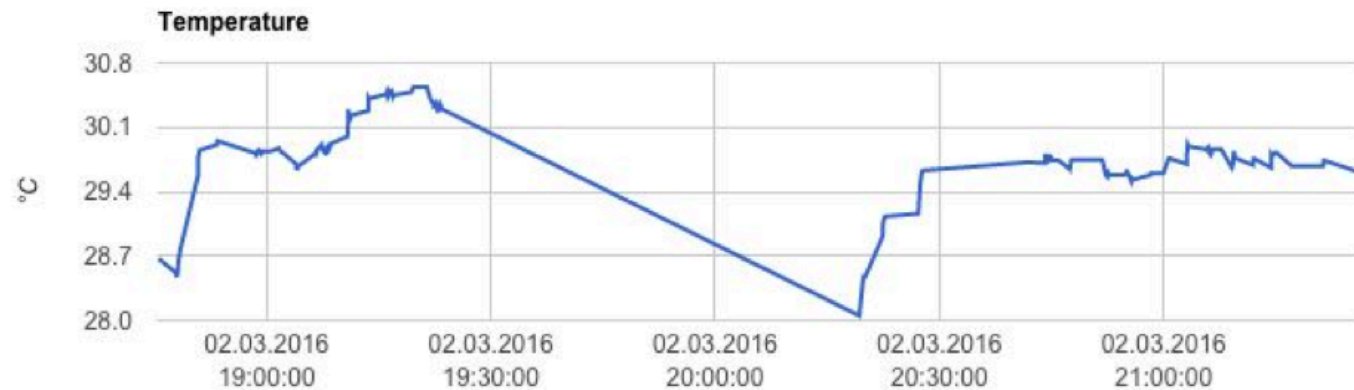
[Link to snapshot](#)

# Google Charts vs Xively Visualization



Xively

Google  
Charts



# Conclusion

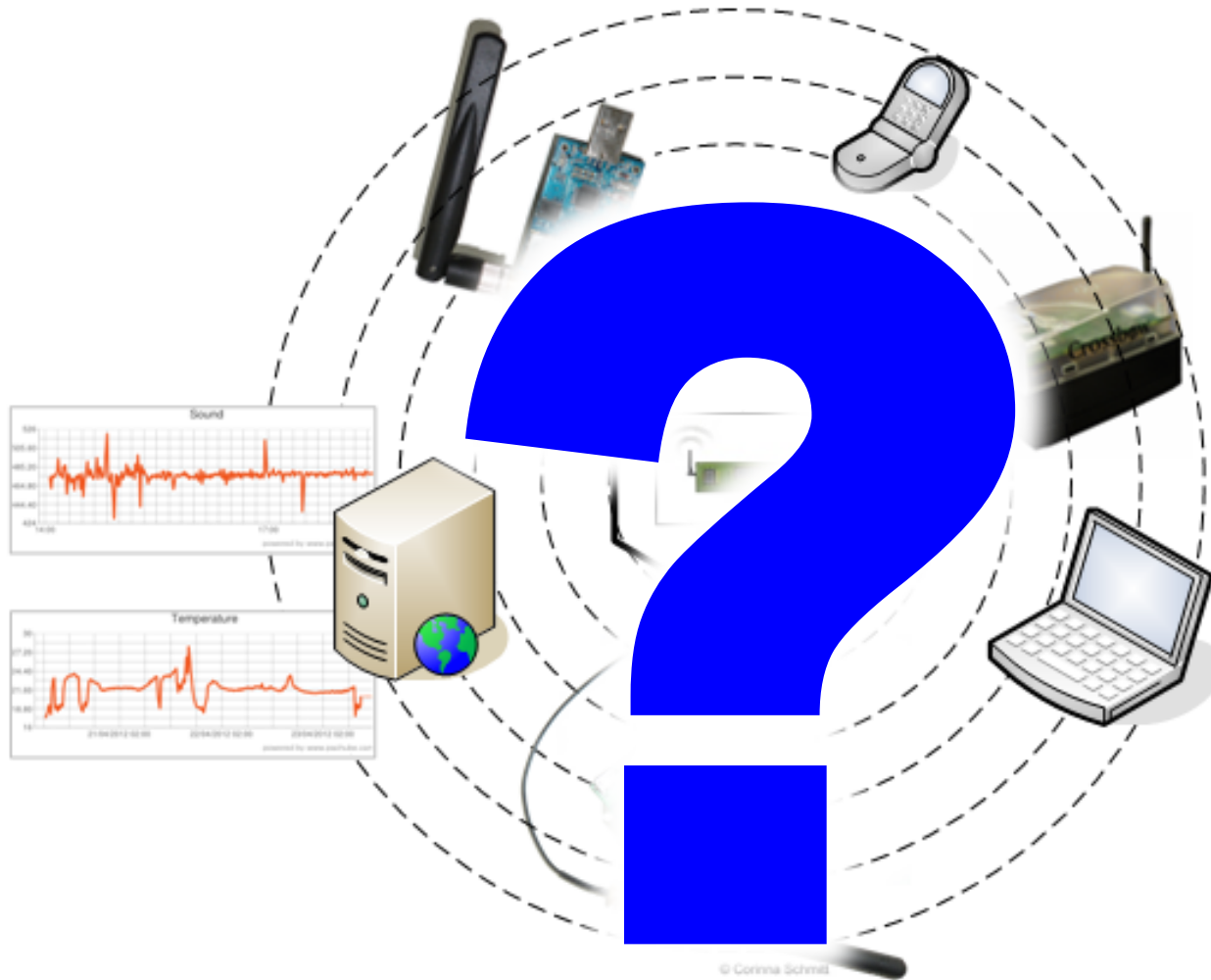
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- ❑ Successful exchange of third party visualization!
- ❑ All Drawbacks eliminated
- ❑ All original features supported and extended
  - Layered Charts
  - Dynamic Snapshots possible
- ❑ Flexible adjustments of other sensor data
- ❑ No security issues due to database running on CoMaDa instance without connection to the outside
  
- ❑ Future work
  - Integration in WebMaDa supporting mobile access
  - Visualization of older data → database solution is needed
  - Support for upcoming measurement types



# Thanks ...

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# References

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- ❑ SecureWSN: <http://www.csg.uzh.ch/research/SecureWSN.html>
- ❑ Tim Strasser: Offline Method for Graphical Visualization of Sensor Data; Universität Zürich, Communication Systems Group, Department of Informatics, Zürich, Switzerland, March 2016, URL: <https://files.ifi.uzh.ch/CSG/staff/schmitt/Extern/Theses/Tim-Strasser-VA.pdf>
- ❑ C.Schmitt, A.Freitag, G.Carle: *CoMaDa: An Adaptive Framework with Graphical Support for Configuration, Management, and Data Handling Tasks for Wireless Sensor Networks*, 9th International Conference on Network and Service Management (CNSM), IFIP, Zurich (CH), ISBN: 978-3-901882-53-1, pp. 211-218, October 2013