

# GreenClouds

Karel van der Veldt, Hao Zhu, Paola Grosso, Cees de Laat  
System and Network Engineering Group, University of Amsterdam

## Problem Statement

ICT today is responsible for approximately 2% of the global carbon emissions, and is expected to overtake the airline industry in the near future. The question arises how much of the power consumed by ICT infrastructure (computer networks, clusters, and clouds) is spent well, how much is wasted, and how we can improve the overall energy efficiency.

To answer these questions, we are developing the GreenSONAR architecture, capable of measuring and publishing power and performance metrics of ICT infrastructures. The collected data is semantically annotated using the Energy Description Language (EDL). Using GreenSONAR and EDL, it becomes possible to analyze the behavior of large-scale ICT infrastructures, in order to answer the questions just raised, and ultimately to find solutions for reducing the carbon emissions of the global ICT world.

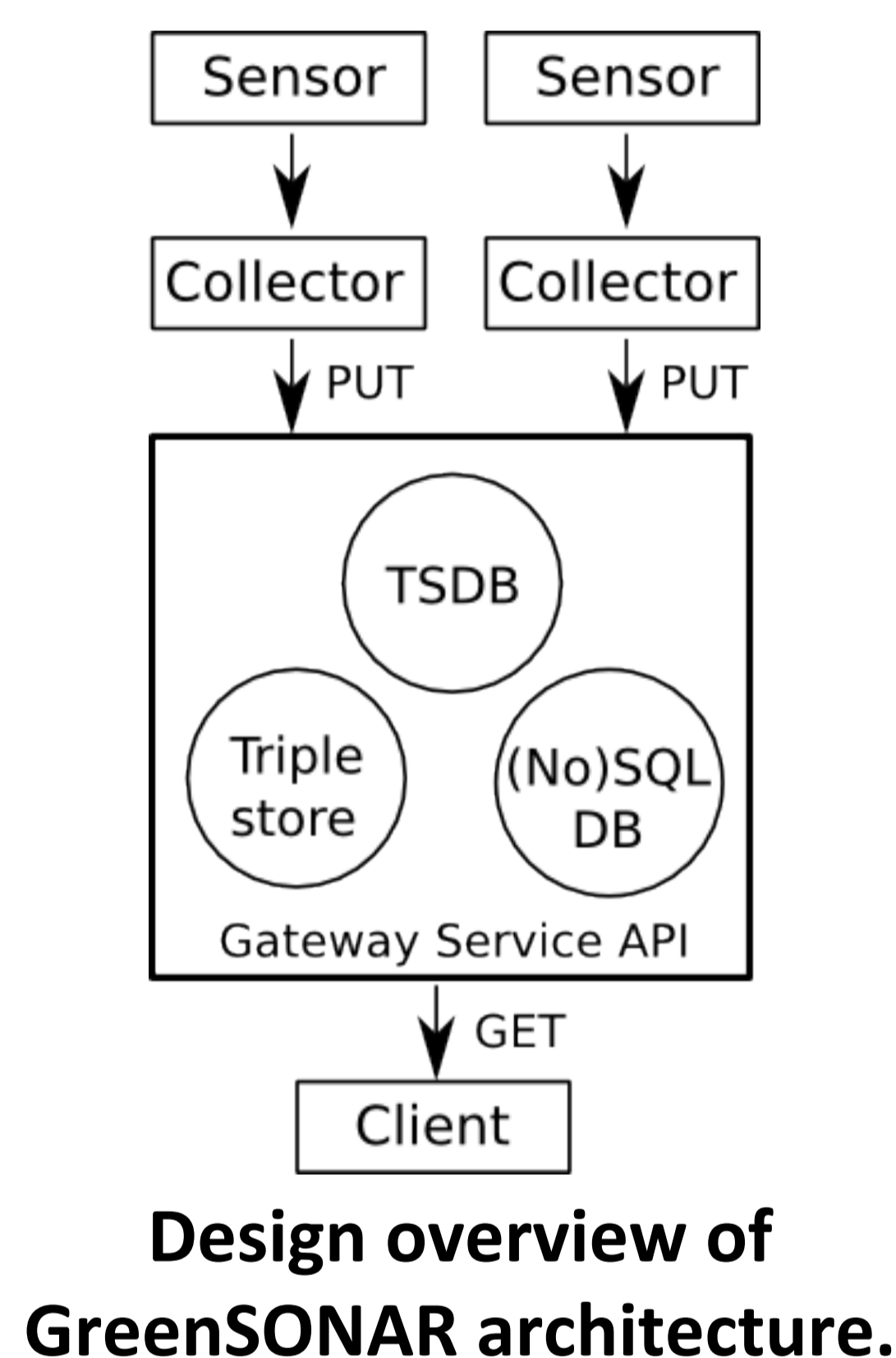
## GreenSONAR

GreenSONAR is a distributed service architecture, designed to monitor and publish power consumption and performance metrics of ICT infrastructure. The collected data is stored in a high performance time series database and is semantically annotated using EDL.

Using the GreenSONAR architecture, it will be possible to analyze the power usage and performance over time of large-scale computer infrastructures with the goal to reduce the overall power consumption and ultimately greenhouse gas emissions.

### Applications & Future Work

- Visualization
- Pattern detection
- Trend prediction
- Task scheduling
- "Green" path finding



## Collaborations

In the GreenClouds project we work together with the VU University, who research GPU-based methods for reducing the power consumption of HPC tasks.

We are looking for organisations who want to help us in our research by monitoring and analyzing their infrastructure using GreenSONAR. Currently we are starting collaboration with:

### Energy Sciences Network (USA)

High-speed optical computer networks for science.

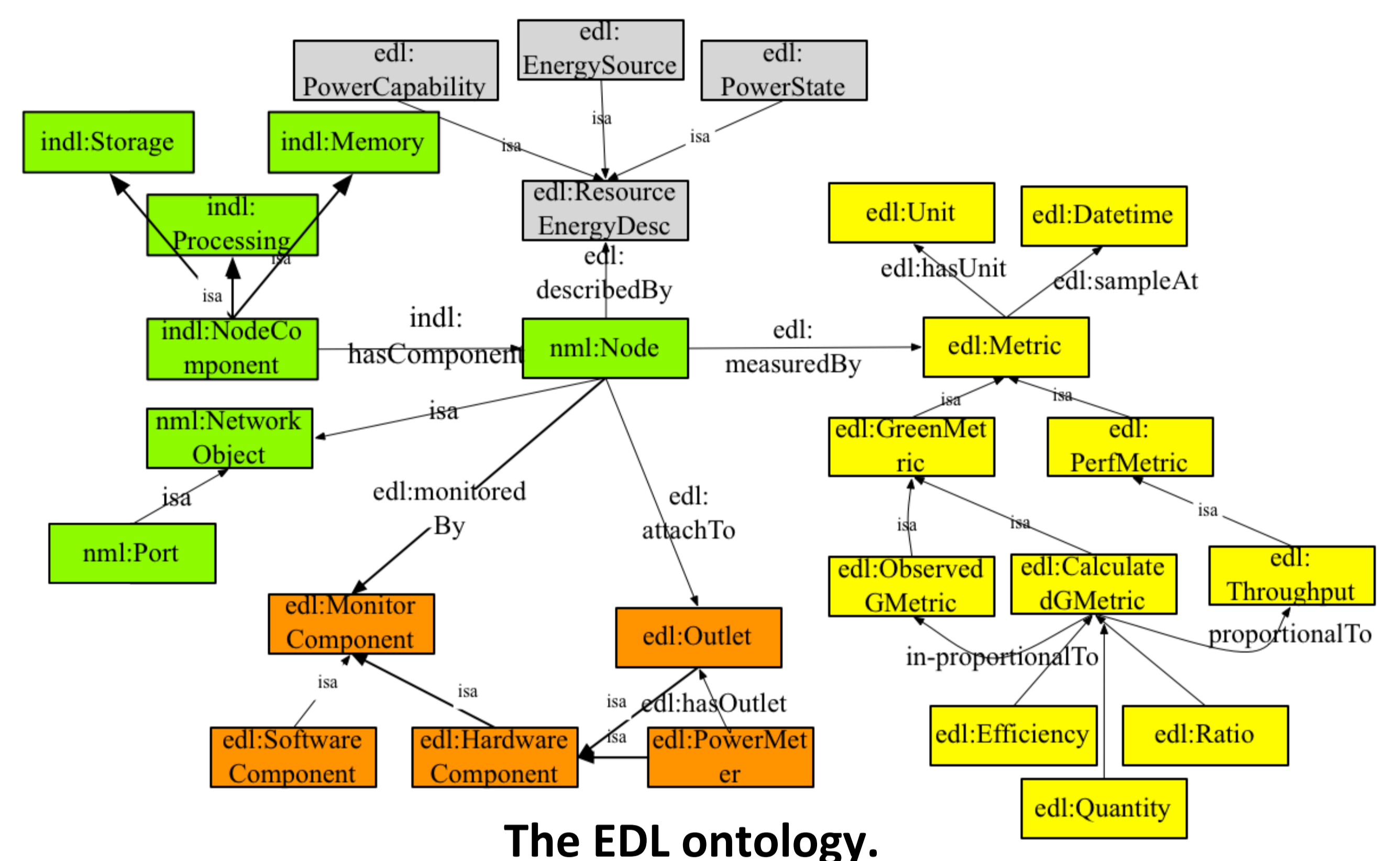
### ASTRON (NL)

GPU-based correlator cluster for LOFAR, due to become operational by december 2013.

## Acknowledgements

Netherlands Organisation for Scientific Research (NWO)

## Energy Description Language



EDL is an OWL ontology which represents the energy attributes of resources in distributed computing infrastructure and the relationships between them. EDL allows us to instantiate various energy metrics and their related attributes in a uniform and highly descriptive manner. EDL provides a consistent semantic description of various energy components.

The semantic description languages NML, INDL, and EDL are layered on top of each other, providing a complete description of topology, infrastructure, and energy characteristics thereof. NML and INDL are also developed at the SNE Group of the UvA.

## References

- Hao Zhu, Karel van der Veldt, Paola Grosso, Zhiming Zhao, Xiangke Liao and Cees de Laat. **Energy-aware semantic modeling for large scale infrastructures**. The IEEE International Conference on Green Computing and Communications (GreenCom 2012) Work In Progress Session, Nov. 2012, France.
- Pavlov, D., Soeurt, J., Grosso, P., Zhao, Z., van der Veldt, K., Zhu, H., de Laat, C., **Towards energy efficient data intensive computing using IEEE 802.3az**. The International Workshop on Data Intensive Scalable Computing Systems, Supercomputing 2012, Salt Lake City.
- Qingwen, C., Grosso, P., Veldt, K. van der, Laat, C.T.A.M. de, Hofman, R. & Bal, H.E. **Profiling energy consumption of VMs for green cloud computing**. The International Conference on Cloud and Green Computing (CGC2011), Dec 2011, Sydney.



Contact: {karel.vd.veldt, h.zhu, p.grosso, delaat}@uva.nl



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