Research
Smart Cities and EDA/CPE

Dominik Stiller

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1 Applications and Stories

"GeoSmart cities: Event-driven geoprocessing as enabler of smart cities" [1, p. 2]:

- Energy consumption profiles
- Concentration and distribution of pollutants
- Urban heat distribution caused by urban structures
- Energy efficient urban design
- Use of public transportation services
- Traffic flow of vehicles
- Movement of goods and freight
- Pedestrian's flow
- Use and load of telecommunication networks
- Presence of citizens in places of interest
- Livability
- Citizens living habits
- Citizen health monitoring

2 Event Definitions

"An occurrence of a change of state associated to a phenomenon of interest ($\mathbb{D}_p$), and which is related to a geographic location ($\mathbb{D}_s$) and a specific time ($\mathbb{D}_t$)." [1, p. 3]

$$\mathbb{D}_p = \{name : value, phenomena : [value_1, value_2, ..., value_n], condition : value\}$$
$$\mathbb{D}_s = \{extent : value, granularity : value\}$$
$$\mathbb{D}_t = \{time - window : value, granularity : value\}$$

3 Architectures

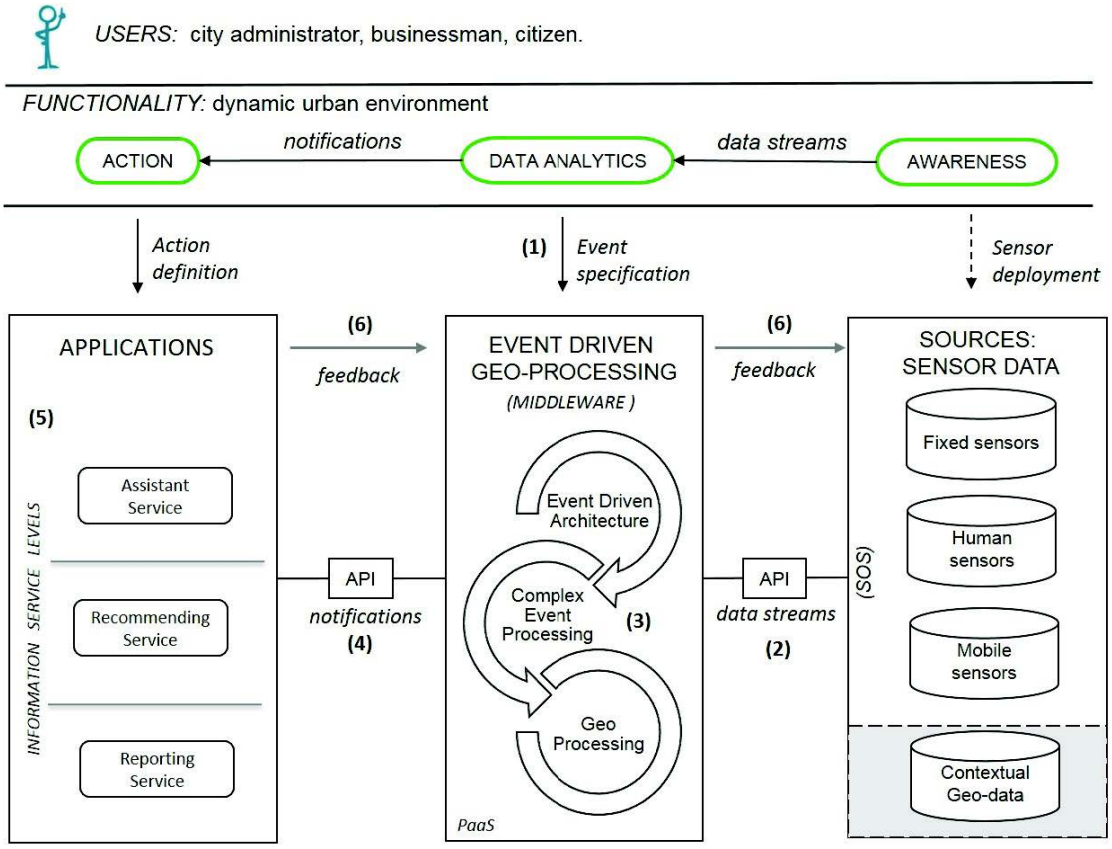

Figure 1: Event-driven geoprocessing system architecture [1, p. 3]

The architecture in Figures 2 and 3 is an instantiation of Figure 1 and was used with data from SmartSantander project to detect geospatial events, e.g. temperature above 0 °C in the city center. Mentions that Flink has good throughput but no geospatial matching capabilities.

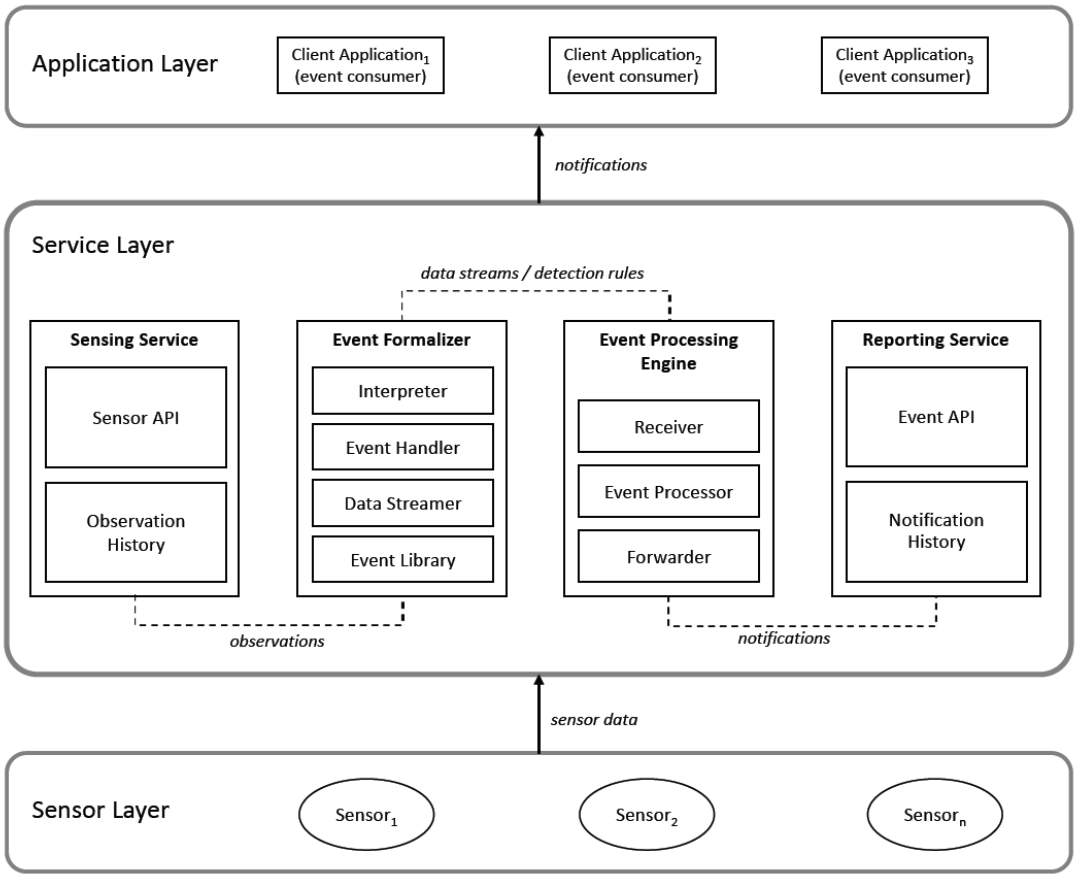

Figure 2: Reference Architecture for Smart City Applications (RASCA) [2, p. 12]

The CityPulse project described in [3], [4], [5] [6] uses AMQP for message transport. The stream processing is shown in Figure 4.

4 Available Data

5 Visualization

6 Challenges

"Geoprocessing of data streams inherits challenges from big data analysis: volume, velocity, variety, value, and veracity." [1, p. 1]

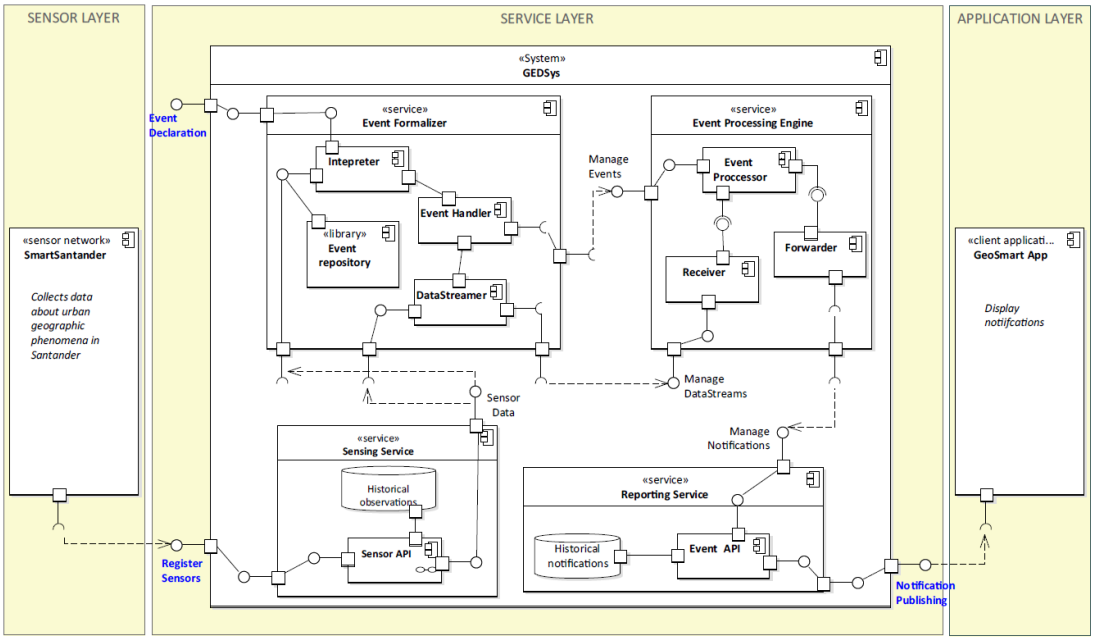

Figure 3: Implementation of RASCA [2, p. 13]

References

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[2] M. Garcia Alvarez, J. Morales, and M.-J. Kraak, "Integration and Exploitation of Sensor Data in Smart Cities through Event-Driven Applications," *Sensors (Basel, Switzerland)*, vol. 19, no. 6, 2019. DOI: 10.3390/s19061372.

[3] V. Tsiatsis, "Real-Time IoT Stream Processing and Large-scale Data Analytics for Smart City Applications: Smart City Framework," 2015. [Online]. Available: http://www.ict-citypulse.eu/page/sites/default/files/citypulse_d2.2_smart_city_framework_final.pdf.

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[5] D. Puiu, "Real-Time IoT Stream Processing and Large-scale Data Analytics for Smart City Applications: D3.3 Knowledge-based Event Detection in Real World Streams," 2016. [Online]. Available: http://www.ict-citypulse.eu/page/sites/

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[6] D. Puiu, P. Barnaghi, R. Tonjes, D. Kumper, M. I. Ali, A. Mileo, J. Xavier Parreira, M. Fischer, S. Kolozali, N. Farajidavar, F. Gao, T. Iggena, T.-L. Pham, C.-S. Nechifor, D. Puschmann, and J. Fernandes, "CityPulse: Large Scale Data Analytics Framework for Smart Cities," *IEEE Access*, vol. 4, pp. 1086–1108, 2016. DOI: 10.1109/ACCESS.2016.2541999.

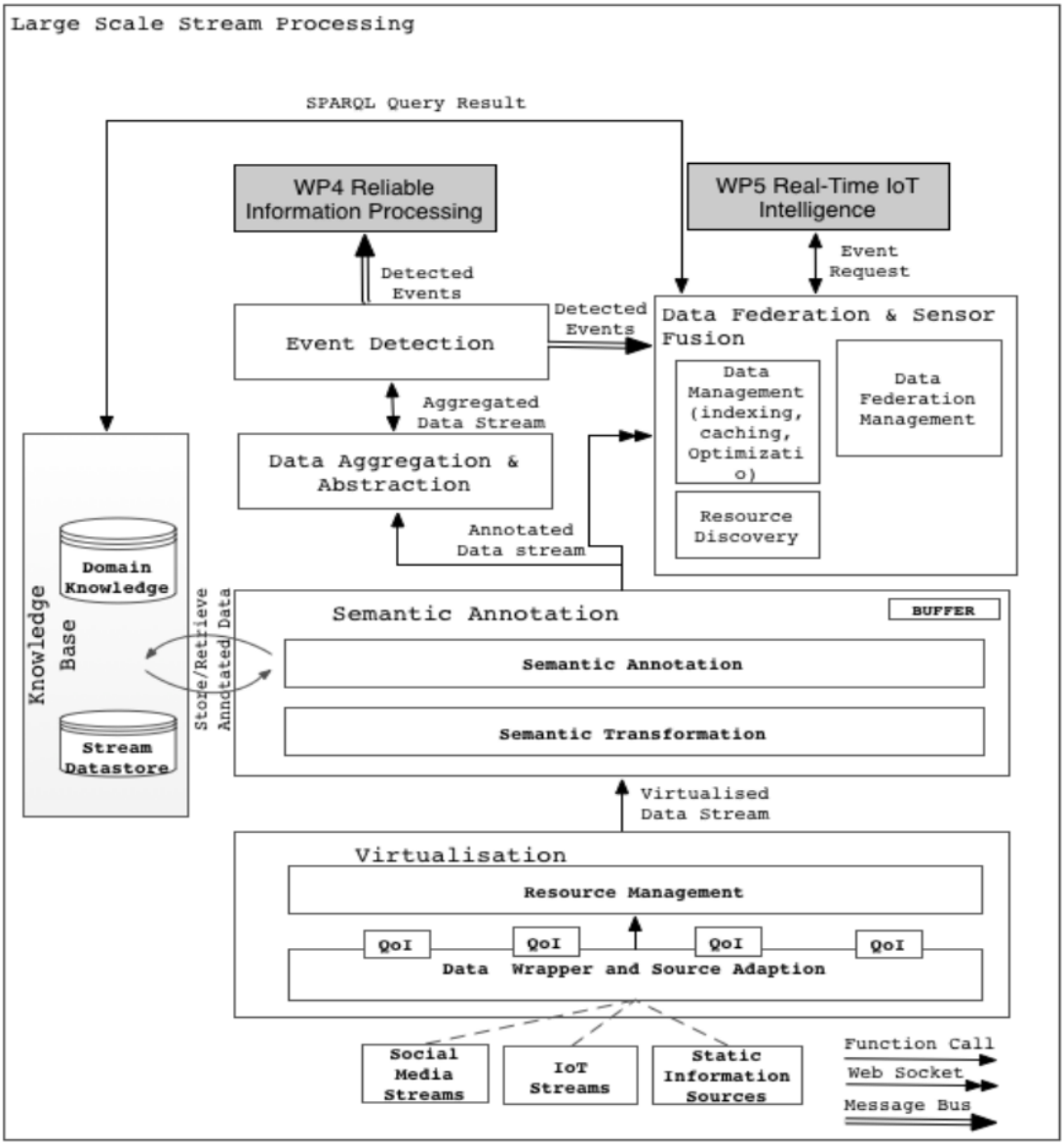

Figure 4: Large Scale Data Analysis Functional Group for CityPulse [3, p. 25]