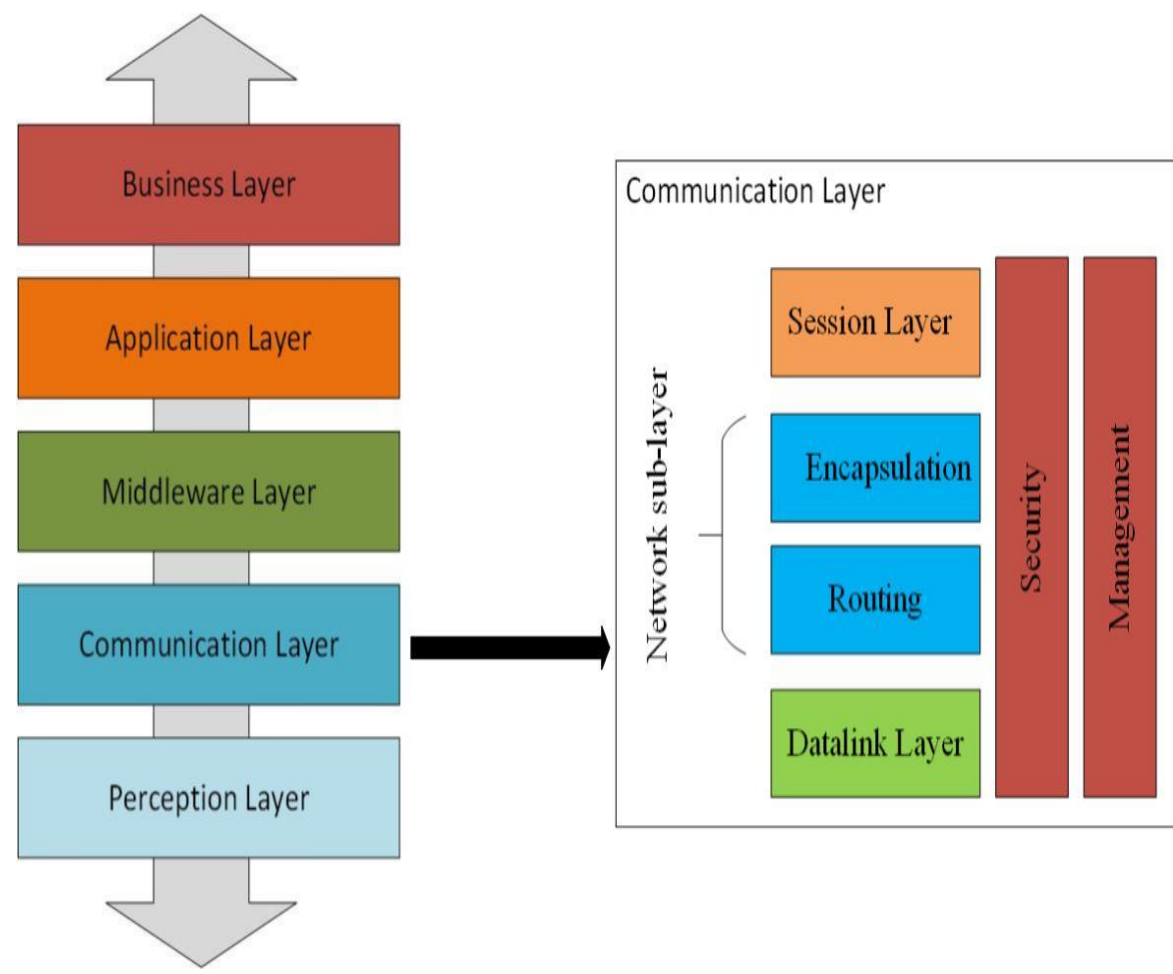
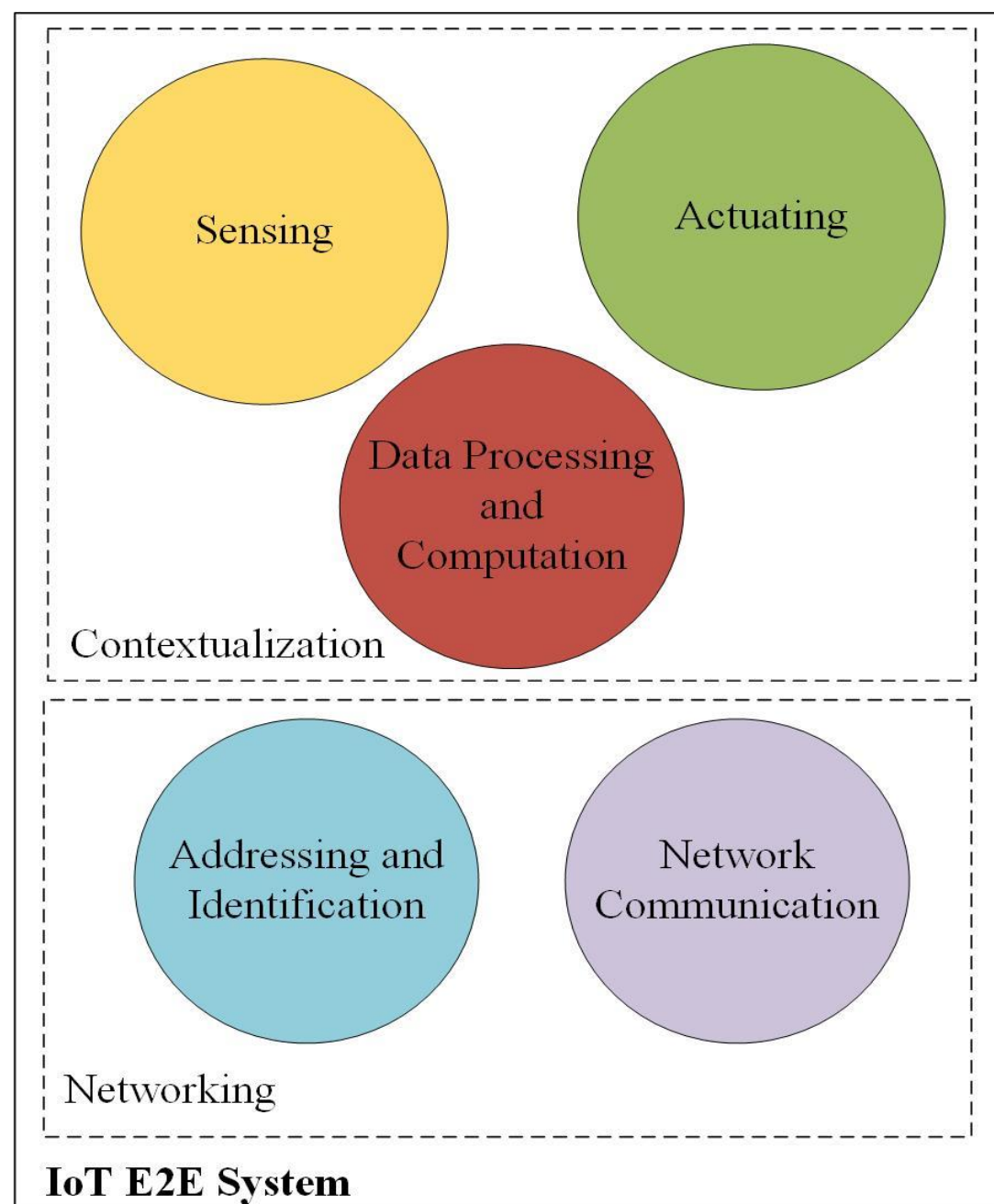


Introduction

- 50 Billion objects are to be connected by 2020.
- Massive number of heterogeneous networks and protocols.
- Wide range of applications for smart homes, smart factories, smart cities, etc.



- IoT system consists of two main functions: **contextualization and networking**.
- IoT system architecture [1,2,3]

Challenges for IoT communications [1, 2, 3]

- **Interoperability:** Support the heterogeneity as objects connected are different in functionality, technology and application while belonging to same communication environment.
- **Scalability:** The system should be capable to handle all IoT connections at acceptable Quality of Service (QoS).
- **Mobility:** The movement between different platforms and communication networks should occur smoothly without service interruption.
- **Security:** Connecting different networks and objects together requires solutions to guarantee security and privacy for connections and data.
- **Energy:** Large part of the objects runs on batteries and thus requires low computational complexity of the wireless communication techniques to save energy.

Context-Aware IoT Communications

Idea: Use context information gathered by sensors to adapt the communication protocols. This helps in solving the challenges of IoT by implementing software agents as actuators operating on the communication protocols/network configuration.

Application Example

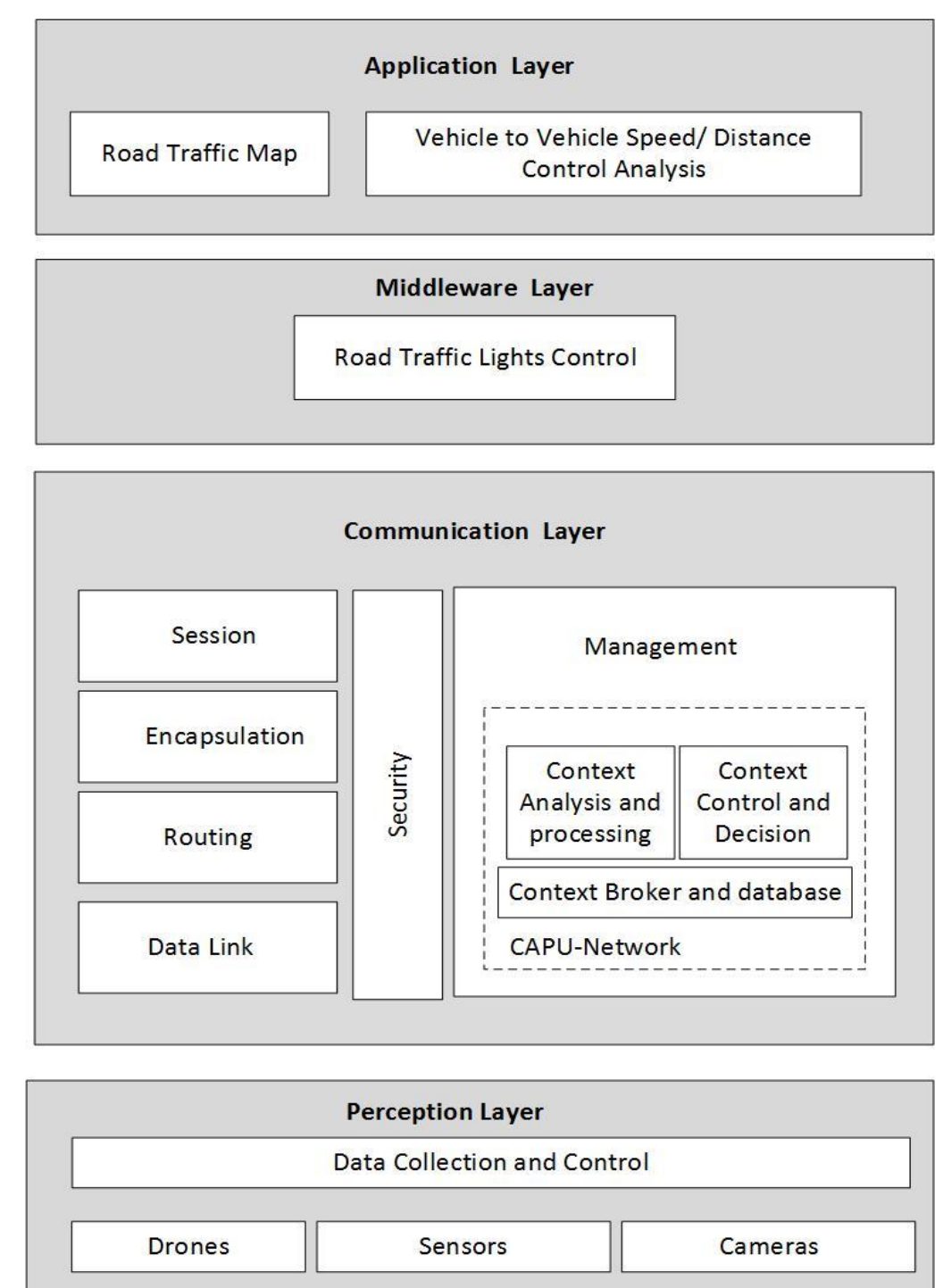
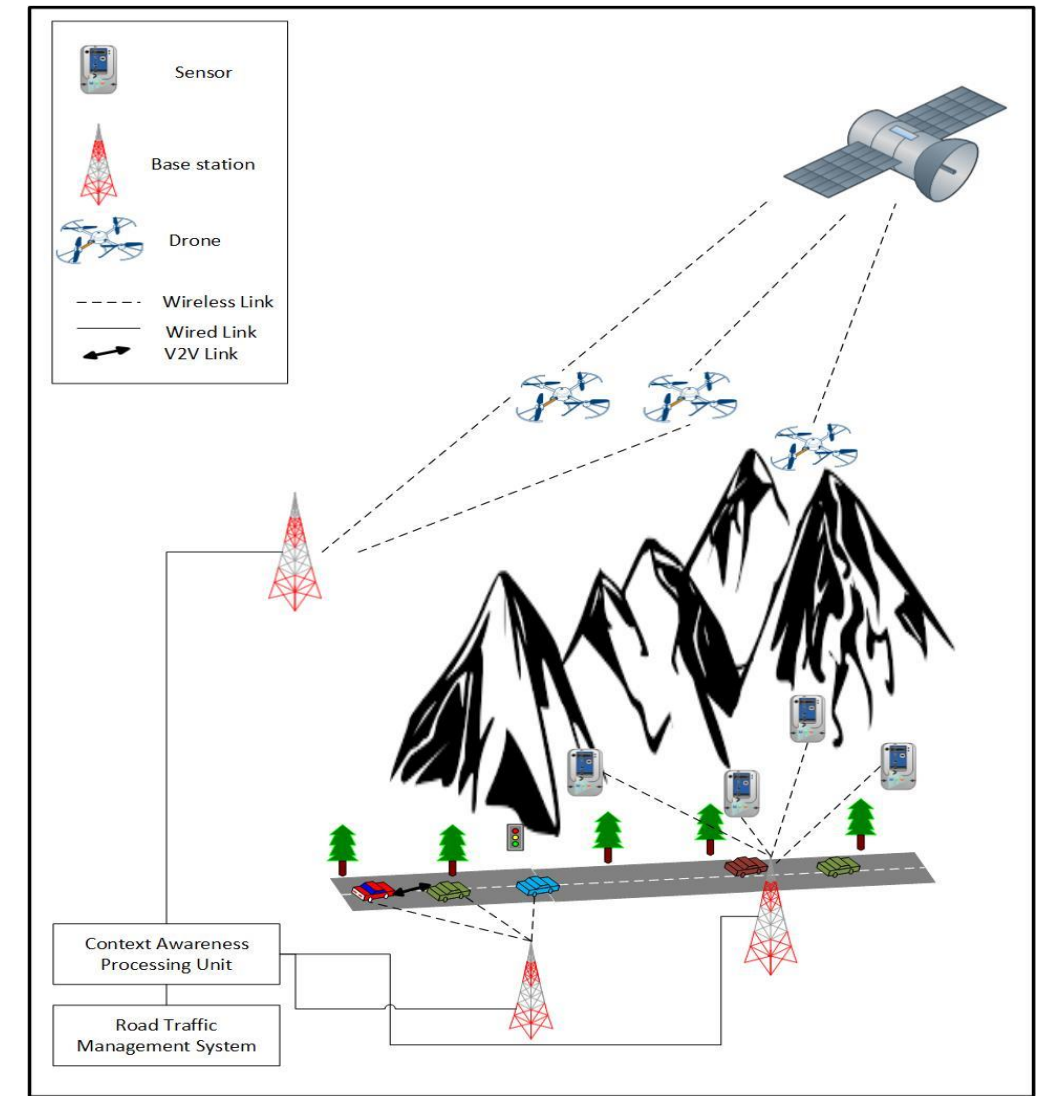
- Detect rocks movement and rain level in mountains using sensors.
- Sensed data is collected, processed and analyzed to decide if drones are needed to fly to collect more information.

- Drones form “Network-on-demand” or “Network-infrastructure-on-demand” on a very dynamic time scale that requires their own network slice.

- Traffic lights and routes are adjusted based on the context gathered.

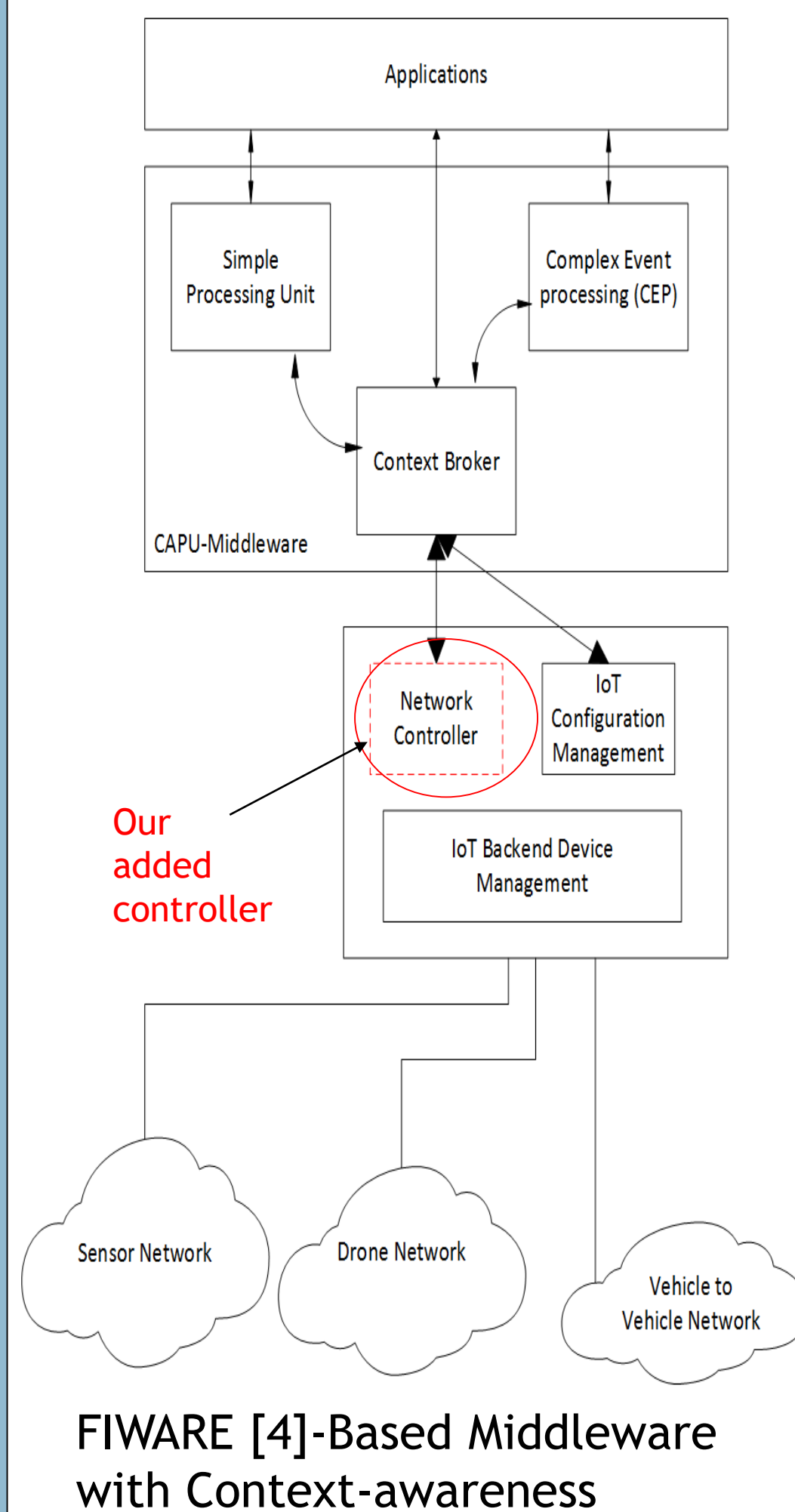
Advantages:

- **Interoperability:** CAPU (Context Awareness Processing Unit) is able to handle different types of devices (Sensors, Drones, etc.) and activates network slices on demand.
- **Scalability:** CAPU reporting mode is hybrid, which combines the time-driven, query-driven and event-driven modes to avoid overflow of communication network with lots of sensed data.
- **Mobility:** Moving the sensor nodes from a place to another will still keep them tracked by the CAPU.



- **Security and Privacy:** CAPU guarantees the access to information to the only concerned entities. Thus, security is preserved across different networks.

- **Energy efficiency:** Transmission is switched ON/OFF by CAPU when needed. Thus, energy is saved.



FIWARE [4]-Based Middleware with Context-awareness

References

[1] Ala Al-Fuqaha, Mohsen Guizani, Mehdi Mohammadi, Mohammed Aledhari and Moussa Ayyash “Internet of things: A survey on enabling technologies, protocols, and applications.” IEEE Communications Surveys & Tutorials, vol. 17, no. 4, pp. 2347–2376, 2015.
 [2] Rafiullah Khan, Sarmad Ullah Khan, Rifaqat Zaheer and Shahid Khan, “Future Internet: The Internet of Things architecture, possible applications and key challenges,” in Proc. 10th Int. Conf. FIT, pp. 257-260, 2012.
 [3] Z. Sheng, Shusen Yang, Yifan Yu and K.K. Leung “A survey on the IETF protocol suite for the Internet of Things: Standards, challenges, and opportunities,” IEEE Wireless Commun., vol. 20, no. 6, pp. 9198, Dec. 2013.
 [4] <https://www.fiware.org/>.