LIFEonLive

ARGOS early warning

Mobile-based video and fusion of sensor network data for better surveillance.

Field experiences with the Madrid City Police and the FP7 ARGOS project

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HI iberia

1 Framework

2. ARGOS+LoL, Key Concepts and Goals
3. General architecture of ARGOS+LoL and technologies used
4. Possible Application Scenarios and field experiences
5. Conclusions

Framework

- Protection of critical infrastructures key to create a more secure Europe.
- Problem: ever growing threats, stable or shrinking resources.
- New practices and ideas are required to optimize those resources.
- Many projects promoting the use of physical sensor networks, audio and video for the prediction and management of threats in CIs.

Framework

HI Iberia has worked on two R+D developments for this

- **ARGOS** is an European project co-funded by the European Commission under the FP7-SEC-2012 that is grounded on the extraction of new information from the fusion of data from physical sensor networks to predict threats to CIs.

- **LifeOnLive** is a R&D development by Hi-Iberia based on video streaming technologies, with pattern recognition algorithms, through mobile devices and over regular 3G/4G networks.

2 ARGOS+LoL key concepts and goals

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ARGOS+LoL

Core idea: Live video feeds as an additional sensor to complement the ARGOS ones

- **ARGOS+LoL** will leverage on the successful results of ARGOS and LoL to advance in the State of the Art of threat prevention in CIs.
- **ARGOS+LoL** will fuse information from video, with recognition patterns, and information coming from networks of sensors to extract deeper meaning, previously only tapped when humans were in the loop.
- **ARGOS+LoL** will store all data under a common interoperable paradigm (based n a common model or *ontology*) and enable rapid, multimodal searches upon data.

This will address all procedures involved in the detection of threats

Key Concepts

The key functional concepts of ARGOS+LoL are**:**

- **Early consciousness of the severity of the threat** and communication to field end-users (police, private safety providers)
- **Analysis** and **classification** of suspicious **activities based on risks posed**
- **Pattern recognition algorithms in real-time** to semi-automatically detect features of interest (e.g., license plate numbers, faces of persons, headcount in scenes).
- **Multimodal** network with different advanced **physical sensors** (vibration, audio analytics, fixed video) and **streaming of mobility surveillance video**
- **Energy efficiency** in devices, networks, algorithms and communications

Goals

The main goals of **ARGOS+LoL** are to complement existing security deployments for CI by augmenting providers with:

- **Monitoring** and **identification** of **suspicious activities** (e.g., loitering, repeated entry into extended perimeters)
- **Broadening of the "security zone"** beyond the perimeter of the Critical Infrastructure
- Detection of both **inland** and **aerial threats** (e.g., detection of helicoters achieved through vibration monitoring)
- **Minimization** of the number of false alarms
- **Distinction** among human and non-human detection: animals, humans and vehicles (inland and aerial) have different profiles of detection.
- **Facial** and **Licence Plate recognition**
- Capacity to be **deployed** over **mobile networks** such as **3G** and **4G**
- **Minimization of deployments** of agents/operators on the field (one agent covering the áreas previously patrolled by many).

3 General architecture of ARGOS+LoL and technologies used

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Technologies in Use

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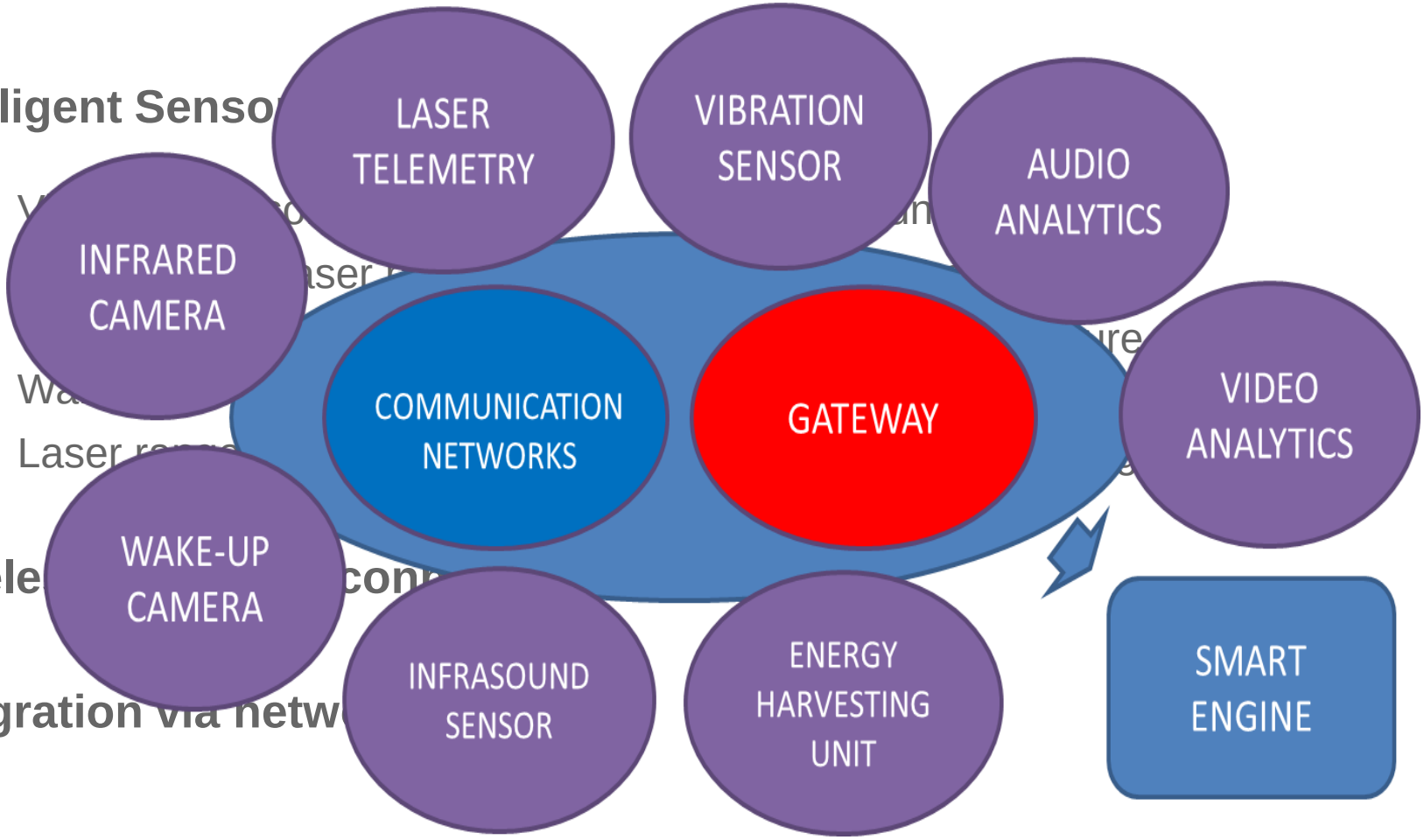
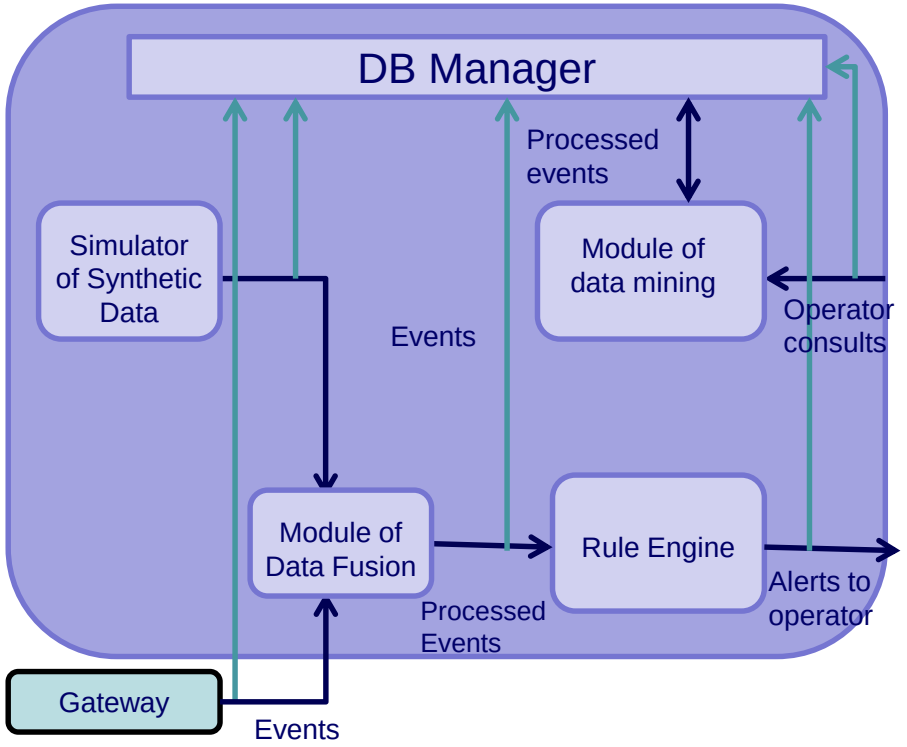


Technologies in Use

Smart Engine overview

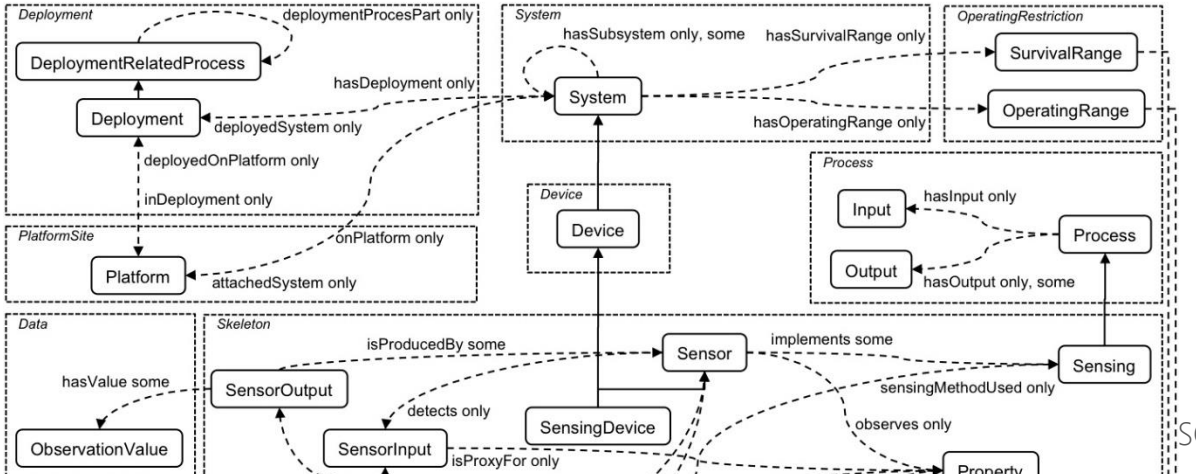
- **Interoperable**, **semantics** based storage of the events generated by sensors.
- Fusion of information based on **semantics** and **complex event processing** techniques
- Implementation of correlation schemes and cross-validation techniques through data mining (supervised post-processing of captured data).
- Statistical patterns and detection of outliers for advanced detection of suspicious activities
- Supervised learning based discrimination of false alarms
- Warning process to the C2 Centre operators and management of resolution phase



Technologies in Use

Smart engine components

- **Data fusion module**
  - Ingrating heterogeneous data captured by sensor network in an interoperable manner.
  - Using semantics:
    - **Ontology** (semantic data model) adapted to the protection of Cis.
    - **Reasoner** including known logical rules that define our domain and doing the fusion itself.



Technologies in Use

Smart Engine use case

1. Some sensors from the network of sensors send an event (Event 1) because they have detected smoke.
2. The smartphones worn by staff on patrol record video and send dentity of detected people (Event 2).
3. Sensors detect also rapidly rising temperatura (Event 3)
4. The Data Fusion Module receives the Events 1, 2 and 3 and fuse the information:
   - heat + smoke → fire
   - unknown person in the vicinity may be related.
5. This is transferred to the C2 centre and a person is dispatched,
6. The Data Fusion Module generates a processed event and sends it to the Rule Engine to higher processing, indicating that there is a fire, the image and location of the person who could have generated the fire and other related events
7. The complete sequence of Events is recorded and then processed by the Data Mining algorithm so future events can be recognized with more confidence.

Technologies in Use

Smart Engine components

- **Data Mining Module**
  - **Semi automatic** extraction of patterns in stored data to **enhance** data fusion and/or new rules.
  - Different approaches used
    - Clustering.
    - Association Rules and Decision Trees.

- **Rule Engine**
  - **Alert generation** based on the results of Data Fusion, rules semi-automatically generated by the Data Mining and certain rules defined by the operator
  - Current implementation is custom, will transition to **standards based** (JSR-94, etc.).

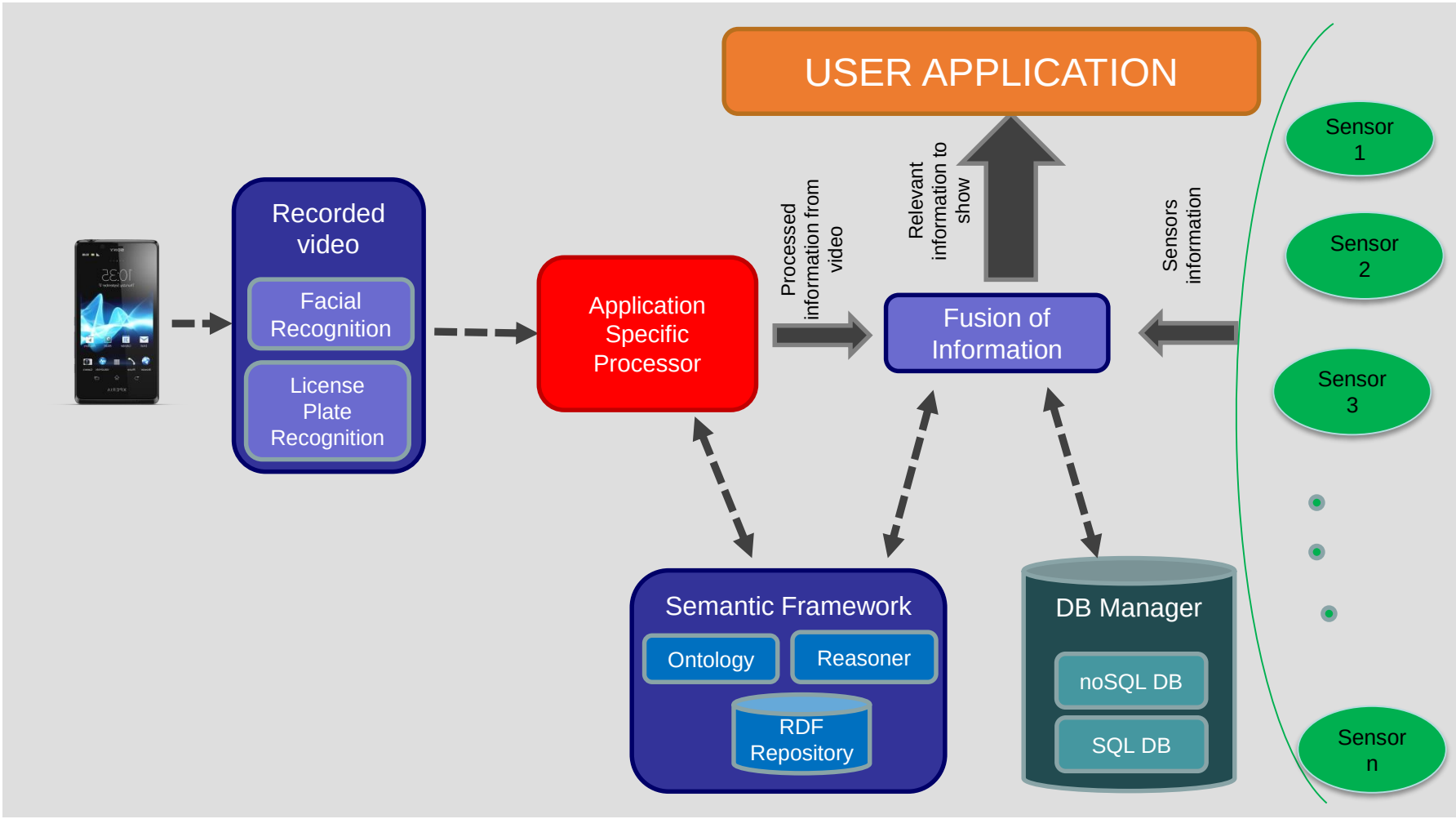
Technologies in Use

LifeOnLive Module

- **Mobile Networks**
  - Android-based application, Works with very inexpensive (~150€) phones (i.e., Samsung Galaxy S4 mini) and ruggedized ones (Samsung Xcover)
  - Sensor data from mobile phone embedded in the stream: A-GPS position, accelerometer data.
  - 3G mobile broadband and higher can be used for high qualty video.

- **Video analysis**
  - Face recognition using NEC technology (world leader), plate recognition using open source OCR libraries.
  - Facial recognition server side only to ensure that lost devices don't compromise privacy
  - Video in WebM in different qualities (from QCIF to SVGA), packet transmission in RTMP
  - Future extensions: device side processing for non-critical data (face detection for headcounts, plate recognition)

General architecture of ARGOS+LoL



4 Possible Application Scenarios and field experiences

5. Conclusions

Possible Application Scenarios

ARGOS+LoL covers many kinds of threats…

Aerial transport

Inland transport

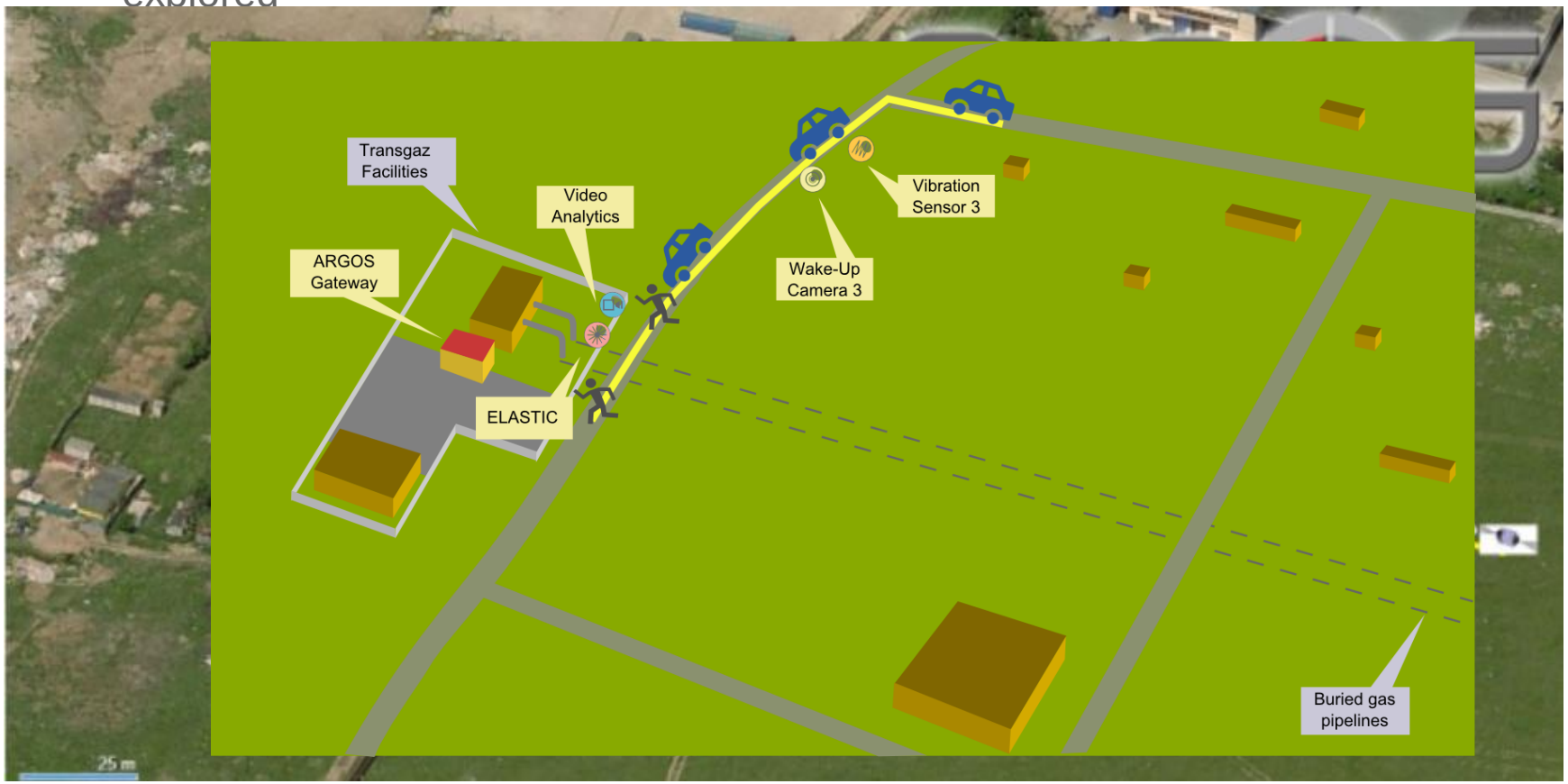
Detection of Arms, untrusted objects

Others? Extensions under consideration for **coastal** border protection.

What follows are descriptions of past experiences in 2014-15.

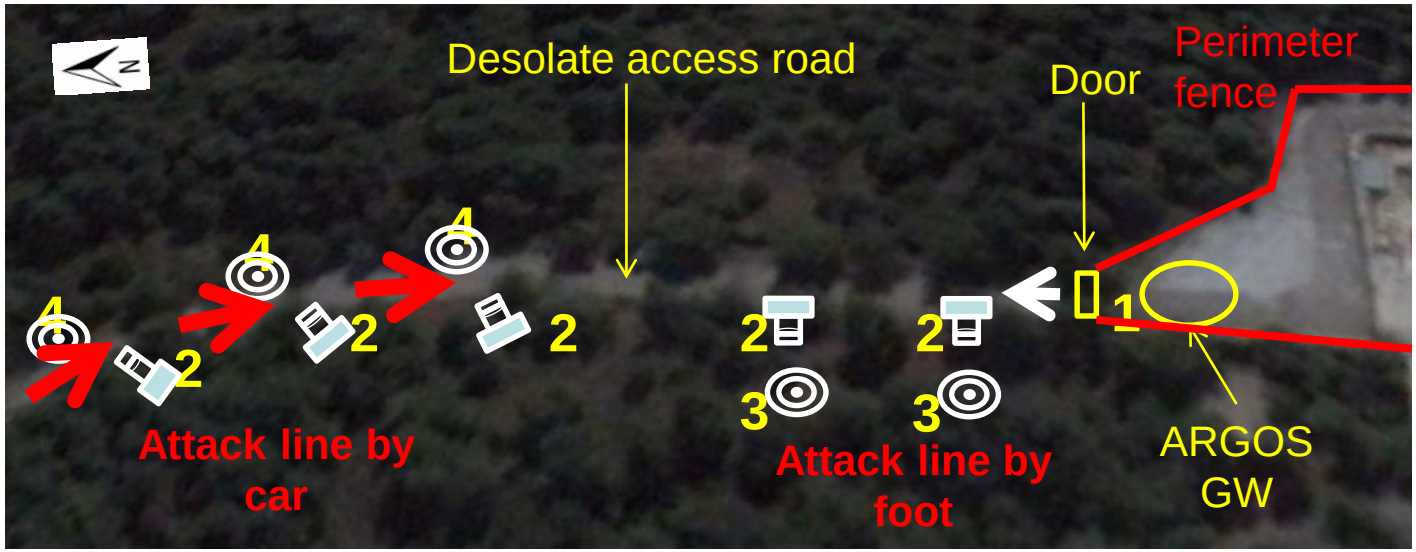
Field Experience with FP7 ARGOS Project

- Gas pipeline of the state-owned enterprise Transgaz (Bucarest, Rumania)
  - Efficient protection of long gas and oil pipelines → not usually protected
  - Re-compression station near Bucharest: traditional CI, problematic scenarios explored



Field Experience with FP7 ARGOS Project

- Nuclear Research Center in Demokritos (Athens, Greece)
  - Nuclear Research Center hosting research infrastructures (test reactor, etc.). Surrounded by thick forest near the city centre.
  - CI = Energy production instalation + dangerous elements storage
  - The external perimeter must be protected of possible threats which try to access to the instalation



Field Experience with Madrid City Police

- Used by security staff of the Spanish President in his official residence (Palacio de la Moncloa):
  - Semi-automated detection of unauthorized personnel in the premises by single patrolling agent.
- Used by members of the Madrid City Police in two cases:
  - late summer ‘14: Search for a child rapist who had raised social alarm
  - June ‘14: Security monitoring during the proclamation of King Felipe VI

5 Conclusions

Conclusions

- ARGOS+LoL provides advantages with regard to other protection sytems:
  - Use of non invasive, low power and inexpensive technologies
  - Multimodal data fusión and understanding
  - Data interoperability through technologies in semantics
  - Early detection of threats

Future work lines

- Inclusion of more sensor network modalities (Social Media analysis?)
- Deeper integration of surveillance video as a sensor.
- Broader approach: bridges to citizen-sensors, surveillance from vehicles…
- More trials will be developed through additional experiences in R&D projects and field experience with the Madrid City Police.

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Argos early warning

Thanks for your attention

Questions?