Welcome to ACTIVAGE Project:
Technology breakthrough for IoT for Smart Living Environments (SLE)

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ACTIVAGE Project Coordinator from MYSPHERA
Breaking barriers for a sustainable Active and Healthy Ageing through IoT technologies
A single common interoperable
ACTIVAGE IoT Ecosystem

Value creation

New Business Models

IoT technology
This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement Nº 732679.
ACTIVAGE IN NUMBERS

5 IoT platforms

> 40,000 devices

One IoT for SLE Ecosystem

- FIWARE
- universAAL
- SOFIA 2
- SENSINACT
- IoTIVITY

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ACTIVAGE IN NUMBERS

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One IoT for SLE Ecosystem

- Ambient Sensors
- Medical devices
- Wearables
- Environment
- Activity
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ACTIVAGE IN NUMBERS

5 IoT platforms

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One IoT for SLE Ecosystem

AIOTES

ACTIVAGE IoT ECOSYSTEM SUITE
ALEJANDRO MEDRANO - POLITECHNIC UNIVERSITY OF MADRID
IoT Cluster Coordinator.
ACTIVAGE’s reference architecture for semantic interoperability in an IoT for SLE ecosystem
Experience of ACTIVAGE in deploying AIOTES in 9 Deployment Sites in Europe

CLARA VALERO - POLITECHNIC UNIVERSITY OF VALENCIA
Interoperability layer design and development
Semantic Interoperability Layer (SIL) implementation

STEFANOS STAVROTHEODOROS - Centre for Research and Technology Hellas (CERTH)
AIOTES Service Layer design and development
Techniques, tools and methodologies supporting the IoT for SLE ecosystem
ACTIVAGE’s reference architecture for semantic interoperability in an IoT for SLE ecosystem

Alejandro Medrano - UPM
INTEROPERABILITY PROBLEM

- Fundamental barrier of Internet of Things (IoT) ecosystems
  - Lack of interoperability across IoT platforms and things
  - Each IoT platform talk its own “language”

- An common language is needed
WHAT IS AIoTES?

- ACTIVAGE IoT Ecosystem Suite
- It’s a framework, a software that allows data sharing from different platforms
- Building IoT solutions upon AIoTES will solve the interoperability problem.
WHAT IS AIoTES?
ARCHITECTURE

- Allows the establishment of an **abstraction layer** between the deployment Sites and the applications.
INTEROPERABILITY OF DEPLOYMENT SITES

- Maria lives in Galicia
- She is a dynamic, independent and cheerful person
- She likes to live on her own, at her house, but she needs some health monitoring

ACTIVAGE Smart sensors in her house allow her to stay safely at her home

Galicia Deployment Site uses SOFIA2 and FIWARE
INTEROPERABILITY OF DEPLOYMENT SITES

▪ Mario loves tranquility, good memories and pasta.
▪ He likes to be at home and prepare his own macarroni.
▪ Monitoring sensors allow him to stay at home alone in a safe way.

The Smart Home and Medical Smart Devices of Mario, in Parma, use UNIVERSAAL and FIWARE
INTEROPERABILITY OF DEPLOYMENT SITES

- Red Cross has an application for health emergencies.
- This application was created to work with OpenIoT sensors in Smart homes.
- Unfortunately, it doesn’t work with other platforms.

- ACTIVAGE makes it possible to allow AHA applications to work with any platform
- The Red Cross emergency application now works for Maria and Mario, through AIoTESc

Galicia Deployment Site uses SOFIA2 and FIWARE

The Smart Home and Medical Smart Devices of Mario, in Parma, use UNIVERSAAL and FIWARE
INTEROPERABILITY ILLUSTRATIVE BENEFITS

▪ For AHA solution deployers

“*I can update my installation, including a new IoT platform, transparently, with no service interruption regarding the already running apps.*”

“I can pick any existing apps used in any of the 8 other deployment sites from the AIOTES marketplace and make it run in my DS”

▪ For AHA app developers

“The app I developed for this particular AIOTES compliant IoT platform can operate on the top of the AIOTES framework “

“So I can propose my application to any AIOTES compliant DSs.”

“I develop once / I can deploy everywhere”

▪ For IoT platform developers

“Other AIOTES ready IoT platforms interoperate mutually with mine, and independently from mine:”

“My IoT platform eco-system remains”

“Improvements of your IoT platform improve also mine”

**Final benefit => Mutualize efforts / Enlarge the AHA ecosystem**
INTEROPERABILITY OF DEPLOYMENT SITES

Monitoring application

Use of AloTES API

AloTES

universAAL FIWARE Sofia

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INTEROPERABILITY CONCEPT

- Smart living Apps
- Different IoT platforms
- Specific gateways
- Heterogeneous devices
AIOTES DATA MODEL

IoT
Internet of Things Services

IoT
Healthcare Medical

IoT
Active and Healthy Ageing

Privacy and Security

- ACTIVAGE Core
  - GloTP,
  - OpenIoT,
  - FIESTA-IoT,
  - BIG-IOT,
  - WGS84,
  - W3C SSN/SOSA,
  - IoT-lite,
  - M3-lite,
  - DUL,
  - Time
- AHA
  - Wearables
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Security & Privacy Authentication and access control module:

- **User**
- **Other AIOTES services**

**Security & Privacy Authentication and access control module**:

- **PEP**
- **PDP**
- **PAP**
- **IdM**

**External Identity Providers**:

**Policies Database**

**Information Database**

- **IPSM**
- **SIL**
- **BRIDGE**
- **Other AIOTES services**

Users and services request are handled by S&P module. Users must authenticate using IdM and then send the token received to the PEP for authorization.

Services handled the request and return the response to the S&P module. Services are unaware of security mechanisms.
GDPR

- Protection of natural persons with regard to the processing of personal data and on the free movement of such data,

Requirements: Meet in particular the principles of data protection by design and data protection by default.

- Minimising the processing of personal data,
- Pseudonymising personal data as soon as possible,
- Transparency with regard to the functions and processing of personal data,
- Enabling the data subject to monitor the data processing,
- Enabling the controller to create and improve security features.
Semantic Interoperability Layer (SIL) implementation

Clara Isabel Valero - UPV
SIL IMPLEMENTATION
ARCHITECTURE

▪ Provides interoperability among IoT Middleware platforms.

▪ Scalable architecture.

▪ Interoperability Layer
  ▪ Communication and control
  ▪ Platform bridges
  ▪ Services

▪ Semantic Interoperability Layer
  ▪ Interoperability Layer
  ▪ IPSM
SIL IMPLEMENTATION
SYNTACTIC INTEROPERABILITY: PLATFORM BRIDGES

▪ Act as a middleman between the SIL and IoT platforms.

▪ Platform specific.

▪ Each bridge should implement the a set of common features.
  ▪ Allow effective decoupling at both conceptual and implementation level.
    ▪ The addition of a new platform does not require any changes in the implementation of already existing bridges.
SIL IMPLEMENTATION

SEMANTIC INTEROPERABILITY: IPSM

- Each DS uses its own platform and data model.
  - Syntactic conversion not enough.
  - The meaning of the information from an IoT platform cannot be understood by another platform.

- Semantic translation is performed by IPSM component.

- Configuration: upstream and downstream alignments.
SIL IMPLEMENTATION
INTEROPERABILITY USE CASE 1

Applications

IoT platforms

Gateways

Devices

AIOTES Semantic Interoperability Layer

Single ACTIVAGE Deployment Site

Third-party HW devices
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Multiplatform applications
Techniques, tools and methodologies supporting the IoT for SLE ecosystem

Stefanos Stavrotheodoros - CERTH
The **Service Layer** is at the top of the AIoTES architecture, providing functionalities and tools that allow the usage of core components such as the SIL. It consists of the following components:

- **Development tools**, which provide tools to assist the development of applications on top of AIoTES
- **Deployment tools**, which provide tools to assist the deployers and administrators of installations and deployment sites
- **Marketplace**, which provides an access point for new users and developers to discover existing services and applications and advertise their own
- **Data Layer Support Tools**
  - **Data Lake**, which provides access to integrated raw data and stored analytics metadata.
  - **Data Analytics**, which provides methods of data analysis.
  - **Visual Analytics**, which provides methods for data visualization.
The ACTIVAGE development tools offer means to facilitate the design, the implementation and test of new AHA IoT applications.

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<tr>
<th>SIL tools</th>
<th>Data Lake tools</th>
<th>Data / visual analytics tools</th>
<th>IDE tools</th>
<th>Support tools</th>
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<td>Data model workbench</td>
<td>Data analyser</td>
<td>AIOTES IDE</td>
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<td>Ontology explorer</td>
<td>Metadata storage explorer</td>
<td>Data manipulator</td>
<td>Code generator</td>
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<td>Device semantics editor</td>
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<td>Visualization explorer</td>
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<td>Service semantics editor</td>
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<td>Feature / result viewer</td>
<td>ClickDigital</td>
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<tr>
<td>Query translator</td>
<td></td>
<td>Data lake tools</td>
<td>Source code templates</td>
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**SIL tools**
- AIOTES SIL tool
- Ontology explorer
- Device semantics editor
- Service semantics editor
- Query translator

**Data Lake tools**
- Data model workbench
- Metadata storage explorer

**Data / visual analytics tools**
- Data analyser
- Data manipulator
- Visualization explorer
- Feature / result viewer

**IDE tools**
- AIOTES IDE
- Code generator
- Service composer
- ClickDigital

**Support tools**
- ACTIVAGE wiki
- Wiki content
- Code samples
The deployment tools aim to develop an infrastructure to assist deployers and administrators in setting up and configuring installations in Deployment Sites and deployment units.

- **Device manager**
- **Benchmarking tool**
- **Service manager**
- **Semantic auto-discovery platform**

**Deployment management**
- **AIOTES Private docker registry**
- **AIOTES docker**
- **Component configuration**
- **Deployment manager**
- **Maintenance panel**
- **Update manager**
The ACTIVAGE IoT Marketplace is a **one-stop-shop** for all Active and Healthy Ageing (AHA) Applications based on any IoT Platform. Its purpose is to:

- **Unify platform application ecosystems**
  - Those that have and those who do not have a marketplace

- **Discover and get new applications, use across sites**
  - Deployment Sites
  - Third-parties
  - Grow the user ecosystem

- **Attract new developers and publish new applications**
  - Monitor, manage and monetize them
  - Grow the developer ecosystem
  - Post-project sustainability
DATA LAYER SUPPORT TOOLS

FLOW

Raw data from the SIL

Data Lake
- Independent data storage
- Analytics metadata storage
- Data Integration Engine

Data analytics
- Feature extraction/selection
- Anomaly detection
- Classification
- Prediction
- Clustering
- Hypothesis testing

Information visualization
- Common chart types
- Graph-based

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The Data Lake provides access to all raw data collected by the IoT platforms, as well as to metadata generated and used by data analytics tools.

The Data Lake consists of three components:

- independent data storage for IoT platforms not having their own
- metadata storage for trained models produced by the data analytics methods
- Data Integration Engine, for providing access to the data collected in the distributed IoT platforms.
Data analytics methods are used to automatically detect patterns in the data, and provide the operator with reduced and representative features and analysis results.

It receives input directly from end-users in order to perform one of the provided types of analysis, selecting which data to use from the Data Lake, or data directly provided through the API.

It exposes an API, through which the following types of analysis are supported:

- Feature extraction
- Feature selection
- Anomaly detection
- Prediction
- Clustering
- Hypothesis testing
The visual analytics component is a Web-based front-end component, supported by back-end services, offering a set of data visualization types and means for interacting with them.

The end user communicates with the Visual Analytics component by interacting with its GUI.

The Visual Analytics component communicates directly with the Data Lake component, in order to visualize the raw sensor data.

It also communicates with the Data Analytics component, through the latter’s API, in order to visualize the results of analyses.
Experience of ACTIVAGE in deploying AIOTES in 9 Deployment Sites in Europe

Alejandro Medrano - UPM
Experience of ACTIVAGE in deploying AIOTES in 9 DS
PILOTS’ CHALLENGES (OR HOW TO BUILD BRIDGES)

- Sintactical Interoperability (AIOTES Bridge)
  - Work for DS
  - Work for “local” platform
  - Generic enough for any DS

- Semantic interoperability (AIOTES Data Model)
  - Platform & Local Model
  - AHA & IoT Model

- Business Interoperability (UC exchange)
  - Services
  - Applications
  - Devices
Experience of ACTIVAGE in deploying AIOTES in 9 DS

PILOT STATUS

- AIOTES V1.5 is installed at least in testing environments
- “Local” Bridges deployed and configured
- Some initial tests with devices
- Ongoing Semantic alignments
  - AIOTES Data Model iterative releases
  - Extensive AHA Domain
  - Semantic interoperability definitions
### Experience of ACTIVAGE in deploying AIOTES in 9 DS

#### UC EXCHANGE

<table>
<thead>
<tr>
<th>Offering</th>
<th>1 GAL</th>
<th>2 VAL</th>
<th>3 MAD</th>
<th>4 RER</th>
<th>5 GRE</th>
<th>6 ISE</th>
<th>7 WOQ</th>
<th>8 LEED</th>
<th>9 FIN</th>
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<tr>
<td>1 GAL</td>
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<td>3 MAD</td>
<td>Behaviour analysis @ Home</td>
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<td>4 RER</td>
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<td>Visualization of behaviour patterns outdoors</td>
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<td>GoodLife TV Trainer</td>
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<tr>
<td>5 GRE</td>
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<td>Behaviour analysis @ Home</td>
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<td>6 ISE</td>
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<td>Balance Assessment and training</td>
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<td>Bedsensor</td>
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<td>8 LEED</td>
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<td>Drugs consumption monitoring</td>
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<td>House energy performance tracking</td>
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<td>9 FIN</td>
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</tbody>
</table>

### Details

**1 GAL**
- Drugs consumption monitoring
- House energy performance tracking, Social service
- Smartwatch for detection of falling

**2 VAL**
- Behaviour analysis @ Home

**3 MAD**
- GoodLife TV Trainer

**4 RER**
- Visualization of behaviour patterns outdoors
- Step count for alert to physical changes

**5 GRE**
- GoodLife TV Trainer

**6 ISE**
- Balance Assessment and training
- Bedsensor

**7 WOQ**
- Bedsensor

**8 LEED**
- Drugs consumption monitoring
- House energy performance tracking

**9 FIN**
- Brain training game

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WHAT IS actIVAGE OPEN CALLS PROGRAM?

- **First Open Call**, launched in July 2018, currently under execution, is financing 10 innovative start ups to develop new AHA services and technologies that will be integrated for evaluation in the current DSs.

- **Second Open Call**, launched in March 2019 is addressed to cities and regions in the EU that are willing and committed to Set Up ACTIVAGE IoT for Active and Healthy Ageing ecosystem framework and services in their local ambit and commit the contribution in the evaluation and evidence creation process of ACTIVAGE as well the sustainability and growth beyond the end of the project.
Thanks for your attention!!