

Service-oriented Architecture Lab

- Authors: L.Gaillard, M.Chevalier, P.Collet

Objectives

- Build and maintain a working ecosystem of microservices.
- Integrate micro-services using an Event-driven Architecture.
- Deliver and deploy a reproducible environment with Docker.
- Plan for and implement future requirements and features around your architecture.
- Identify the (very-)Minimal Viable Product that fulfills the requirements.

Project Vision: Smatrix Grid - Shifting the energy paradigm

Electric power is everywhere present in unlimited quantities and can drive the world's machinery without the need of coal, oil, gas, or any other of the common fuels. - Nikola Tesla

The third millennia is filled with radical transformations, faster than ever. Consumption and production models in every sector are shifting, the way people and individuals interact with systems at scale has changed. The world is becoming more and more decentralized. Think *AirBnb*, *Uber*, and even *Amazon* to a lesser extent, these companies do not own flats, taxis, or goods, but they are leaders in their industries no matter what.

The energy domain is missing out for now, which is where Smatrix Grid comes into play. It is time for the people and variously sized businesses to join the game against and with the mastodons which used to rule the *centralized* energy world.

The grid, which interconnects every single device no matter its size needs to be stable, production must match consumption at any time, and it is up to energy supplies to match and adapt to the demand. Obviously, there are many challenges down the road, a complex system like the grid that most humans living on this planet depend on so heavily is not easily handled.

Streamlining the processes and modelizing the grid and all of the actors involved is key. A wise man once said that *Simplicity is the ultimate complexity* (Leonardo Da Vinci), organizing your system into different services, while making this whole orchestra sound like a symphony is a challenge, it is *your* challenge. Smatrix Grid: *Shifting the energy paradigm*.

Expected work (groups of 5)

Your role is to define, implement the *Minimal and Viable Product* (MVP) associated with the Smatrix Grid ambitions. The ambitions are going to be defined by a set of user stories. It is your duty to **identify the services** to expose in order to support these scenarios and to **properly integrate** them altogether in a viable way (e.g., persistent data, automated acceptance scenarios, controllable).

It is absolutely essential to maintain during the entire course of the project a **working** set of services, and which can prove that your entire system is functional: **you cannot afford the grid going dark**. We will extend the supported features with new user stories, it should be part of the plan, while not overengineering your current implementation.

We insist, but keep in mind that the expected delivery is small in terms of business coverage and algorithmic logic, but it requires a non-negligible effort to **deliver it properly** (e.g., justified API and choices, persistence layer, turn-key containers).

Deliverables

- **FINAL DUE DATE: 7th of November at 18:00 (Paris time, 6PM equivalent).**
Expected tag is *delivery-final*.
- A single github project named *smatrix-21-22-soa-21-22-x* (x being your team identifier) into the Polytech organisation. The project should comply with the following rules:
 - The name should be *smatrix-21-22-soa-21-22-x*
 - There should not be any git submodule
 - We will execute your project according to the following sequence:
 - ~\$ git clone [git@github.com:pns-si5-soa/smatrix-21-22-soa-21-22-x.git](https://github.com/pns-si5-soa/smatrix-21-22-soa-21-22-x.git)
 - ~\$ cd *smatrix-21-22-soa-21-22-x*
 - ~\$ git checkout tags/delivery-final
 - ~\$./prepare.sh
 - Load dependencies, compile if necessary, prepare the environment and start the docker containers.
 - ~\$./run.sh
 - Run the acceptance scenarios associated with your project and your APIs. It must show each step of your acceptance scenarios in a comprehensive manner and include enough logs/traces for us to get a grasp of your architecture as a whole (request payloads, etc...).
- A README summarizing what we need to expect when running your project.
 - The README should also include a repartition of 100 points between the members of the team, as you are now used to it. It should represent the implication of each member in this project and their impact.
- A PDF report describing your architecture and the design choices, assumptions, state of the project:
 - Explanations for your current architecture, including diagrams. Keep them simple, we do not need them to follow strict conventions. We do absolutely need at least one diagram that spans the entire architecture comprehensively.
 - Details about the interface of each of your services, and the domain objects they manipulate.
 - Clarifications about your understanding of the project and the comprehensive choices you have made along the way, including

- constraints and how the way you designed your architecture actually helps your system to cover the scope you have decided.
 - Comprehensive explanations about the scenarios that you have chosen to cover the use cases.
 - Sequence diagrams for each scenario, nothing fancy or extremely conventionned, we just want to see what happens within your system to cover the scenarios, because we won't see the insides from the execution.
 - Explanations about the limits and the constraints of your design (points of failure, points of high loads, etc), and the potential improvements you could make.
 - Details about the changes of your architecture needed to cover the stories not implemented.
 - We are not expecting anything all fancy and shiny, we want readability and clarity.
- **A demonstrably working project needs to be ready to be shown each week. The scripts should be kept up to date for this purpose, it would be great for the readme to follow as well. Nonetheless, there is no need to keep the PDF report, we will *never* check it out between due dates.**

Personas

- **Nikola**, the Chief Operating Officer responsible of the grid stability from an Energy Supplier
- **Charles**, the CEO of Smartrix Grid
- **Pierre & Marie**, technological-driven family house owners, Smartrix Grid customers
- **Elon**, the Chief Technological Officer of a newgen electric vehicle company
- **Albert**, the Chief Product Officer of a solar panel provider
- **Thomas**, the Chief Operating Officer of a battery selling company

User stories

1. As **Pierre & Marie**, I want to see the electricity consumption of my household, in order to have a better understanding of what is consuming most of my energy and when.
2. As **Nikola**, I need to guarantee that the production is equal to the consumption on the whole grid in order for the grid to not go dark.
3. As **Charles**, I want to have an overview of my clients' usage of energy, in order to assess their potential needs and adapt my commercial propositions.

Added 20/09:

4. As **Elon**, I want my vehicles to be able to recharge overnight, so that my customers are able to drive to work each morning.

Added 27/09:

5. As **Charles**, I want to have communities of households, so that the energy can be managed in a more local manner (local production, balance of global production of the community, ...).

6. As **Nikola**, I need to guarantee that there is never an energy consumption peak too large in a localised area, so that a specific part of the grid is never overloaded.
7. As **Charles**, I want to be able to schedule the charge of the electric vehicle of my clients, so that the vehicles are not necessarily charging as soon as they are plugged-in, allowing for a smoother load on the grid.

Added 04/10:

8. As **Albert**, I want to install solar panels on the roofs of residential households, so that they can provide a source of energy production during the day.
9. As **Nikola**, I want to be able to buy the excess of local production in residential households, so that the local production is not wasted in case the household is consuming less than what their local production is able to produce.
10. As **Charles**, I want to have a control on non essential electric consumption inside the residential areas, so that I can reduce the global consumption on the grid.

Added 11/10:

11. As **Pierre & Marie**, I want to be able to know if I have reached autarky (self-sufficiency regarding energy production/consumption), so that I can adjust my consumption in case I am not yet self-sufficient.
12. As **Pierre & Marie**, I want to be able to retrieve my monthly invoices of my energy consumption for the past year, so that I can get a big picture of how much I paid, and potentially how much I saved through Smatrix Grid.
13. As **Pierre & Marie**, I want to see how much I will have to pay for my energy consumption for the current month, so that I can adjust my budget as closely as possible.
14. As **Charles**, I want to be able to see if a community of users has reached autarky, so that I can reason about the community as a self-contained part of the grid and adapt Smatrix business strategies.
15. As **Thomas**, I want to provide battery setups to Smatrix Grid customers with solar panels, so that they can store the surplus of energy production, and use it later, helping them reach autarky.

Added 18/10:

16. As **Charles**, I want to have the capacity to handle a large amount of households and communities (at least a few thousands), so that my company can achieve the desired growth.

Added 25/10:

You need to implement at least 2 stories in the 5 listed below. Feel free to implement more.

Provide the architectural design of all of the stories below.

17. As **Charles**, I want to aggregate the energy production and storage of my customers to build a Virtual Power Plant (VPP), so that I have the capacity to trade the excess energy production on the global energy market.
18. As **Charles**, I want to sell the device consumption/production data to partners (exemple: x€ / 1000 datapoints) stored in Smatrix systems, so that I can generate more revenue from the data collected, in accordance with privacy policies.
19. As **Nikola**, I want the system to adapt to a limited production capacity (thus not infinite) in order to match the real world production sites which are limited in size and in power.
20. As **Pierre & Marie**, I want to be notified about the autarky state changes (reaching autarky, or not being in autarky anymore) of my household and my community, so that I can be aware of my installations status.

21. As **Charles**, I want to monitor the data collection of the households and communities and be alerted of a malfunction, so that I can send a technician to diagnose and resolve the issue.