Aitek and Circle Garage supported Sinelec in all phases of the Plug & Toll project, the web application for software configuration and update integrated into the S * GATE platform, a Multi-Lane, Free-Flow tolling solution.
The development of innovative software solutions has always been the mission of Aitek and Circle Garage. This means not only creating solutions and products that take into account the latest technological developments, but also providing know-how in the choice of technologies capable of improving the efficiency of the Customer’s systems and products.

In recent years, new technologies have radically transforming the design and development of applications for the management of complex, distributed systems with high online traffic. In more detail, approaches based on microservices have stood out for their modularity which allows to develop the software architecture of any application.

**The microservices**

The great strength of microservices is they allow to modify, replace or delete a single service without affecting the entire application.

In a traditional architecture, defined as “monolithic”, developers create a single large application that can meet all the requirements for which it has been designed. On the contrary, microservices are the ideal solution in terms of flexibility and time savings, as developers can build a number of smaller applications, each of which performs functions specific to the main application.

The structure is therefore distributed in a single application, consisting of a number of independent services that communicate with each other through a process based on the exchange of messages.

**The project**

From these technological considerations, the Plug&Toll project was created for Sinelec, the technology company of the ASTM Group, the world's second-largest operator of toll motorway networks and a global player in the design and construction of major infrastructure works.
Sinelec has been addressing toll collection issues for over 20 years and today, thanks to the expertise gained working together with concessionaires, it is one of the leading Italian companies in this sector. Its solutions manage almost 1,000 toll gates and process about 3 billion euros in economic transactions, for over 200 million transits each year.

Plug&Toll is a web application, integrated into S*GATE (Star Gate), Sinelec’s Multi-Lane, Free-Flow toll collection platform. Plug&Toll enables technical and application monitoring of field devices employed by S*GATE, such as different types of cameras, thus optimizing system management and maintenance over time. Furthermore, the functional value of Plug & Toll is expressed through a simplification of software configuration and updating tasks, which are faster and more efficient.

Aitek and Circle Garage provided their know-how in all phases of the project, from the embedded operating system, specially optimized by Aitek for on-premise solutions in motorway scenarios such as S*GATE, to the choice of using the microservices approach, up to the analysis of the tools that best met the Customers’s operational requirements.

Container, Docker, orchestration: the tests

The described benefits, combined with the availability of fully mature technology, have led the development team of Sinelec, Aitek and Circle Garage to choose microservices as the ideal solution to implement and maintain the software architecture of the S*GATE project, of which the Plug&Toll application is an integral part. In particular, the design choice fell on the Docker Swarm environment for on-premise "roadside" environments and on Google Kubernetes for center solutions.

Introducing the concept of container (literally, as in "container" for freight transport) allows to "package" applications, including their dependencies on the operating system, and simplify their use. The result is a reliable tool that allows to handle or move entire applications limiting human errors, very long checklists to control and all the nerve-wracking and risk-laden steps required for deployment.
To automate application deployment, management, scalability, and networking processes, Aitek and Circle Garage employed the container orchestration technique. Among its features, the orchestrator provides easy maintenance of the software, efficient management of resources and allows to update, modify or replace individual nodes as needed, while maintaining system operation.

Specifically, the analysis carried out by the Aitek and Circle Garage team involved two of the most common orchestrators, Google Kubernetes and Docker Swarm. The comparison tests between the two orchestrators allowed to determine the performance difference between them, with particular attention to the following areas of interest: update with no service interruptions (updating deployments without downtime in “zero downtime” mode), rollback of configurations, comparison of CPU/RAM consumption, verification of the times for balancing a microservice from one node to another, verification of continuity and load relocation times, control of times required by scaling and restarting microservices, as well as load and performance tests.

The test results led to choose Docker Swarm as the most suitable orchestrator for this project. In fact, since the end systems based on the S * GATE platform will have to operate in edge environments such as the motorway, Docker Swarm guarantees lower consumption (in terms of RAM, CPU and network resources) and faster responsiveness.
The DevOps (DEVelopment OPerationS) methodology is used to optimize the deployment process of S*GATE's peripheral subsystems. By integrating the activities between Dev, Quality Assurance (QA) and IT Operations, it describes a series of best practices for software development, testing, and release.

Through a simple graphical UI provided by Plug&Toll, the operator can configure and activate new services on the system. User choices are automatically converted by Plug & Toll to a dynamic configuration that describes each component of the system: active processes, networking and parameters.

An agent on the peripheral machine allows operators to send the configuration to Sinelec's automated deployment pipelines, which download and reconfigure in real time without service interruptions.

The result is an advanced tool for the real-time deployment, update, and monitoring of all S*GATE platforms installed by Sinelec.
In the images: the web interface for monitoring device status and configuring S*Gate through the Plug&Toll application.
The choice to make S*GATE modular and microservices-based - like many other Sinelec applications - has turned a complex system, such as multi-lane free-flow transit management, into a flexible and adaptable to market requirements one. As a result, our engineers have focused on business technology challenges, relying on a smart, scalable and reliable architecture.

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