



SMART CITIES AND SMART MOBILITY

City solutions adaptable, flexible and low cost

With the contribution of



FIWARE - OPEN APIs FOR OPEN MINDS

October 19, 2020 @ FIWARE Foundation, e.V. – www.fiware.org

Challenge & Context

How can you build effective service chains and deliver them to end-users at the right time? This was the core question that [Phoops srl](#), an Italian SME based in Florence, faced when it started the development of [MUV-APP](#) (Virtual system for Urban Management).

Since the very beginning, Phoops realized the need to manage more efficiently large amounts of data in accordance with Mobility-as-a-Service (MaaS) solutions for public organizations' business logic, aimed at delivering better services to end-users (mobile and web applications).

That time, a series of critical issues had to be overcome:

- creating an **effective architecture** to support the defined **business logic**;
- managing the **complexity of heterogeneous data**, in compliance with **GDPR**;
- creating a multi-agent architecture with **real-time communication**;
- managing the **concurrent access and interaction** in a multi-agent environment.

Was **crucial to Phoops to find the right mix of technologies and models** to define a solid architecture: this is where FIWARE played a crucial role.

Thanks to the **FIWARE Accelerator frontierCities**¹ (2015), Phoops boosted their technological know-how. The company designed, developed and perfectionated its MUV-APP, a Microservice Architecture (MSA), dedicated to the management of complex urban mobility systems².

¹ frontierCities was a quantum leap in the scope, ambition and service of the Acceleration & Incubation process of FIWARE SMEs and Start-ups. frontierCities provided EUR 1.6 million in grant funding across two Open Call strands to SMEs and start-ups to develop and commercialise FIWARE-powered smart-cities applications.

² Bellomo, S., Gorton, I., & Kazman, R. (2015). Toward agile architecture: Insights from 15 years of ATAM data. *IEEE Software*, 32(5), 38-45.

However, from the very start, it became clear that flexible and innovative technologies – to be applied to MSA – would need to walk hand in hand with a **“service-related business model”** that follows an **end-to-end logic from data gathering to services delivery**. Moreover, the development process of MSA, dedicated to the Intelligent Transportations Systems and Services (ITS), needed to ensure **that the FIWARE architecture was able to support solutions in other fields of applications**, such as Smart Cities, Smart Industry, and Smart Energy.

This was possible thanks to the following elements:

- Flexibility and adaptability;
- Small cohesive functional units;
- Open Source and vendor free components;
- Scalability and data interoperability.

Bearing these four important aspects in mind, MUV-APP went beyond the mere management of urban mobility to become something extremely flexible and adaptable to diverse context areas.

Therefore, Phoops, using the basic architecture of the MUV-APP, created a new solution called **“BriX”**, which goes beyond urban mobility management and adapts to several endeavours:

- **Smart Cities sector:** a platform oriented in the management of overall Smart Cities services named in2iCity (e.g. waste management and smart water);
- **Smart Industry sector:** to achieve a higher degree of production sustainability;
- **Smart Energy sector:** with a particular attention to green energy production and management (e.g. solar plants).

The evolution of the solution is summarized in the following scheme:

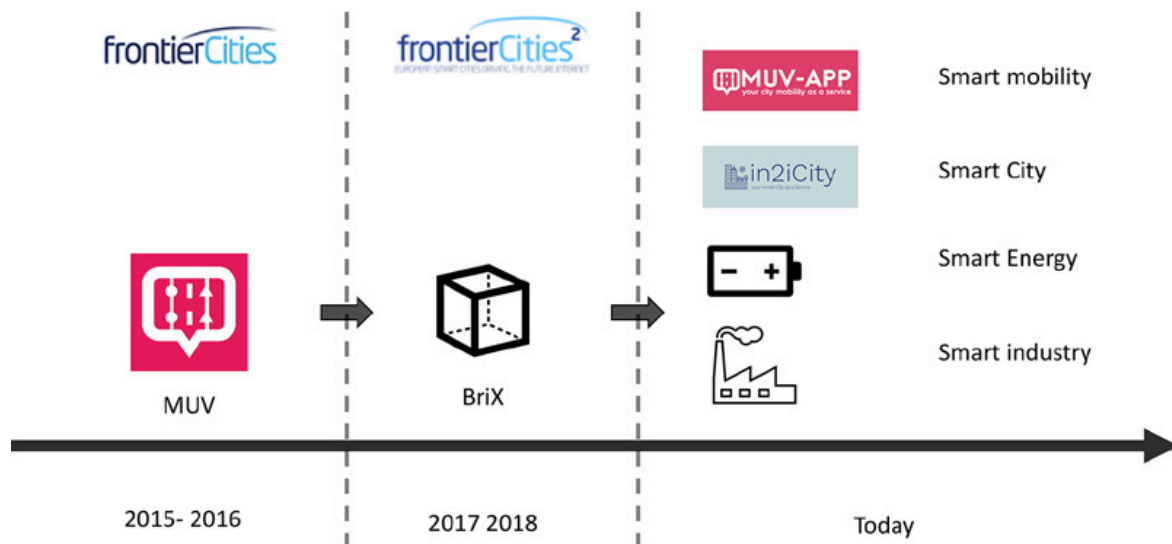


Figure 1 - Schematic representation of Phoops' products evolution through time.

One of the most recent successes has been the deployment of an urban mobility management platform. It was developed in partnership with the [Municipality of Florence \(IF-Infomobilità\)](#), who, thanks to this application, gave **Mobility Managers the opportunity to monitor, in real-time, Florence's urban mobility status, spotting immediately any potential mobility crisis areas.**

This mechanism of real-time mobility policy information/news got integrated thanks to a **feedback system** that allows a direct communication channel between the Mobility Managers and the citizens. In other words, citizens can share their feedback on the current mobility status with the Mobility Manager. This contributes to the creation of a **360° sustainable mobility community**, in which urban mobility services constantly change, according to citizens' needs.

The most significant benefit for the Municipality of Florence is, that based on Phoops's data collection, management and analysis system, they have **become**

the sole owner of urban mobility data, also guaranteeing their citizens' privacy (GDPR compliance).

Solution

BriX supports two main endpoints, a **mobile application** and a **web application**, engaging two different types of end-users: citizens (consumers of services) and **City Managers** (highly technical operators managing services such as Smart Mobility, Smart Cities, Smart Energy, etc...). The ultimate goal is to create an ever-evolving community of conscious users and operators who contribute toward services customizations.

In the case of urban mobility, BriX allows the creation of an urban **mobility ecosystem** that is constantly changing, taking into account ongoing mobility challenges. This logic is even more beneficial in the wake of the COVID-19 pandemic crisis that modified the way we perceive and live urban mobility. MUV-APP is surely linked to these new challenges and fulfills mobility managers' expectations and meets changing needs. As a matter of fact, **it has a module entirely dedicated to the COVID-19 pandemic** to work as a tailored communication channel implementing a feedback logic. Therefore, the strength of BriX lays in the achievement of a high level of personalization, the integration of different kinds of data fluxes (e.g. user generated content, RSS feeds and so on) and devices (e.g. IoT devices) and making them interoperable.

The services gathering hub in BriX is entirely dedicated to the collection and integration of the needed services, offering a clear overview of the services supply chain. This module is specifically dedicated to end-users providing them information about the status of required services.

³ Mikkelsen, A., Grønli, T. M., Tamburri, D. A., & Kazman, R. (January, 2020). Architectural Principles for Autonomous Microservices. In Proceedings of the 53rd *Hawaii International Conference on System Sciences*.

One interesting application of this module within MUV-APP is the interactive homepage offered to citizens. It gathers real-time information concerning the status of urban mobility, e.g. mobility news and alerts or personal information. Furthermore, MUV-APP offers end users an interactive map that summarizes all mobility-related information updated in real-time.

From the homepage to your mobility

Personalize your homepage and get updated information according to **your** mobility needs!



Figure 2 - Service gathering hub showing the mobile application dedicated to smart mobility management (example: Florence)

BriX's profile manager allows end-users to achieve a high degree of services personalization. Thanks to this module, users can create their own profile, rate their favourite services (e.g. favourite e-charger, favourite smart city service, etc.) and store their favourite points of interest. Phoops have applied this module to several contexts, such as **Smart Parking**, to allow users to **book parking slots or seasonal subscriptions**. Furthermore, this module is extremely useful in the Smart Cities context: citizens are invited to store their preferences allowing BriX to provide them with tailored services. A machine learning matching algorithm allows the

application to send customized notifications to the citizen to inform him/her to remove his/her car in the case of street cleaning service or roadblocks.

Another BriX feature is the **feedback module that actively allows users to share their opinions** directly with the service provider. In this case, end-users are the key element to **increase the quality of the offered services**. All in all, the feedback module is a communication channel that directly connects end-users with City Managers and contributes to the creation of a conscious and sustainable community. This module is potentially applicable to several environments, from the field of urban mobility to Smart Cities service management.

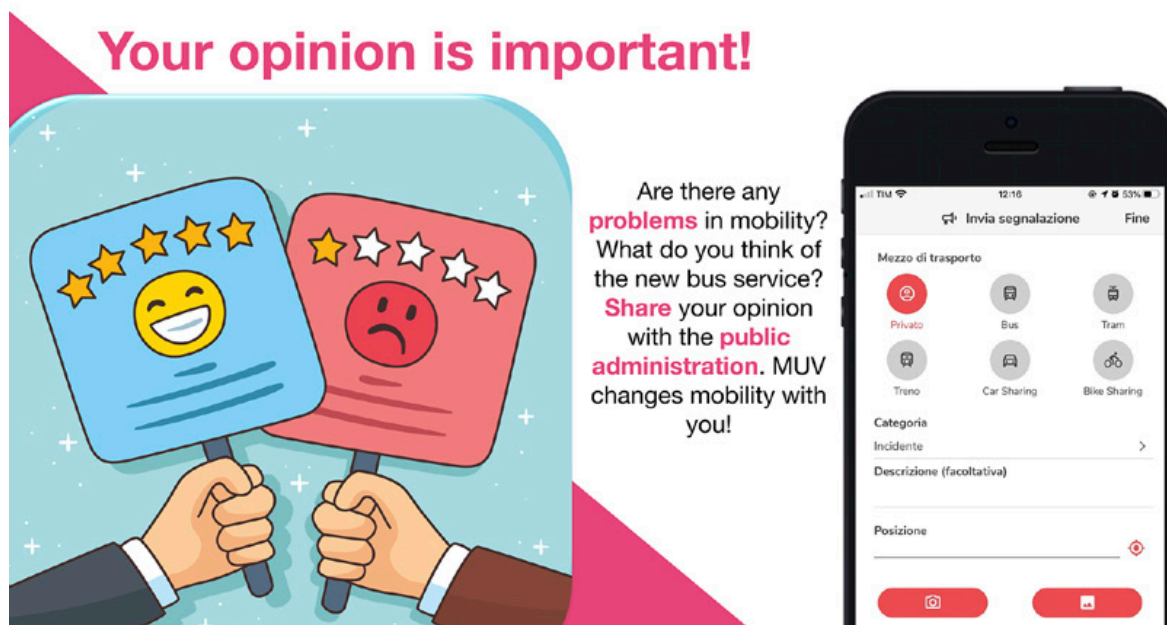


Figure 3 - Feedback module applied to the smart mobility management (example: Florence)

BriX is also equipped with a green heart, **a green module that is entirely dedicated to increasing sustainability**, by using a greener approach to services consumption. Thanks to this module, the service suppliers can support environmentally conscious behaviours among consumers, e.g. through higher attention to material consumption and the reduction of Co2 emissions.

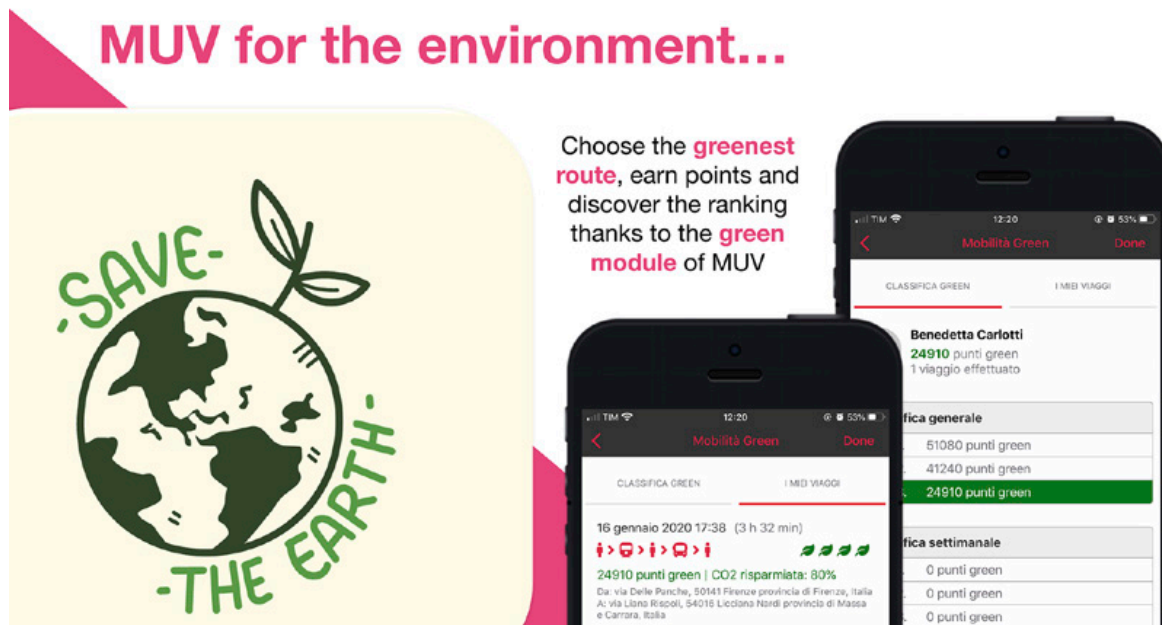


Figure 4 - Green module applied to the smart mobility sector (example: Tuscany, Italy).

Similarly, end-users become actively engaged and encouraged to perform greener behaviours, based on the application of a gamification principle. The module recognizes end users' environmentally friendly behaviours and rewards them through the so-called "green points" that are used in a reward system agreed with the service administrator.

Last but not least, the BriX Big Data and Insights part, the heart of the platform, is a module that receives data from different sources and devices (e.g. IoT, user generated data, PLC, smart cards and so on) to manage and analyse them while granting a high level of interoperability. Thanks to its flexibility, this module is potentially applicable to several context fields, from urban mobility to Smart Cities, from Smart Energy to Smart Industry.

How it works

BriX is based on a FIWARE-based architecture and presents two main endpoints: a mobile application (suited for both Android and iOS devices) and a web application. The former is meant to reach a large variety of end-users (e.g. citizens or City Managers), while the web application is better suited for highly technical operators. The access to the platform's microservices is regulated by an API gateway.

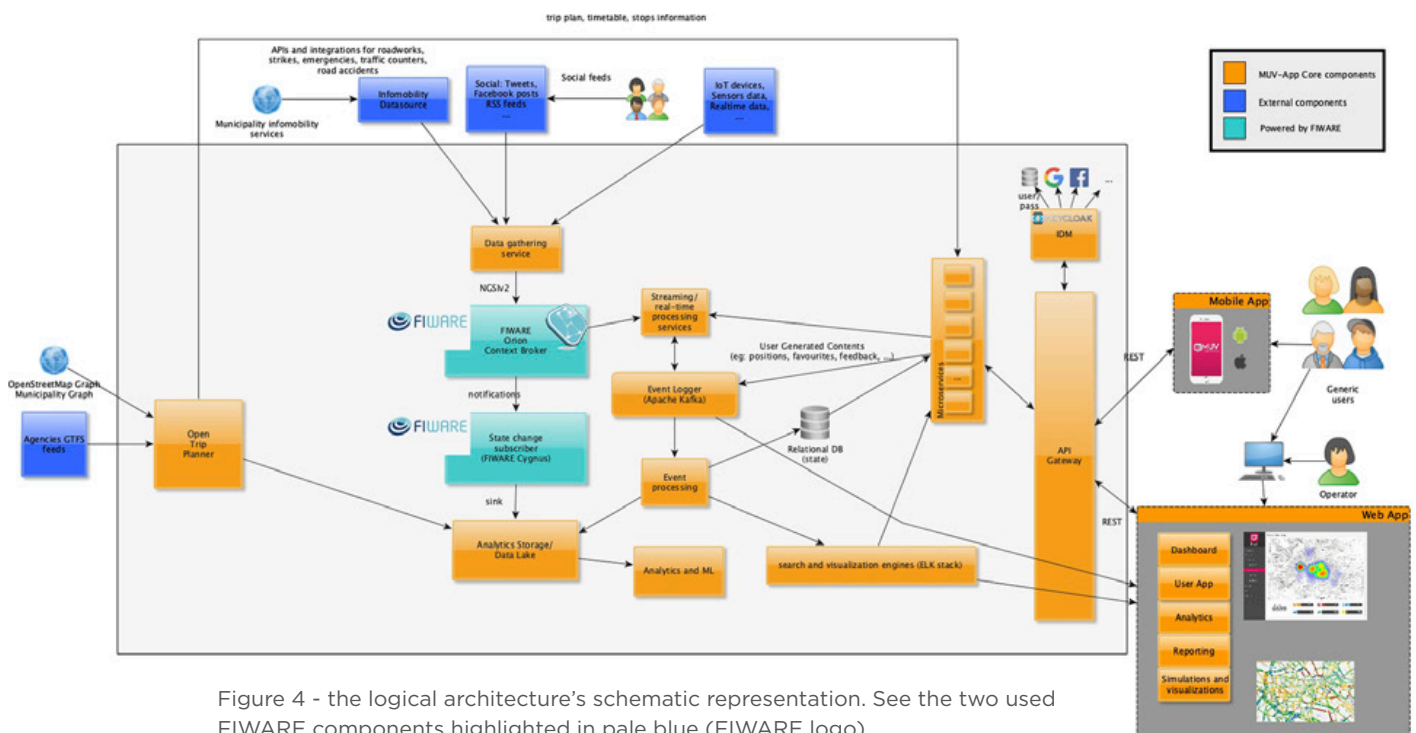


Figure 4 - the logical architecture's schematic representation. See the two used FIWARE components highlighted in pale blue (FIWARE logo).

The platform uses two main FIWARE components: the **Context Broker** (FIWARE Generic Enabler component – GERis, recognized from European Commission as [CEF Building Block](#)) and the **Cygnus state change subscriber** (FIWARE Generic Enabler – GEis). The former serves as a central HUB, in which, on one hand, data providers (all the data sources connected to the platform) register and publish their resources and, on the other hand, data consumers subscribe to relevant

information. The Cygnus component is used as a complementary piece of software for the Orion Context Broker, in order to pass information from the Orion Context Broker to the relational database to the event logger and to the Big Data module.

The entire platform is based on containerized services, orchestrated via standard technologies. BriX provides a central event logger used by service providers and consumers to deal with user interaction data. External data, that are collected thanks to the Orion Context Broker followed by Cygnus – ultimately land on the event logger and/or the relational database.

Benefits & Impact

There are five major aspects that make BriX and its several applications a highly beneficial FIWARE-based platform for its customers:

- A **high degree of customizable features** allows customers to personalize each single aspect of the platform to meet their needs;
- The platform's **modular approach** allows the implementation of the actual needed modules. In other words, this approach also ensures a high level of verticalization (e.g. through the application of a single-feature module like a Smart Parking module);
- The **high flexibility** of the architecture allows data gathering from different data sources (e.g. IoT sensors) and makes it highly adaptable to customers' needs;
- High **integrability** with customers' existing systems;
- It enables a high level of **interoperability** between different data sources.

Some of Phoops' implemented solutions/platforms are:

- Mobility-as-a-Service platform developed together with the **Tuscany Regional administration**;
- Mobility-as-a-Service platform developed for the public administration of the **Municipality of Florence**;
- Smart parking platform built with the **Municipality of Arezzo**;
- **Smart Energy management** of 22 solar plants together with a multinational enterprise;

- **Smart Industry optimization** together with four enterprises, active both at a national and international level;
- Pilot for a Smart City platform, currently under development, in the **Municipality of Wolfsburg**.

Added Value through FIWARE

Phoops has been a **FIWARE Foundation Gold Member** since 2019. Thanks to FIWARE, MUV, MUV-APP, and later on, BriX and its affiliated applications, have been so successful. Adding to the technological benefits, another success factor has been FIWARE's ever-growing international community that actually invests in innovative solutions and then successfully disseminates them to the market.

Phoops has been benefiting from many FIWARE opportunities to leverage them throughout **multiple marketing initiatives focused on Smart Mobility and Smart Cities sectors, from PR work to fairs, from being involved as speakers on international stages and ultimately growing its contact and customer network solidly**. This has provided the company with new and ongoing partnerships for platform development work, too. Furthermore, the **FIWARE Open Source approach allows Phoops to develop Open Source Solutions** from data acquisition to end-users consumption, from data management to data analyses.

Next Steps

Throughout Q4/2020, the BriX platform aims to grow by:

- acquiring new specific know-how in mobility management system, adapting it to the platform feature within different scenarios;
- increasing the development of machine learning algorithms;
- improving a path recognition algorithm for Smart Mobility Management alongside

- the CO2 consumption calculation algorithm;
- improving users' profiling algorithm;
- improving and customizing services' insights;
- adding new Smart Cities services in an attempt to broaden potential markets;
- acquiring new specific know-how and customers within the Smart Energy and the Smart Industry fields.

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- [National Operational Program “Metropolitan Cities 2014-2020” presentation of the App developed for the Municipality of Florence](#)
- [Press article \(Italian\) for the official presentation of IF-App test phase developed together with the Municipality of Florence](#)
- [Press conference's video of IF-App official presentation \(Beta version\)](#). Video in Italian
- Muoversi in Toscana. Project developed together with the Tuscany regional administration. See the link to the production App: [Android](#), [iOS](#)
- Smart parking module vertical implementation. See the App at: [Android](#), [iOS](#)

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Categories

Domains (s) Smart Mobility, Smart Cities, Smart Energy, Smart Industry

User (s) Municipality of Florence, Tuscany Region, Municipality of Arezzo, Wobcom GmbH, Private energy providers, Citizens

Key words MaaS, Web-Apps, microservices architecture, Context Broker, Open Source, Open Data, Big Data

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