



SMART CITIES AND DIGITAL TWIN

A/RporTWIN: FIWARE powered AR tool created for airport operations

With the contribution of



Challenge & Context

A/RporTWIN¹ is the next **digital twin powered by the FIWARE platform** concerning the management of various infrastructures. Designed from the ground up, it provides a **powerful data visualization and analytical tool** to be **used by managers and operators** of various mobility systems (airports, seaports, roads, railways, etc). It not only allows the user to visualize the infrastructure itself but it also integrates data from different sources and derived insights that are useful during day-to-day operations. It supports standard 2D visualization tools as well as proofs compatible with Augmented Reality/Virtual Reality (AR/VR) equipment, depending on the selected use case.

A/RporTWIN is based on well-established open standards: Web 3D and WebVR standards enabling high-quality model representations on-demand, and NGSI² for integration of the different modules as well as for digital twin data management.

Current digital-twin platforms are based on proprietary software which is very limited in relation to Augmented Reality or Virtual Reality capabilities. Moreover, **these proprietary software solutions are unable to be extended with new functions.** However, A/RporTWIN relies on standard-based Open Source technologies and Open Data Models bringing a unified platform for the management of complex infrastructures based on the management of context/Digital Twin data.

¹ A/RporTWIN A/RporTWIN is a common data analysis and visualization tool for airport infrastructure managers. It will bring together different sources of information that are useful during daily operations. This tool will act as a single source of information for airport operators. Some of its most notable features are compatibility with VR/AR technologies and third-party data integration. Additional information on EIT Digital, [IPTC](#).

² NGSI is a protocol developed by OMA to manage Context Information.

Solution

Airports are complex infrastructures dealing with an incredible amount of processes involving numerous tasks which have to be synchronized. Most of these tasks follow a strict schedule that must work flawlessly in order to offer quality service to airport users, both passengers and airlines. Having a sound understanding of the actual state of the different processes as well as a clear way to manage challenges like delays is crucial.

A/RporTWIN allows operation managers to monitor aircrafts in an airport, specifically turnaround operations. Such processes, concerning all the interactions between the plane, the stand and auxiliary vehicles (stairs, pushback trucks, etc.) have been identified as one of the potential bottlenecks and mission critical factors in the operation of airports. For this reason, the A/RporTWIN tool in the current phase focuses on the management of these processes.

Three main data sources are gathered in the platform related to the turnaround operations. These include an aircraft tracking provider, a computer vision-based event system that processes images from Closed Circuit Television (CCTV, well known as video surveillance), and internal airport data. These sources act in a complementary way to give the user a holistic view of the state of the airport and/or current process.

The aircraft tracking provider is used to monitor the position of all nearby planes so the turnaround process can be planned without exiting the application. This also allows the visualization of every aircraft's position in a later analysis, which may unveil bottlenecks due to stand allocations.

In order to detect the different events in the turnaround process, a computer vision algorithm is applied to the already existing CCTV images. This algorithm is focused on the detection of certain events that mark the beginning or the end of a task (e.g. the stairs truck not moving anymore). This approach allows the implementation of A/RporTWIN in an airport even when there is a low level of digitalization.

These data sources are complemented by the airport's own data. This data may vary between airports, therefore the final product may experience modifications from one client to another. Some basic data used by the application refer to flight identification and the association of flights with other processes. For example, the baggage information and the responsibility for each operation are shown, so an overall understanding of the situation can be grasped by the users.

A/RporTWIN initiative's partners are:

- [KTH, Royal Institute of Technology in Stockholm](#): possess high levels of expertise in user interface and data representation. KTH participation allows A/RporTWIN to provide a consistent and useful experience to the final user.
- [UPM, Universidad Politécnica de Madrid](#): a member of FIWARE Foundation, UPM is in charge of configuring and deploying the FIWARE infrastructure, modelling data and customizing FIWARE components to the requirements of the service.
- [Fundación Ci3](#): developers of the first Proof of Concept (PoC) of the system, Ci3 coordinates the project and participates in the frontend implementation.
- [Ferrovial](#): managers of the assets in the airport, Ferrovial helps to establish the scope of the project and the critical assets to be managed.
- [AGS Airports](#): owner of Aberdeen's airport, AGS acts as the customer in the project, in charge of sharing data, defining the needs and testing the final product.

How it works

A/RporTWIN service can be divided into two main parts: the frontend and visualization related APIs (models, textures, behaviours, etc.) on one hand, and the FIWARE-based backend. The latter deals with the connection of data sources, and implements the general server API allowing the airport system to be updated (e.g. turnaround timeline reports).

The A/RporTWIN backend is based on FIWARE components providing near real-time (right-time) and batch access to Context/ Digital Twin data by applications.

The Orion Context Broker³ manages all the context / digital Twin data related to departure and arrival airport scheduled flights. Orion enables access to data through the main operations of a CRUD (Create, Read, Update and Delete) implementation. Moreover, it notifies all interested client applications of any update in the Context / Digital Twin representation of airport entities through its system of publications and subscriptions.

Various information sources are processed in the following way (as demonstrated in Figure 1): external data sources send data to the FIWARE Draco⁴ component using different protocols and data formats. Then, Draco transforms the incoming data into updates on the Orion Context Broker via the NGSI API⁵. Additionally, other parts of the application perform updates directly on Orion via NGSI with information on flight notifications.

When updates are received by Orion, it sends a notification to all subscribed client applications providing them the new information. Then, the clients process the incoming data. In parallel, Draco saves the history of Context / Digital Twin data on a Mongo database MongoDB⁶ for future batch processing.

³ Orion Context Broker allows you to manage the entire lifecycle of context information including updates, queries, registrations and subscriptions. It is an NGSLD server implementation to manage context information and its availability.

⁴ FIWARE Draco is an easy to use, powerful, and reliable system to process and distribute data. Internally, Draco is based on Apache NiFi. NiFi is a dataflow system based on the concepts of flow-based programming. It supports powerful and scalable directed graphs of data routing, transformation, and system mediation logic. It was built to automate the flow of data between systems. While the term 'dataflow' is used in a variety of contexts, we use it here to mean the automated and managed flow of information between systems.

⁵ The current version of the specifications of the FIWARE NGSI API are the FIWARE NGSI-LD API specifications. In 2016, the European Commission published "The 2016 Rolling Plan for ICT Standardisation", in which it requested ETSI create a ISG (Industry Specification Group) aimed at the definition of a standard Context Information Management API with FIWARE NGSI as candidate. ETSI created this dedicated ISG beginning of 2017 resulting in a new standard, NGSI-LD, in November 2018. This API specification is compatible with the FIWARE NGSIv2 API specifications supported by the FIWARE/CEF Context Broker, adding new features that bring support to Linked Data. More information about the cross-sector Context Information Management (CIM) ISG at ETSI can be found in the FIWARE portal on www.fiware.org.

⁶ MongoDB is a general purpose, document-based, distributed data platform built for modern application developers and for the cloud.

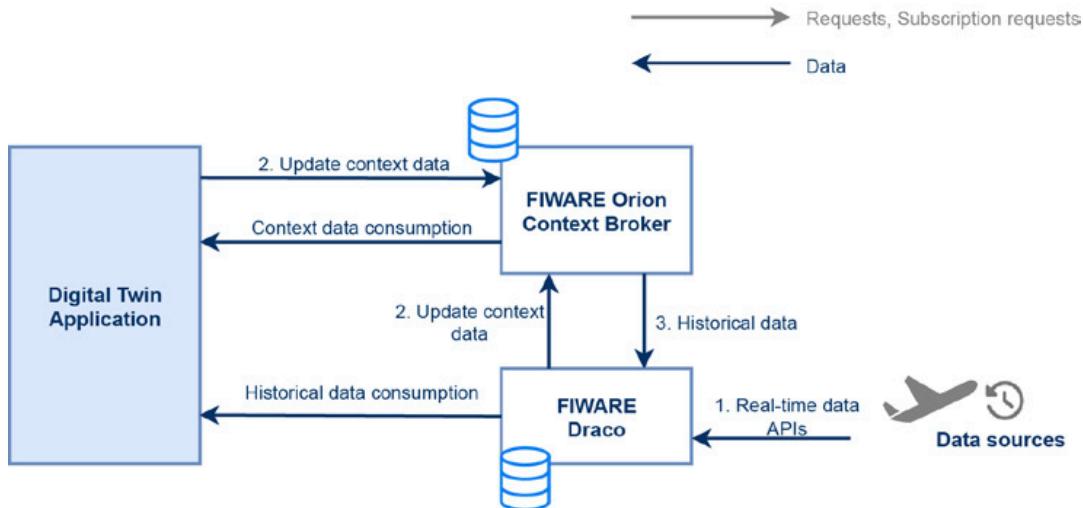


Figure 1 - Architecture

Benefits & Impact

The competitive advantages of A/RporTWIN are summarized in the following points:

- Unified and generic web-based platform for Airport management operations;
- Natively compatible with Extended Reality technologies;
- Modular design, mixing both geometrical data with streamed and historical data;
- Supporting
 - both near real-time and batch data processing;
 - both discrete and stream data processing;
 - third party integrated data sources;
- Aimed at the integration of future capabilities such as analytics or simulation.

The target market and customer segments are the following:

- Small & medium airports;
- Large Airports;
- Infrastructures concessionaires covering the whole life cycle;
- City councils;

- Facility management companies;
- Medium and large manufacturing Industries.

The Digital Twin market size was USD 5.10 billion in 2020. This value is projected to reach USD 35.8 billion by 2025 and USD 115.1 billion by 2035, growing at an estimated CAGR of more than 23.2%. Taking into account there are more than 40,000 airports all over the world, of which 17,600 are commercial. The global market for Smart Airports is projected to reach USD 22.6 billion by 2025⁷, driven by surging passenger traffic, growing investments in airport modernization and increasing investments in disruptive technologies which help improve the efficiency and effectiveness of airport operations.

A/RporTWIN solution is currently deployed at the **Aberdeen International Airport, located in Scotland, UK. The airport is owned and operated by AGS Airports which also owns and operates Glasgow and Southampton airports**. A total of just under 3.1 million passengers used the airport in 2018 with more than 90,000 movements. Thanks to the A/RporTWIN deployment, operators can visualize and manage turnaround operations and communicate with airport staff for scheduling flights and reporting delays in near real-time with a digital solution.

Added Value through FIWARE

A/RPORTWIN platform is composed of a set of software modules covering the full stack of a typical 3-tier web service architecture. These tiers correspond to the user interface tier for consuming and providing information, the business logic tier for managing such information and the persistence tier for storing the information. User interfaces are provided by web and desktop applications for visualizing 2D and 3D models of the airports, for managing notifications between users, and for visualizing airport scheduling.

⁷ Forecast developed in pre-Covid period.

A/RporTWIN relies on **FIWARE components** to 1) manage publish/subscribe patterns linked to updates on airport Context / Digital Twin data in near real time, 2) to ingest Context / Digital Twin data from different sources and process them before making them available for consumption by the applications, and 3) to store historical data for further processing and analysis.

On the other hand, to support full interoperability and replicability (portability) of the solution, a set of **FIWARE Smart Data Models** for the aeronautics domain have been created according to the requirements of the data sources used in the project.

ARporTWIN takes advantage of the following FIWARE components (Generic Enablers):

- 1 Orion Context Broker** for managing Context / Digital Twin data;
- 2 Draco** to store the history of Context / Digital Twin data and to ingest data into Orion from heterogeneous data sources;
- 3 Cosmos** to allow the execution of real-time big data analysis and machine learning over history data as it is generated;
- 4 Keyrock** and **Wilma** to allow the management of identity and access control.

FIWARE offers a powerful standard-based security framework that enables A/RporTWIN being compatible with new IoT solutions.

Next steps

During 2020, the first version of A/RporTWIN service was developed and deployed at Aberdeen Airport. During 2021, the solution is in its testing phase for further new functionalities involving real users and live cases. Together with partners like AGS (Ferrovial's participating company in charge of the management of several UK based airports (Aberdeen, Glasgow and Southampton), other airports are already explored as future targets for deploying this solution.

References

- [A/RporTWIN Innovation Report \(published by EIT Digital\)](#)
- [Project information at CI3 site](#)
- [A/RporTWIN project video](#)
- [Research paper about modelling Digital Twin with FIWARE](#)

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