Tools for the lifecycle of standard-compliant digital twins

FA³ST – Fraunhofer Advanced AAS Tools for Digital Twins

FA³ST facts

1. Tools for configuration, deployment and management of digital twins based on the Asset Administration Shell (AAS)
2. Interoperability by using/integrating standard technologies
3. Easy extensibility of the AAS environment

Digital twins, Industrie 4.0 and the Asset Administration Shell

Due to the advancing digitalization of industrial value chain, increasingly large amounts of data are being generated in industry. Making consistent use of this data opens up great potentials, such as:

- shorter development cycles
- use of artificial intelligence methods
- transparency in supply chains and production processes.

This requires that the data can be interpreted across system and company boundaries, generally referred to as interoperability. To meet this challenge, Plattform Industrie 4.0 has developed the Asset Administration Shell.
The Asset Administration Shell (AAS) describes a specification for modeling and representing real world components in the digital world. The goal is to create standardized digital twins. Standardization and the resulting uniform interfaces ensure interoperability between AAS-based digital twins.

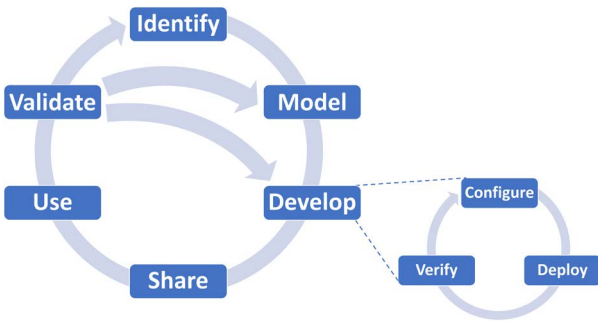### FA³ST: Tools for the digital twin lifecycle

Initially however, the AAS is only an abstract concept and needs to be implemented in software. One such implementation is the FA³ST service, part of the Fraunhofer Advanced Asset Administration Shell Tools for Digital Twins (FA³ST). FA³ST is a collection of tools for modeling, creation and use of digital twins based on the AAS. The individual tools target individual phases of the digital twin lifecycle.

Modeling, development, deployment and more

For the modeling phase, there is an OPC UA crawler that automates the generation of AAS models based on existing OPC UA servers. In addition, the model generator enables the generation of Asset Administration Shells based on existing sources (e.g. CSV files) by defining and applying mapping rules. During the development phase, the FA³ST service is configured and used to generate executable digital twins from the created models.

During the sharing phase, the FA³ST Registry enables the discovery of all the registered Asset Administration Shells. For secure and data-sovereign communication between companies, the use of IDS connectors (International Data Spaces) has also been implemented as a further feature. An extension is provided for the smooth integration of an AAS into the Eclipse Dataspace-Connector. For the usage phase, an AAS management tool is provided to monitor, control and document execution. With FA³ST visualization, the data and models can be presented in a readable and interpretable way.

Further tools are currently under development. The goal of these tools is to support the use of AAS-compliant digital twins. For example, by providing an AAS client library, the programming effort for projects that require interaction with the AAS can be significantly reduced, thereby increasing the adoption of the AAS standard. For more info about the current status of all tools visit www.iosb.fraunhofer.de/faaast.

The digital twin lifecycle.
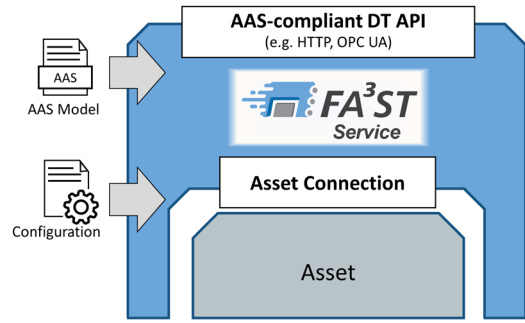
FA³ST service from the user's perspective.

FA³ST Service

FA³ST Service, which is available as open source software, is the central component of FA³ST and makes it possible to provide Asset Administration Shells that communicate via standardized interfaces (also called Type 2 Administration Shells). The modular architecture of FA³ST is based on these defined interfaces and, in combination with the dynamic configuration concept, enables easy extensibility of the functionality, which can also be obtained from third-party suppliers or developed in-house if required.

The most important interfaces concern the synchronization of the digital twin with its rea-world counterpart (Asset Connection) as well as the standardized interface for communication with external systems (AAS-compliant DT API). By default, FA³ST supports the OPC UA protocol as well as MQTT for synchronization and HTTPS for external communication. Support for other network protocols can be easily added if required.The FA³ST Service is developed based on Java 11 and published under the Apache License 2.0 (https://github.com/FraunhoferIOSB/FAAAST-Service). You can use the FA³ST Service as a console application, as a software library in existing applications or directly as a Docker container (https://hub.docker.com/r/fraunhoferiosb/faaast-service).

FA³ST in use

An exemplary use case for FA³ST is the digital representation of an inspection system (see figure), which automatically checks the quality of workpieces and stores the measured values. Both the production plant and the products are represented via AAS-based digital twins. Current information, such as the set target pressure or the current status of the system (normal, faulty), is stored in the system's AAS. A log of the latest maintenance is also stored.

The Asset Administration Shells for the products are created before the measurement process and then dynamically filled by the AAS of the plant, for example with the determined measurement, the quality (OK, faulty), the measurement time and the customer data. For this purpose, the plant's AAS communicates with the product's AAS. The FA³ST visualization uses this data to display dashboards, enabling both monitoring of the plant and traceability of the product manufacturing process. For example, the products can be identified via NFC and the relevant data can then be displayed.

In addition, the digital twin is also the basis for communicating with the customers and manufacturer of the measuring system used. In order to make this external data exchange as data-sovereign as possible, so that the data flow is traceable and the data is only used for predefined purposes, FA³ST supports the International Data Spaces. Using the AAS extension for the Eclipse DataspaceConnector, both components can be started and integrated simultaneously. Thus, FA³ST allows customers and manufacturers protected access and use of data across company boundaries.

Contact

Dr. rer. pol. Ljiljana Stojanovic
Tel. +49 721 6091 287
ljiljana.stojanovic@
iosb.fraunhofer.de

Fraunhofer Institute of Optronics, System Technologies and Image Exploitation IOSB
Fraunhoferstr. 1
76131 Karlsruhe
www.iosb.fraunhofer.de
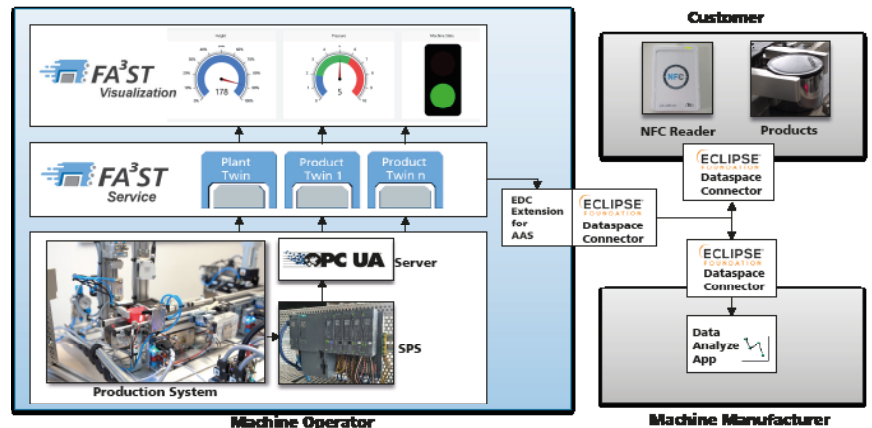
FA³ST in use, providing digital twins of products and of a production plant in a cross-enterprise scenario.