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MindSphere Closed-Loop Foundation

Enable a closed-loop digital twin by connecting MindSphere with enterprise systems

Benefits
- Maintains the correlation of physical and virtual models through the entire lifecycle of the system
- Enables users to feed real-world operational data into design, planning and production models
- Helps optimize product performance and efficiency
- Easily builds digital twin integrations with any PLM system using the connector to improve product insights

Features
- Manages enterprise model definitions using JSON-based schema or industry-standard FMI 2.0
- Configures connectors to establish secure communication with enterprise systems
- Enables custom connector development
- Monitoring of jobs submitted by closed-loop applications

Summary
Closed-Loop Foundation is a MindSphere® application that provides a foundation to connect different applications like Simcenter™ Amesim™ software, Plant Simulation from the Tecnomatix® portfolio and Teamcenter® software with MindSphere. Enterprise application capabilities can be exposed as services in MindSphere Closed-Loop Foundation, which another MindSphere application can consume. It provides services and a user interface (UI) to create mappings between the asset data model and different models in system simulation and discrete events simulation. It also allows services to easily configure the model for simulation and run it using an asset's operational data. It provides a mechanism to register and connect on-premise/cloud-based applications using a connector. A specification is also provided to build a connector for third-party applications.

Figure 1: Register a connector end point using an enterprise gateway.

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Challenge

Throughout their digitalization journey, enterprises have developed virtual models for different aspects of their product or production in dispersed applications like simulation tools, product lifecycle management (PLM) systems, etc. These models need Internet of Things (IoT) data to transform into the digital twin of the asset, which can provide real insight about the product or production. A comprehensive digital twin of the product/production can be used to improve the virtual model as well as the product's predictive and diagnostics purposes. The issue is that there is no consistent way to connect virtual models from different applications to the physical assets in an IoT system. It is a complicated process to run these models with IoT data and use the simulated result for further analysis.

The other obstacle to provide the full power of the digital twin to the larger user base is the lack of support for the services provided by the enterprise applications in a cloud-based application development environment. The enterprise application landscape is complex and hybrid in
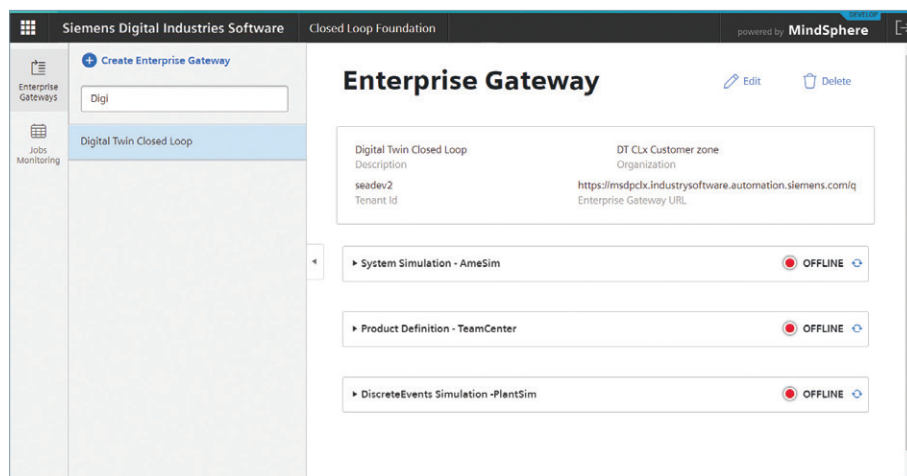

Figure 2: Connect to multiple applications through enterprise gateway connectors.

nature, and security is the highest concern.

Solution

MindSphere Closed-Loop Foundation provides a mechanism to map the virtual model with the physical model and apply it consistently to different domains like product and production. It allows the user to define the mapping at type level and reuse it for individual instances of the assets. It provides a secure foundation to connect to the

application using a connector. Connectors implement services leveraging the capabilities of the applications. These services are exposed in the foundation, which a MindSphere application can consume. It also allows customers/partners to write a custom connector to an application for which out-of-the-box (OOTB) support is not available. MindSphere Closed-Loop Foundation also provides support to manage configurations to run a simulation and trace the simulation result.
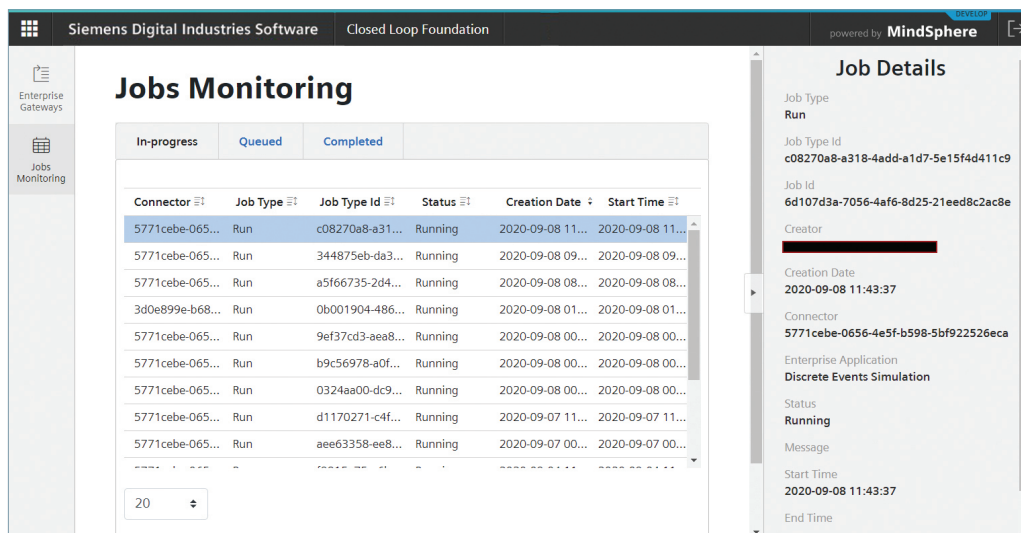

Figure 3: Jobs monitoring view to see jobs that are in-progress, queued and Completed.

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Enterprise gateway

The enterprise gateway provides a secure way to communicate between MindSphere to the enterprise systems deployed inside on-premise/cloud corporate networks. MindSphere Closed-Loop Foundation allows a MindAccess™ IoT Value Plan user to register a connector endpoint using a router and resides within the corporate network. It supports basic and OATH 2.0 security for the communication between MindSphere Closed-Loop Foundation and the connector. A connector can support one or multiple applications. Enterprise systems can be registered along with the connector.

Jobs monitoring

Jobs monitoring allows users to view scheduled jobs posted by closed-loop applications. The UI allows users to view in-progress, queued and completed jobs. The user also can view complete details of each job.

MindSphere

MindSphere is a leading industrial IoT as a service solution that uses advanced analytics and artificial intelligence (AI) to power IoT solutions from the edge to the cloud. Built on the Mendix™ application platform, it empowers users to quickly build personalized IoT applications. MindSphere is a part of Xcelerator™, a comprehensive and integrated portfolio of software and services from Siemens Digital Industries Software.