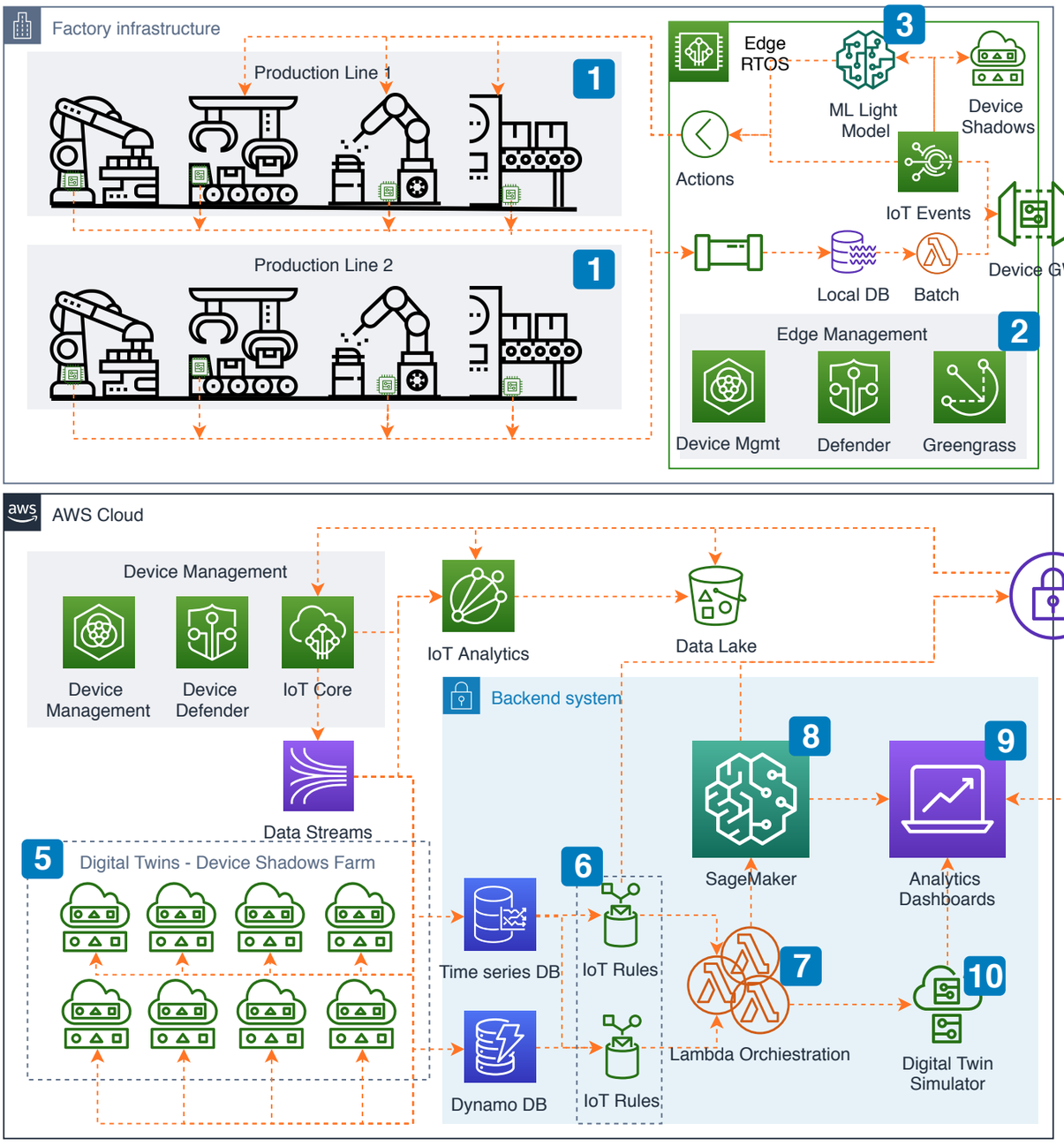
Mesh Twin Learning ("MTL")

Implementation of Edge devices at factories to enable data gathering and light ML models usage.



1 **Production lines with Edge Devices -** each machine at a production line is equipped with a micro-pc device that contains a real-time operating system, with all tools enabling the local setup of Mesh Twin Learning. Each of the devices collects the data from sensors and actuators, before proceeding with processing.

2 **Edge management tools -** the local representation of AWS tools, allowing for the remote management and monitoring of Edge devices. Each is responsible for another area – such as on-the-air updates, security and data streaming.

3 **Local Light Machine Learning model -** a trained and optimised model that constantly acts on real-time data received directly from edge devices. Depending on the nature of the component, asset, process or system responsibility, it can optimise, monitor and alert, predict or classify the current state of production.

4 **Secure connection with the Cloud -** an established and secured channel to transfer data and models to and from the Cloud. The safety of the information, as well as governance, is provided on all levels of implementation. Communication security is enforced by the usage of encrypted channels, VPN connections, the rotation of certificates, etc.

5 **Device Shadows Farm - Digital Twins -** farms of virtualised devices representing the state of the factory and processes, in the form of metadata. Steered by the events and information received from edge devices, they always show the most accurate status. Their presence enables the ability to simulate physical environments, get quicker insights and monitor events with a great magnitude of details.

6 **Rule Engines -** IoT rules and policies that enable the possibility to run supervised simulations – a competition between Machine Learning models - and discover the optimal ones to pass through and update edge devices with.

7 **Backend orchestration system -** a set of backend applications – microservices or lambda functions - responsible for the automation of operational activities before, during and after Machine Learning training, as well as running simulations and processing information.

8 **SageMaker -** The central point of the Machine Learning process, where the model constantly evolves based on newly received data from edge devices and simulations. The next versions of parameters optimisations and light models for targeted groups of edge devices (machines) are produced and propagated here.

9 **Analytical dashboards -** A set of near-real-time dashboards presenting insights into the current state of the factories, production lines, assets and components, as well as other statistics from the KPI perspective i.e. optimisation process efficiency, savings, velocity, etc.

10 **Digital Twins simulator -** a platform allowing the simulation of various conditions and their influence over supervised parts of the production processes. Outputs from the simulations are actively presented to the operators through analytical dashboards and are also used for more advanced ML trainings.