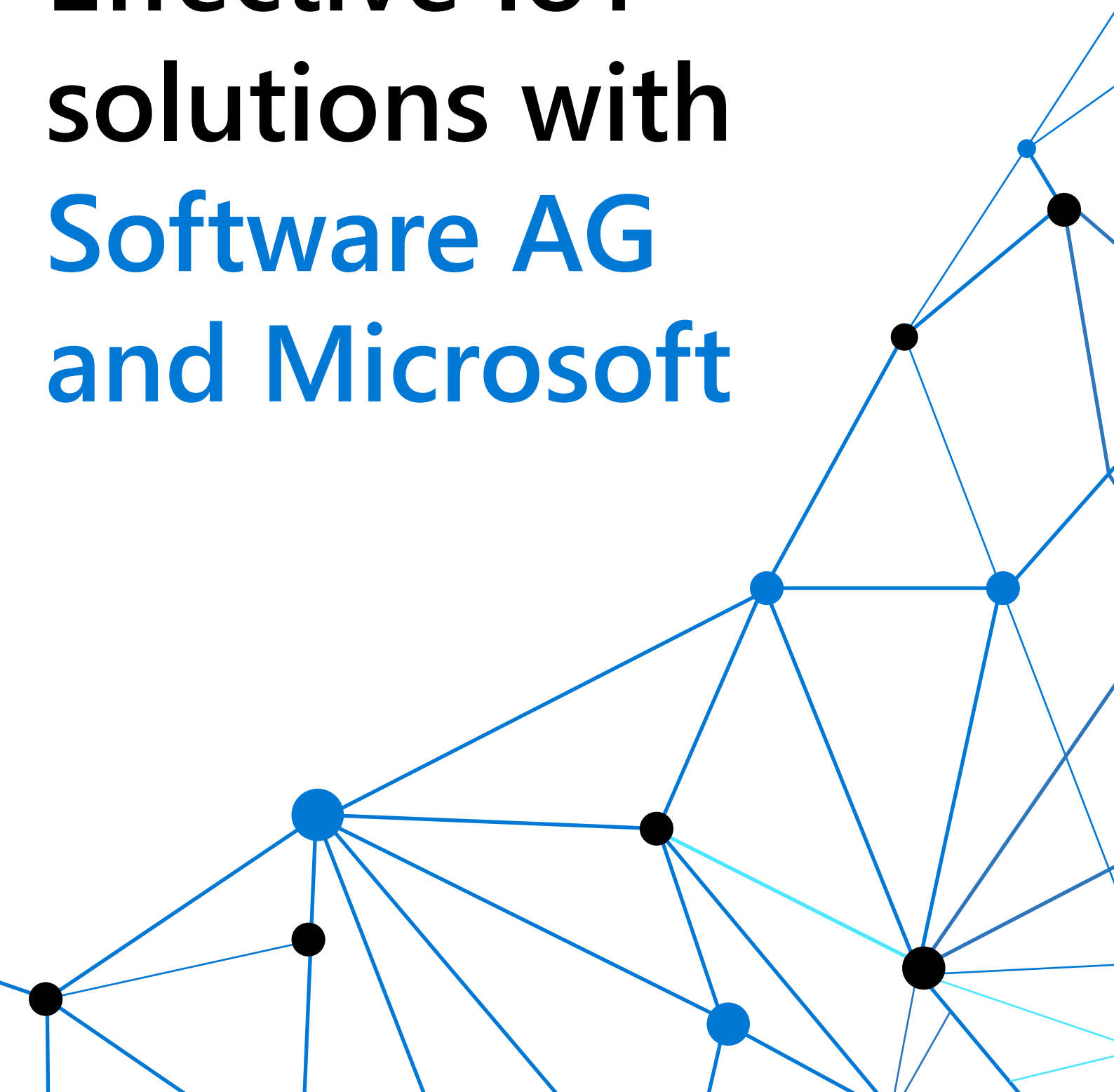
Effective IoT solutions with Software AG and Microsoft



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Effective IoT solutions with Software AG and Microsoft

Building connected technology ecosystems creates a data-rich system that optimizes processes and drives innovations. IoT is the backbone and the data it produces shapes novel ways to improve products and services, create value for customers, and differentiate your company from the competition.

This white paper covers:

- Simplifying, connecting, and managing IoT devices with plug and play specifications.
- Harnessing IoT data for real-time decisions, optimized asset management, and strategic planning.
- Applying machine learning and advanced data science to IoT data sets in the cloud and at the edge.
- Deploying a secure, resilient, and sustainable IoT solution.

Whether your organization wants to build new capabilities or extend the current IoT ecosystem, the solution needs to be cost-effective and easy to implement and maintain. An IoT decision must also provide a fast time to value.

Preserving current investments while growing IoT capabilities

Our research shows that many companies have started IoT initiatives but struggle to scale. Current projects often use propriety code and non-interoperable devices from a single vendor which can get in the way of scaling projects. The projects lack advanced, pre-built device management capabilities and more universal plug and play devices.

Acquiring non-differentiating technical capabilities such as device management and operation, data storage, and infrastructure should not be the sole emphasis of implementation decisions. By acquiring non-differentiating technical capabilities, companies minimize the use of IT resources for under-the-hood tasks. The IT resources can instead be deployed to cloud-based advanced analytics and machine learning initiatives to develop differentiating capabilities—capabilities that use IoT to create a competitive edge.

Therefore, it is important that organizations either buy and build within the existing IoT framework or buy to extend onto a scalable platform. Both approaches preserve the value of the current IoT investments. It is worth noting that, as technology evolves, buy to extend on a cloud-based platform based on universal industry specifications ultimately enables differentiating capabilities without permanently committing to a specific vendor.

The Software AG and Microsoft partnership

Software AG and Microsoft, both identified as a Leader in the 2022 Gartner® Magic Quadrant™ for Global IIoT Platforms, have scalable IoT solutions based on interoperable technologies, industry standards, and non-proprietary formats.

Since both are Leaders in the MQ, it may seem that the product and feature offerings from Software AG and Microsoft have similar capabilities. However, a close look at the actual technologies reveals that while there is some functional overlap, the products cover significantly different situations and requirement sets. Instead of competing offerings, the companies have complementary offerings.

Real-world implementations have shown that when an organization combines technologies from Software AG and Microsoft, it has the best of both worlds to build robust, scalable IoT solutions. The following sections will discuss how to combine elements from both companies to build an IoT environment with confidence.

02

Identify, connect, and manage IoT devices with DTDL specifications

Identifying, describing, connecting to, and managing IoT devices is a fundamental part of any IoT initiative. Fortunately, it has never been easier to do this. Microsoft IoT Plug and Play enables solution builders to integrate IoT devices with their solutions without any manual configuration.

Use certified IoT plug-and-play devices to get to value quickly

Getting to value quickly while navigating the complexity of IoT integration is a common challenge. The **Microsoft Azure Certified Device program** simplifies device integration with the IoT Plug and Play device registry. IoT Plug and Play decouples the software on the device from the IoT solution in the cloud and enables solutions that are device agnostic.

IoT Plug and Play uses Digital Twin Definition Language (DTDL). **DTDL is the language for describing digital twin models and capabilities.** It allows IoT devices to declare their capabilities to cloud solutions. DTDL is used to create a "device twin." Implementing connectivity to a device is simple once the device twin is available, reducing development time, cost, and complexity especially for full-scale deployments.

Add IoT devices with DTDL specifications and Cumulocity IoT

Software AG's **Cumulocity IoT is an independent device and application management IoT platform that embraces DTDL specifications.** The use of DTDL significantly accelerates the creation of IoT based solutions. New device types can be quickly defined in Cumulocity IoT by importing their DTDL. Devices do not need to be physically installed to yield data. The Cumulocity IoT device simulator generates data for single devices and entire groups of devices.

For known devices, Cumulocity IoT has predefined dashboards with rich visualization of the data coming from the devices, based on their DTDL. Building a dashboard for larger objects with multiple IoT devices is done by simply picking a subset of the dashboard elements (widgets) of the devices.

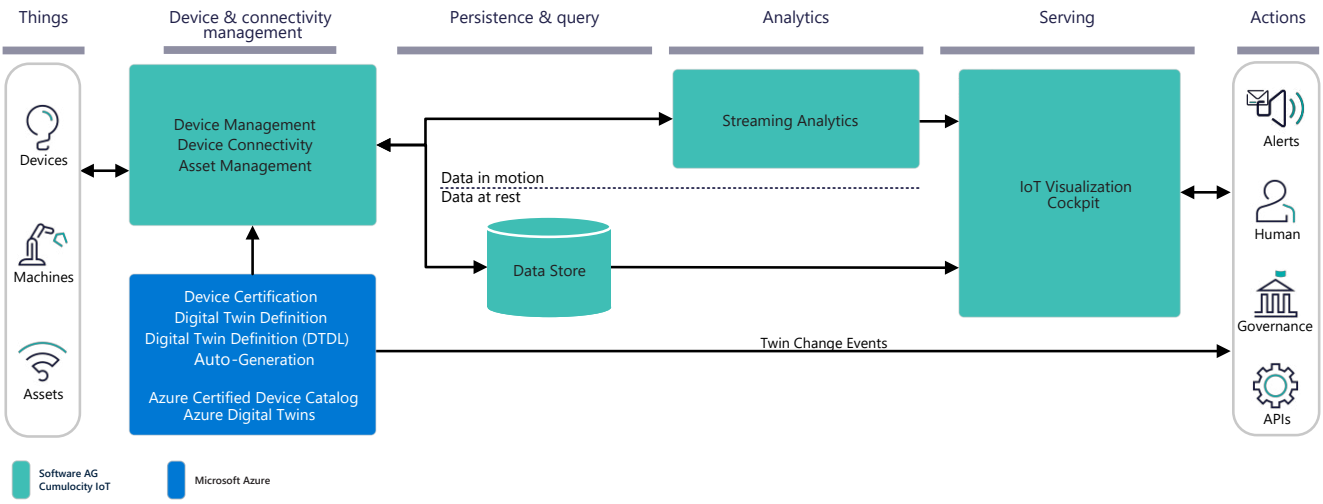
Manage devices in system of growing complexity

When moving from concept to deployment of a system, it is critical that it can be properly operated, maintained, and supported in the future. Robust device management is a foundational element for any large-scale IoT rollout. Whether the plan connects and monitors existing brownfield systems or deploys new greenfield networks, having well-planned device management greatly reduces the complexity—and cost—of managing IoT deployments.

Cumulocity IoT device management efficiently monitors and controls devices, automatically surfacing alerts and connectivity issues. It manages device lifecycles including firmware, software, configuration, and security-related tasks. With the potential to scale support across millions of devices, combining device management with ready-to-use device capabilities can also help reduce management costs.

Well planned and executed device management ensures continued success after the first implementation. The ratio between time spent on system management tasks versus business capabilities does not increase, but rather decreases over time. As it orchestrates distributed workflows and analytics on IoT devices, users can now shift their focus to innovating and building services that have a far greater impact on business capabilities.

Build physical and logical structures for IoT devices



Device and asset management using DTDL specifications for plug-and-play capabilities

As an IoT deployment scales up, managing hundreds, thousands, or millions of devices on an individual basis is not practical. Instead, digital representations of the structures or configurations in which they exist simplify the complexity of device management. These structures can reflect the physical world—devices that are part of an assembly line—or they are logical abstractions like descriptions of device type or ownership. Both types of structures are often hierarchical.

This categorization can be extended to entire digital twins, which are comprehensive models of physical objects including static and dynamic aspects. Beyond twins for IoT devices, Microsoft Azure Digital Twins uses DTDL specifications to model much larger and more complex structures like factories, energy networks, or even entire cities.

The Cumulocity IoT Digital Twin Manager (DTM) makes it easy to give structure to IoT devices. Cumulocity IoT digital twins take advantage of DTDL and IoT Plug and Play initiatives but can run independently. This allows you to create (or import) asset types and entire asset hierarchies and flexibly define the asset properties that are relevant for the IoT solution. Additional features like 'localization' are tailored to the specific needs of asset management in the context of IoT. The multi-tenancy and role-based policies of DTM manage device and data access to increase the security of IoT systems.

03

Use analytics for split-second decisions and long-term strategic planning

The data from IoT devices is a critical component of an organization's decision-making process. The large streams of short-lived IoT data must be **coupled with capabilities to find and act upon immediate insights and to also leverage them in the context of the overall business strategy**. Combining capabilities of Cumulocity IoT on Microsoft Azure support both the short term and long-term data analytics needs.

Keep up with the speed of data with Cumulocity IoT analytics

The Cumulocity IoT platform provides comprehensive, real-time analytics capabilities that **domain experts and line-of-business users can use** without the support of IT staff. The data can be explored and visualized in real time. Even more sophisticated tasks like the definition of important KPIs can be done with ease. For frequent use cases like Operational Equipment Effectiveness (OEE), predefined analytics are available for immediate usage.

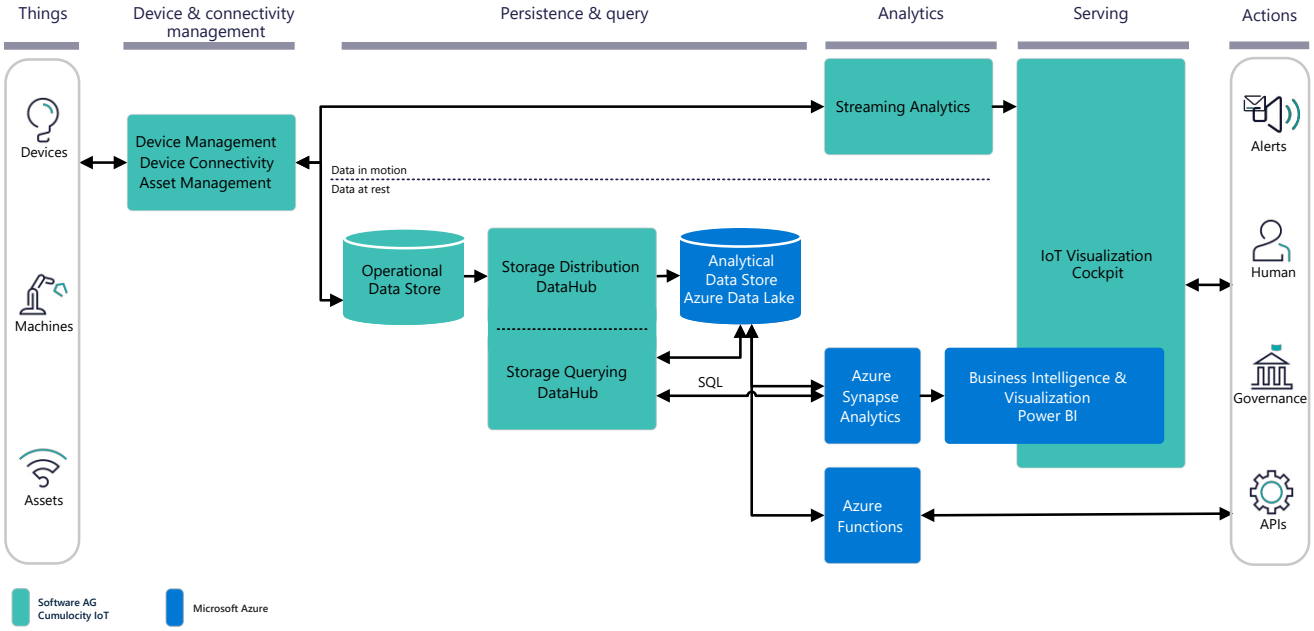
Data from devices can be analyzed, correlated, compared, and acted upon directly before the data is written to storage ("data in motion"). For example, if a production system shows irregularities, the IoT solution provides **split-second decisions and actions to help prevent damage** before the specifics of the irregularities are fully analyzed.

This also includes (but is not limited to) the usage of artificial intelligence. While machine learning (ML) models are most frequently used on stored datasets ("data at rest"), Cumulocity IoT makes it easy to apply them to streaming IoT data. For example, a simple camera can watch over a conveyor belt with an ML algorithm running locally (at the "edge") to detect anomalies.

Cumulocity IoT analytics can aggregate data over time, compare batch results, monitor equipment performance over time, and more. For example, in batch manufacturing, temperature curves per batch run can be correlated to derive a typical temperature curve per batch run ("fingerprint"). This is the basis for predictive maintenance, a prime use case for Cumulocity IoT analytics.

Access and analyze IoT data for true business intelligence with Microsoft Azure

Gaining strategic business insight requires looking beyond the real-time, high-velocity data that IoT devices deliver. That data must be put into context of 'slower' data, in particular data driving business processes. The foundation for deeper more extensive analytics is to have the IoT data stored in the right place and in the right format.



Comprehensive querying and analytic capabilities using non-proprietary data storage

The understructure for achieving that is to have the IoT data stored in the right place and in the right format. Cumulocity IoT's primary data storage is the Operational Data Store, a NoSQL database optimized for time series data. The Cumulocity IoT DataHub offloads the data from that operational data store into a large volume "analytical data store." **The Azure Data Lake (ADLS Gen 2) provides a complementary, scalable, and cost-effective service to store the data for later analysis.**

In the offloading process, Cumulocity IoT DataHub transforms the data from a non-SQL to a SQL-queryable format, leveraging the popular Apache Parquet™ data format. Afterwards, you can query the data using Cumulocity IoT Data Hub's SQL query capabilities. As the data is now in Azure Data Lake, you can of course choose any appropriate query and update tool.

Using Cumulocity IoT, you are not building an "IoT silo" with proprietary and locked-in data. In fact, Cumulocity IoT DataHub provides seamless integration with pre-existing data technology, allowing you to extend and build business value on top of the IoT platform.

The analytical capabilities of Cumulocity IoT focus on devices and equipment, operational optimization, risk mitigation, fast decision-making, and root cause analysis. Microsoft products can extend these capabilities by adding business intelligence, analytics on data from quite diverse sources and different velocities, high levels of aggregation, business process optimization, and ultimately strategic insight.

For most companies, business intelligence is not greenfield. Existing data from multiple sources, organizational structures, technologies, and budgets are in place, possibly in an Azure data lake in combination with Azure Synapse and Power BI—analytics and business intelligence platforms from Microsoft. **Now, it is possible to add IoT as a critical element to existing BI infrastructure.** Without retraining or retooling, IoT provides information that boosts business intelligence for critical business insights.

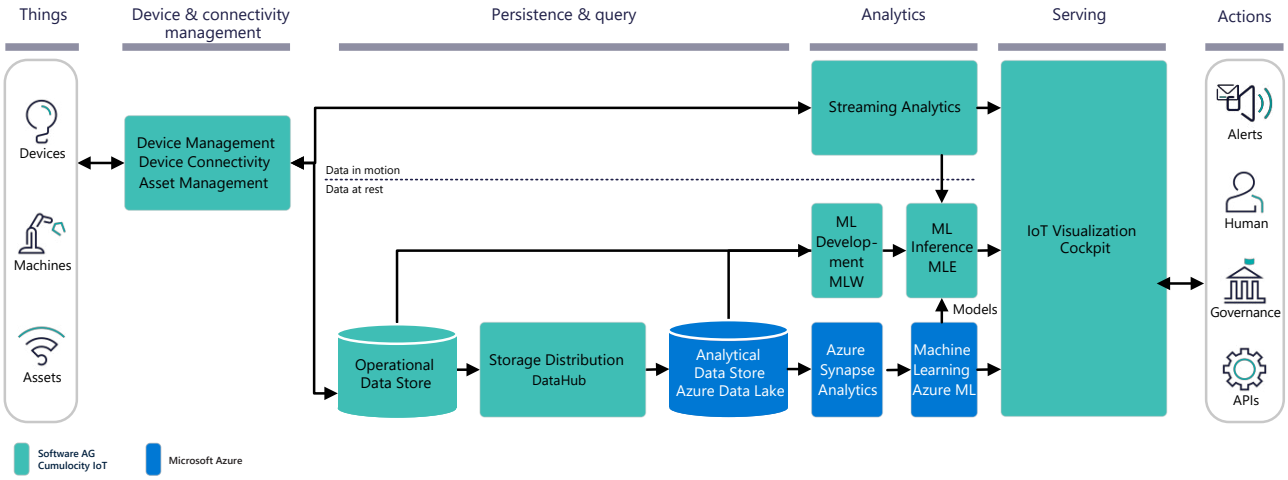
Both Cumulocity IoT and Power BI can create dashboards without writing a line of code. The typical Cumulocity IoT UI, with configurable integration with ADLS and Power BI, is an operational dashboard with self-serving analytics. In contrast, Power BI is a business intelligence dashboard geared towards managerial use. In many cases, however, it makes sense to combine elements of both. You can add Power BI visualizations to a Cumulocity IoT dashboard. This works in edge environments, as well.

The orange box above shows the Power BI report embedded in the Cumulocity IoT dashboard

04

Create an ecosystem fueled by Azure machine learning

Machine learning is no longer done by a few early adopters. Mature cloud-based ML environments, affordable ML capable edge hardware, and other factors have brought it to the mainstream as an indispensable tool to improve analytics, product quality, and product features.



IoT machine learning for cloud and edge

These general analytics capabilities of Cumulocity IoT and Microsoft can also be applied to ML. **Cumulocity IoT offers ML capabilities tailored to IoT, while Microsoft offers a comprehensive, general-purpose ML platform in the cloud.** ML models and data flows freely between both.

Azure Machine Learning is a comprehensive, powerful, and easy-to-use machine learning platform. It is a cloud service, also called Machine Learning as a Service (MLaaS). The popular Jupyter Notebook is built in; and IDEs like R Studio are supported, as well. It also provides industry-leading machine learning operations (MLOps) features.

Azure ML can be used on IoT data in the analytical data store. From small data being offloaded periodically to massive measurements being offloaded daily, data science teams are able to conduct further analysis on, for example, an Azure data lake.

Software AG provides specific components for ML in an IoT context. While ML is most frequently done in the cloud, it is sometimes required to move the execution of the models ("inference"') closer to the devices, either to an edge environment or even directly onto the device. For this, Software AG provides the high-performance inference engine Machine Learning Engine (MLE). Models from popular model development environments can be used because MLE supports the lingua franca of ML models, the open-standard PMML and ONNX representations. This, of course, includes models from Azure ML. Tailored to resource-constrained hardware environments, MLE is an excellent choice for inference on both thick edge and thin edge hardware, as well as on the device. It can consume both data from streaming devices and data at rest.

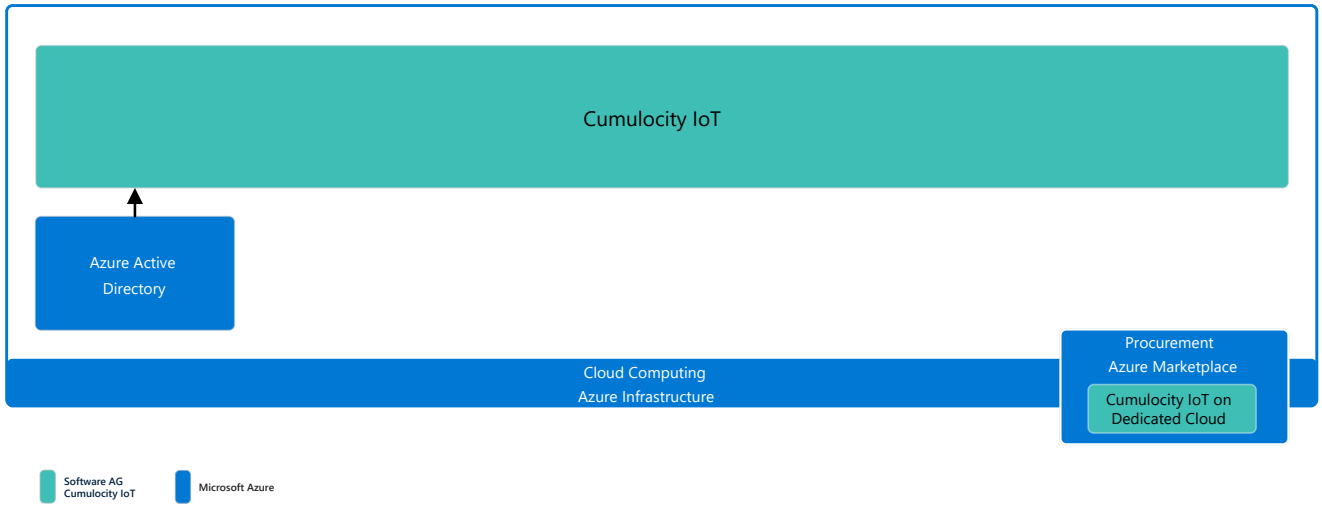
A common pattern is to start by developing and training models in Azure ML. On the analytical data store—specifically for heavy-duty computing—models are executed in the Azure Cloud. For data from other sources or for ML in the cloud or on the device, the MLE is used. The combined features from Software AG and Microsoft cover all data sources and all processing platforms required for modern IoT Machine Learning.

05

Configure an infrastructure based on organizational needs

Cumulocity IoT is the leading IoT application enablement platform. When it comes to deployment, different business challenges demand different approaches. **Software AG has an extensive range of deployment options on Microsoft Azure.**

The Cumulocity IoT Azure Platform as a Service (PaaS) offering delivers a ready-to-go environment in the public cloud in minutes. Of course, a free trial is available for evaluation and first steps. The cloud-based solution handles the burden of hardware provisioning, installation, and operation. It also scales with growing demands. The Cumulocity IoT Azure PaaS environment can operate in the region of your choice to satisfy both data protection and other legal requirements.



Deployment of Cumulocity IoT on Azure

Cumulocity IoT is available as an IoT solution in the Microsoft Azure Marketplace. Benefits of this partnership include managed operations of Cumulocity IoT on Azure by Software AG, simplified billing for both the infrastructure and the IoT platform, integrated authentication with Single Sign-On, and use of Azure's log analytics and integration with other data services.

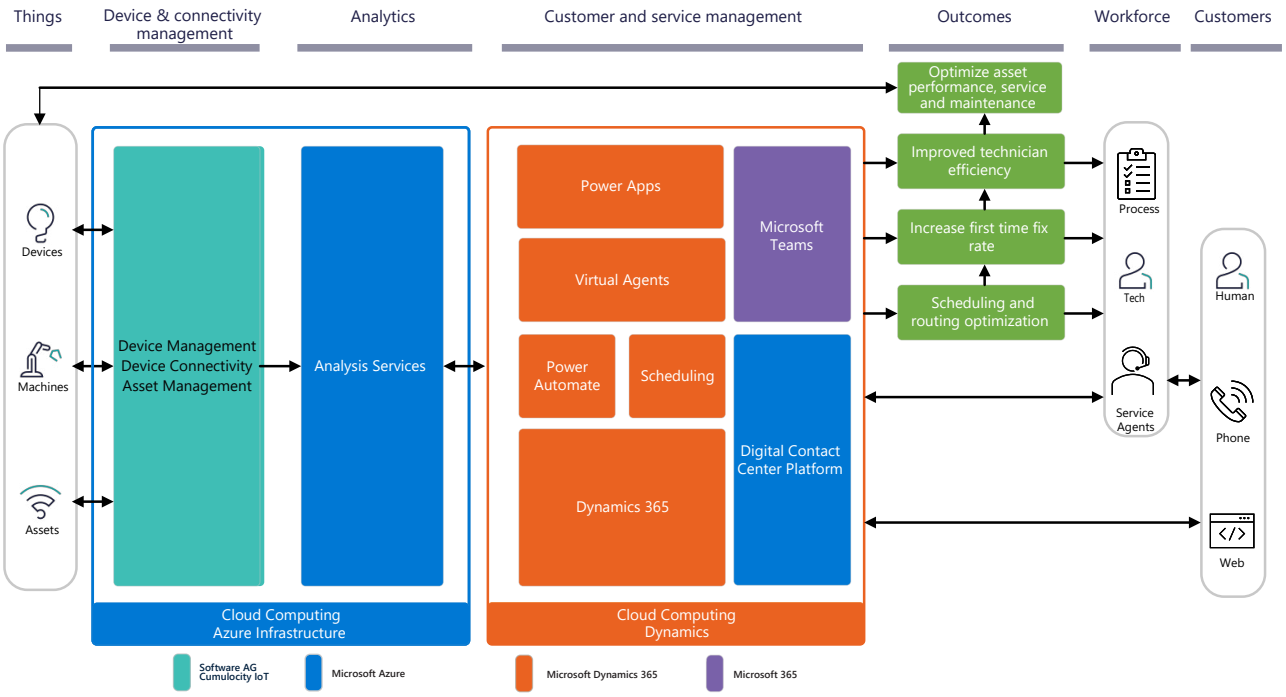
The rise of smart devices supporting machine learning on the edge is driving the growing importance of IoT. Sophisticated edge topologies often ask for the IoT platform to be operated at the edge, or in a hybrid configuration. For such cases, Cumulocity IoT can be installed on a single edge node based on a specifically tailored edge edition. Resource constrained edge devices area handled via the open-source framework thin-edge.io, for which Software AG is a co-initiator and key contributor.

06

Address business challenges with Cumulocity IoT on Azure

Modernize service experiences

Unifying cross functional support and your customer service journeys is possible when Cumulocity IoT's flexible API integrations are coupled with the power of Microsoft Dynamics 365 Customer Service, Field Service, Nuance, Teams, Power Virtual Agents, and Azure.



Cumulocity IoT and components on Azure supporting a modern service experience

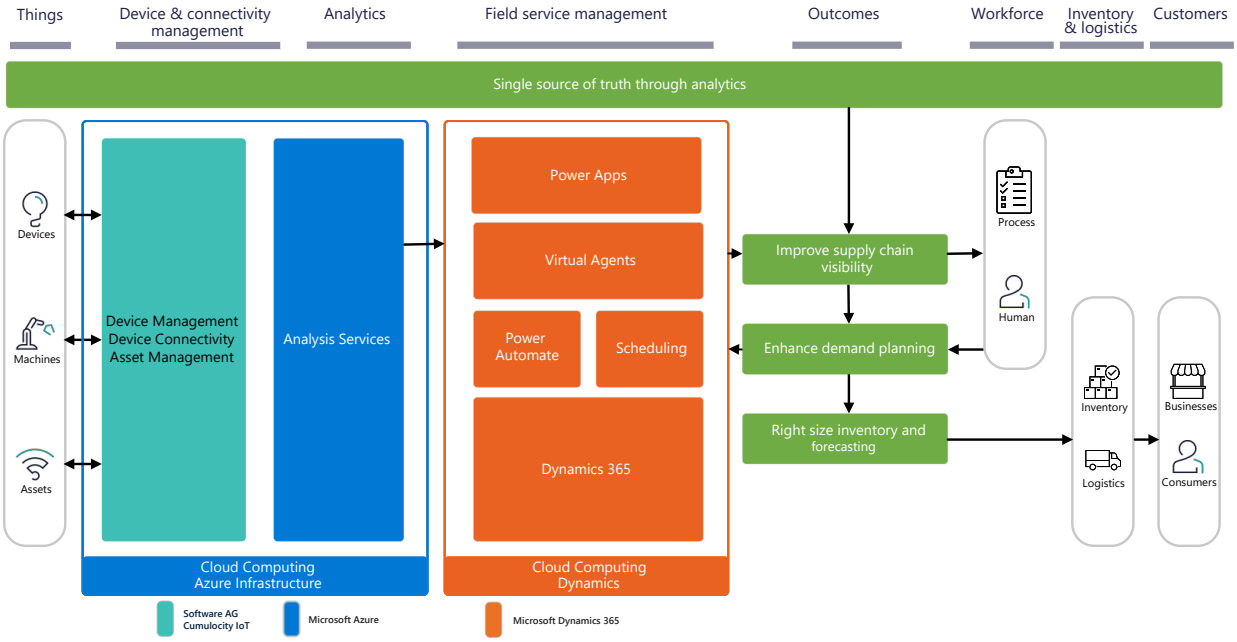
With Cumulocity IoT suppling proactive metadata and events via a digital contact center platform, the open, extensible, and collaborative approach connects contact center leaders with customer service, case management, and contact center AI. This happens through a variety of voice, video, and other digital engagement channels, supported by high levels of automation for innovative customer and agent experiences.

The combination of Cumulocity IoT with modern Dynamics 365 servicing can help increase customer satisfaction scores (CSAT), improves agent productivity, and optimizes service operations while augmenting the service experience to include customer journey orchestration and connected field service for an end-to-end modern service journey.

Enable a resilient and sustainable supply chain

The data collected and enhanced by Cumulocity IoT on Azure can be used to predict supply chain disruptions and proactively mitigate them to meet demand, profitably and sustainably. Connecting Cumulocity IoT to ERP and management systems like Dynamics 365 Supply Chain Management, Intelligent Order Management, Guides, and Power Platform can help you digitally transform supply chains without replacing existing systems.

The global reach of Azure's backbone, support of logging and telemetry standards and unique Hybrid Management capabilities combine with Cumulocity IoT's world class scalability and integration capabilities to transform the supply chain to gain resiliency, make better decisions, and easily adapt to new business models. Using the combined capabilities of Azure and Cumulocity IoT, businesses can turn supply chains into a competitive advantage.



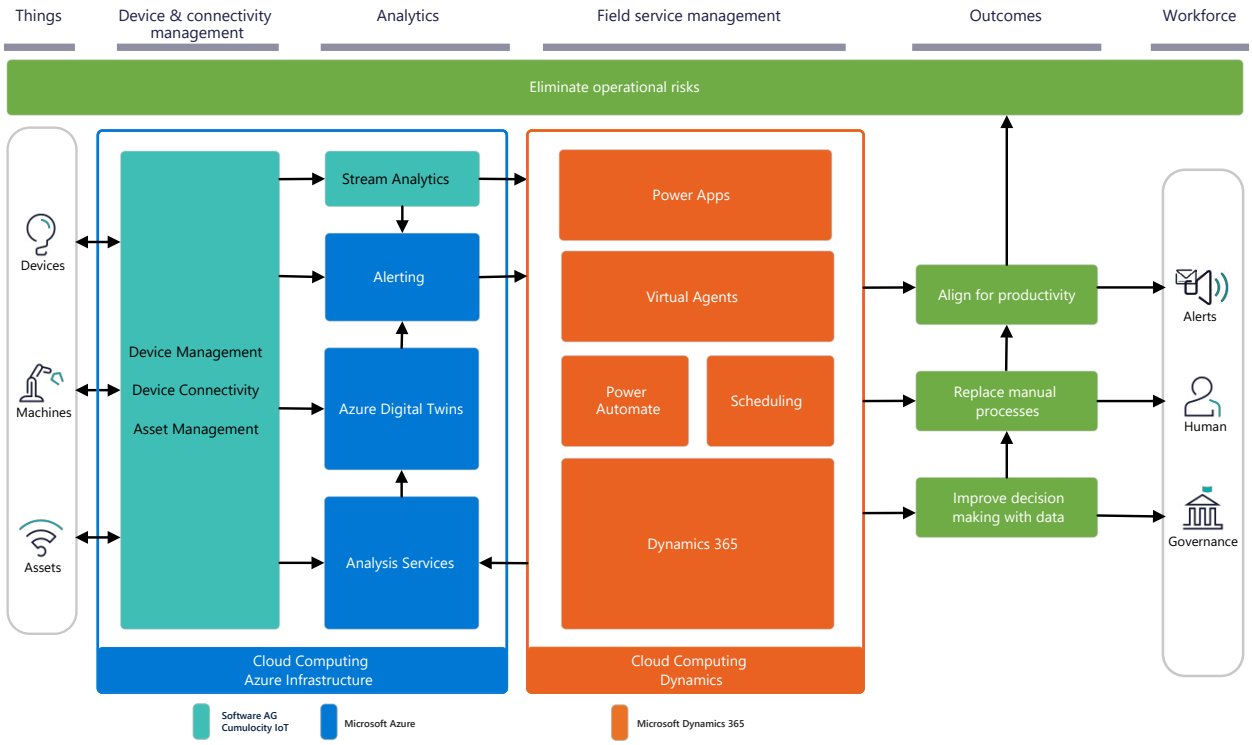
Azure and Cumulocity IoT components interacting to enable resilient and sustainable supply chains

Create more agile factories

Remote work and remote assistance for the frontline workforce are now standard. The existing skills gap in manufacturing continues to grow and there are additional challenges to upskilling the modern workforce for the 'new normal' in manufacturing. Demand uncertainty and disruptions continue to drive a move to agile manufacturing where smaller scale modular plants replace rigid mass production.

To customize your products and services for your customers—and innovate at the speed that product-as-a-service requires—manufacturing sites needs agile, responsive production processes. Analytical, alerting, and low code app capabilities across Cumulocity IoT, Power Platform and Microsoft 365 are uniquely positioned to help support companies looking to modernize and keep up with digital transformation impacting their industries.

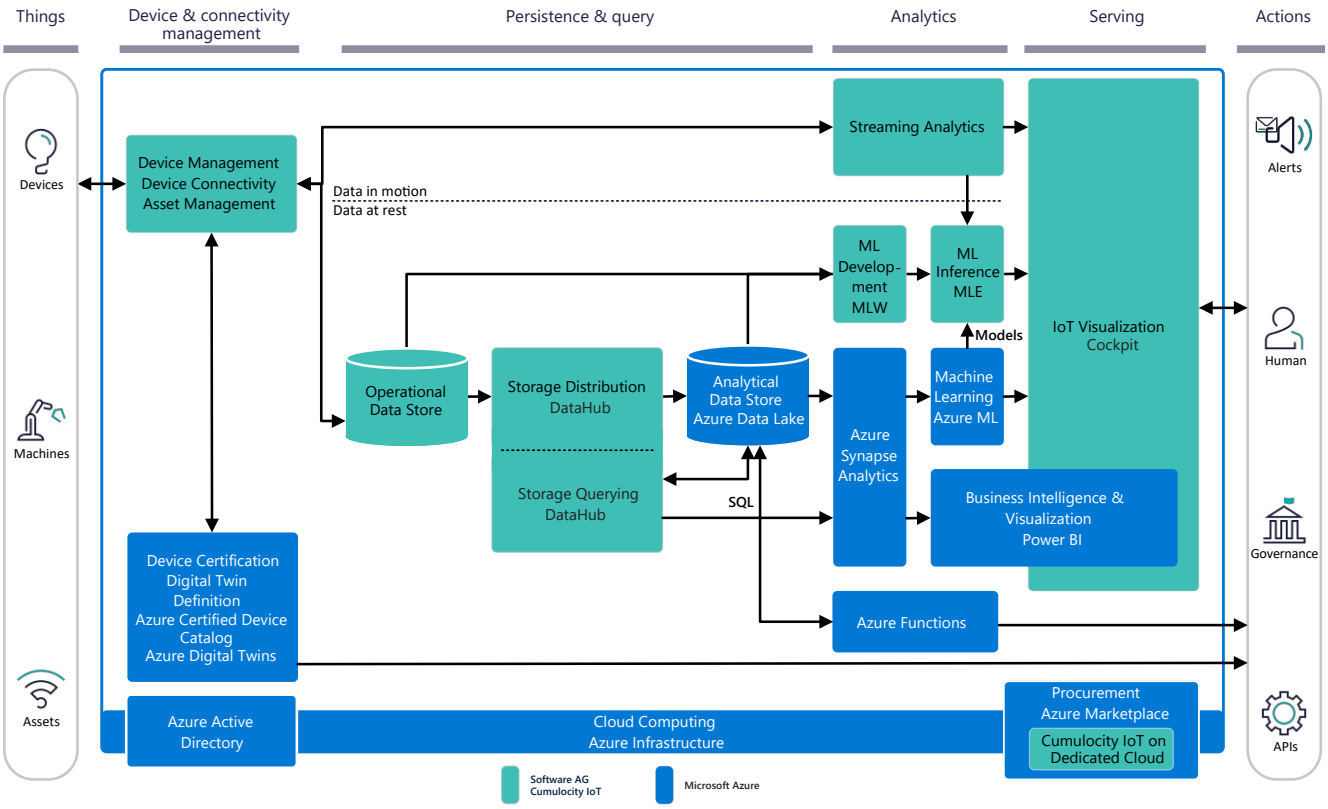
Cumulocity IoT on Azure helps build a "factory of the future" that supports the complex ecosystem of self-regulating machines and optimally allocates resources for sites with customized output. Running Cumulocity IoT in Azure seamlessly connects and monitors factory performance across the globe. Data from smart assets provide operational insights to further optimize production processes. Capabilities to provide advanced IT capabilities on top of IoT are supported by tight integration with digital twins, Azure Functions, AI, and mixed reality.



Cumulocity IoT and Microsoft Cloud components interacting to enable more agile factories

07

Software AG and Microsoft IoT collaboration and interchange



The above illustration captures a high-level summary of how Software AG and Microsoft IoT components work together. It maps out the key interfaces between Software AG and Microsoft technology for IoT, focusing on the main areas of collaboration and interchange. Note that this is an extensible architecture, and the illustration does not represent a complete IoT architecture.

08

Your way forward

Software AG and Microsoft offer market leading IoT solutions that when used in combination create a comprehensive and complementary set of IoT and analytics capabilities. The solutions protect previous investments that avoid creating a closed and proprietary solution. Ready-to-use device capabilities ensure the extensible architecture of the IoT ecosystem is scalable and configurable to meet evolving business needs. From device definitions all the way to user interfaces, the combination operates with interoperable software, industry standards, and non-proprietary formats.

Finding the right solution for your organization primarily requires a precise definition of objectives and software requirements. We encourage you to explore our combined solutions before selecting your IoT technology partners.

Gartner, Magic Quadrant for Global Industrial IoT Platforms, Alfonso Velosa, Eric Goodness, Ted Friedman, Katell Thielemann, Emil Berthelsen, Lloyd Jones, Kevin Quinn, Scot Kim, Peter Havart-Simkin, 12 December 2022

Software AG simplifies the connected world. Founded in 1969, it helps deliver the experiences that employees, partners and customers now expect. Its technology creates the digital backbone that integrates applications, devices, data, and clouds; empowers streamlined processes; and connects "things" like sensors, devices and machines. It helps 10,000+ organizations to become a truly connected enterprise and make smarter decisions, faster. The Company has about 5,000 employees across more than 70 countries and annual Group revenue of over €950 million.