



SAP Cloud Platform Internet of Things

Your Name/Surname, Title
Date

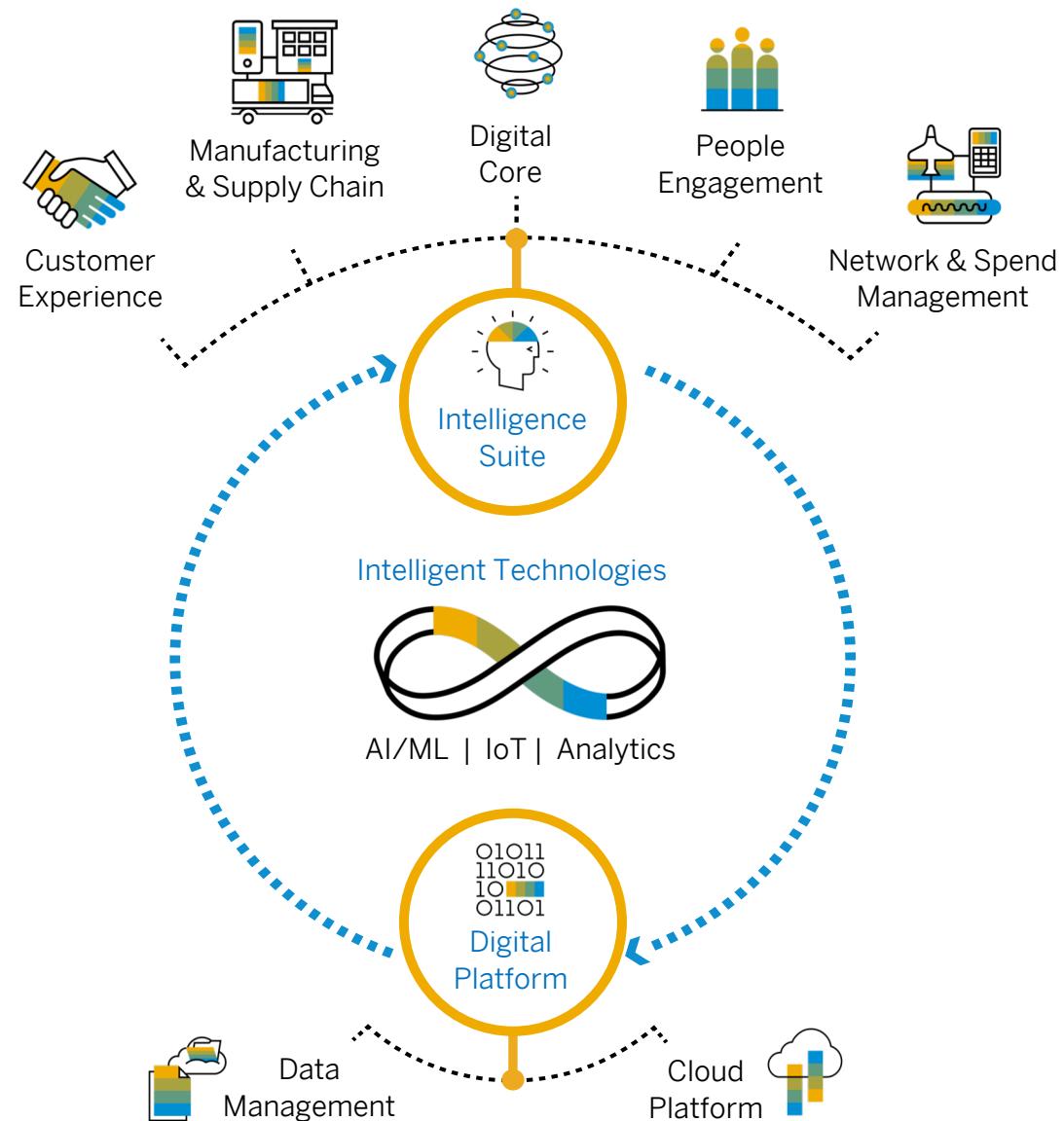
CUSTOMER

Disclaimer

- The information in this presentation is confidential and proprietary to SAP and may not be disclosed without the permission of SAP. Except for your obligation to protect confidential information, this presentation is not subject to your license agreement or any other service or subscription agreement with SAP. SAP has no obligation to pursue any course of business outlined in this presentation or any related document, or to develop or release any functionality mentioned therein.
- This presentation, or any related document and SAP's strategy and possible future developments, products and or platforms directions and functionality are all subject to change and may be changed by SAP at any time for any reason without notice. The information in this presentation is not a commitment, promise or legal obligation to deliver any material, code or functionality. This presentation is provided without a warranty of any kind, either express or implied, including but not limited to, the implied warranties of merchantability, fitness for a particular purpose, or non-infringement. This presentation is for informational purposes and may not be incorporated into a contract. SAP assumes no responsibility for errors or omissions in this presentation, except if such damages were caused by SAP's intentional or gross negligence.
- All forward-looking statements are subject to various risks and uncertainties that could cause actual results to differ materially from expectations. Readers are cautioned not to place undue reliance on these forward-looking statements, which speak only as of their dates, and they should not be relied upon in making purchasing decisions.

Deliver the Intelligent Enterprise

THE INTELLIGENT
ENTERPRISE features
3 KEY COMPONENTS:



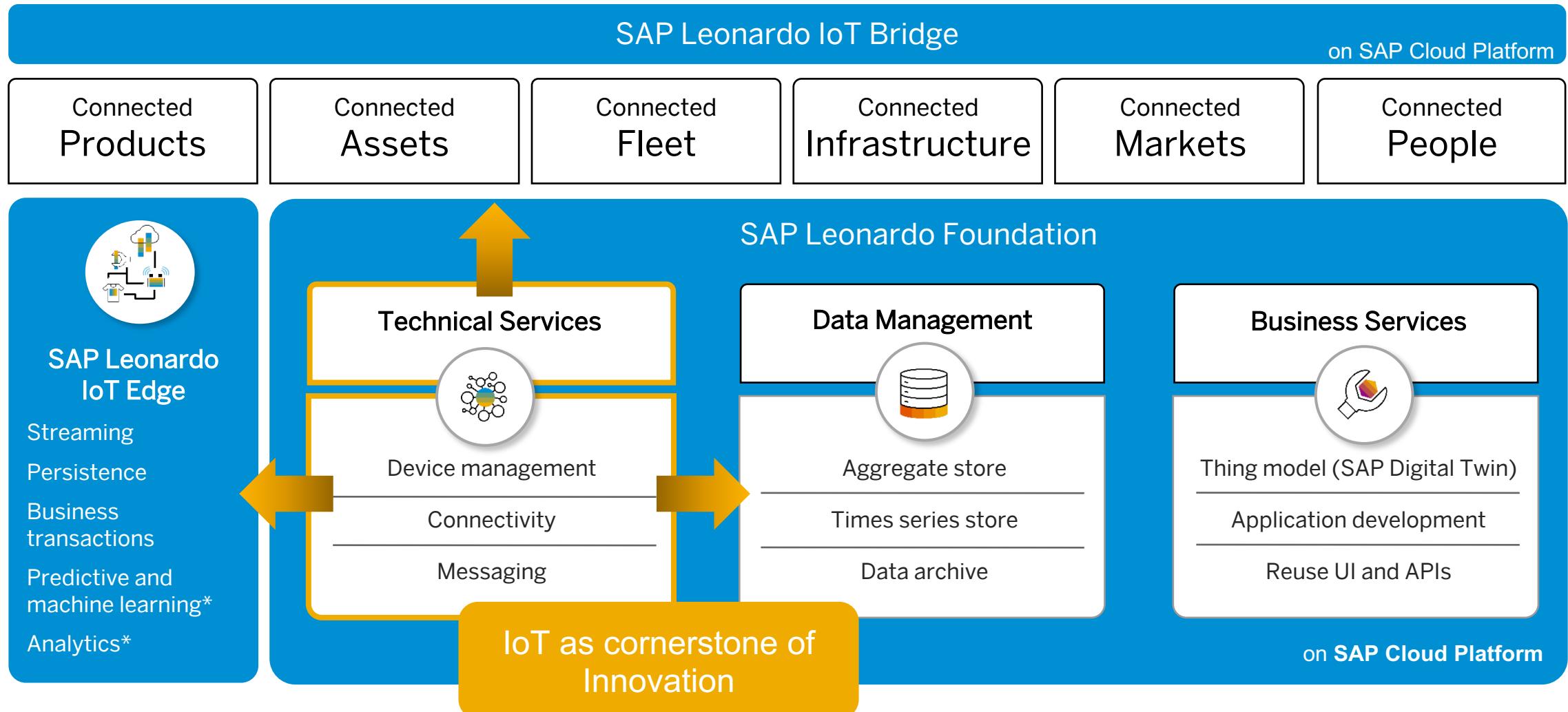
1 Intelligence Suite

2 Digital Platform

3 Intelligent Technologies

SAP Leonardo Internet of Things capabilities

Full stack of IoT solutions and technologies



Internet of Things Innovation

SAP Cloud Platform Internet of Things

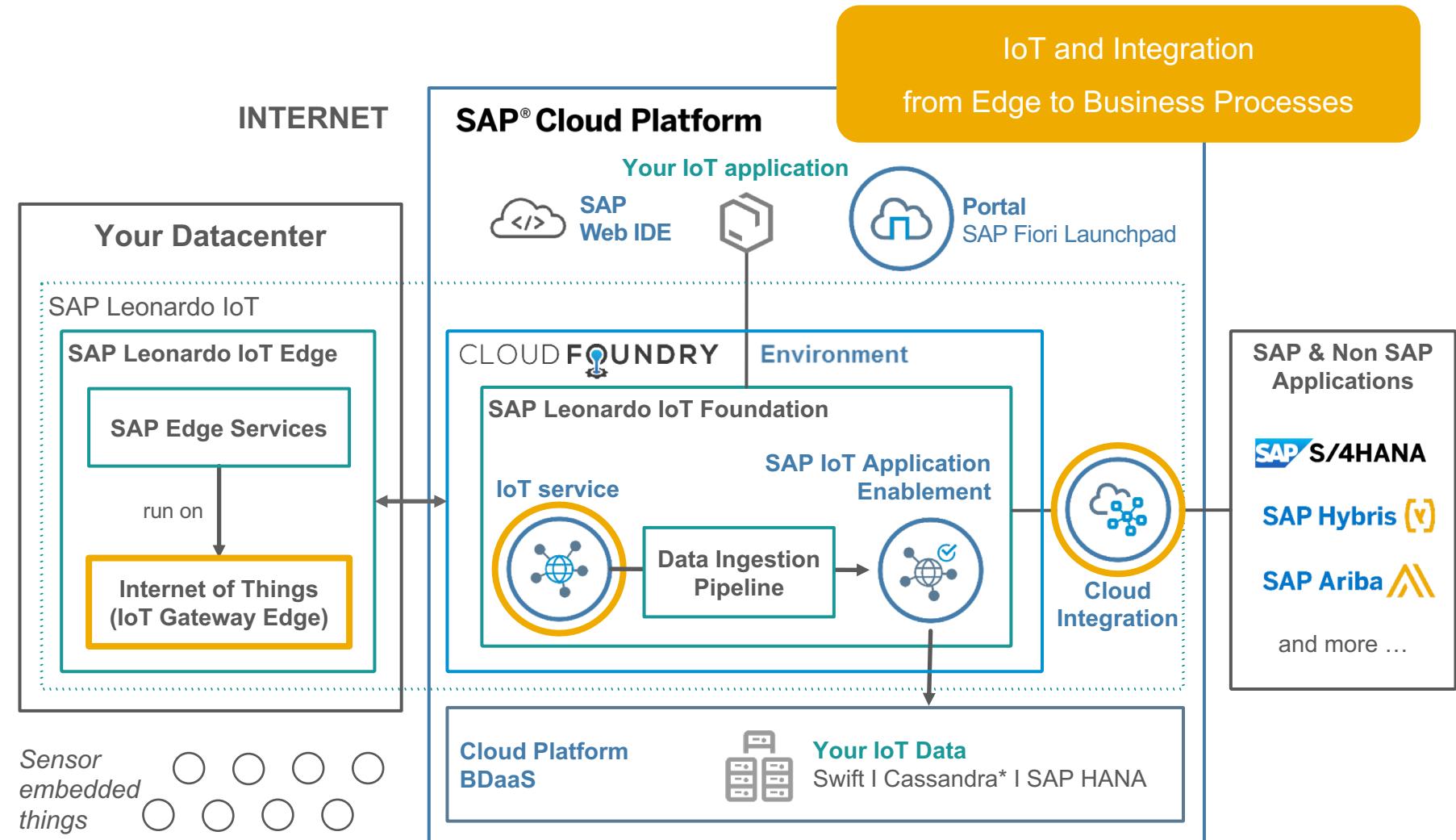
- Device lifecycle management
- IoT Gateway for data pre-processing
- IoT protocol support

SAP Edge Services

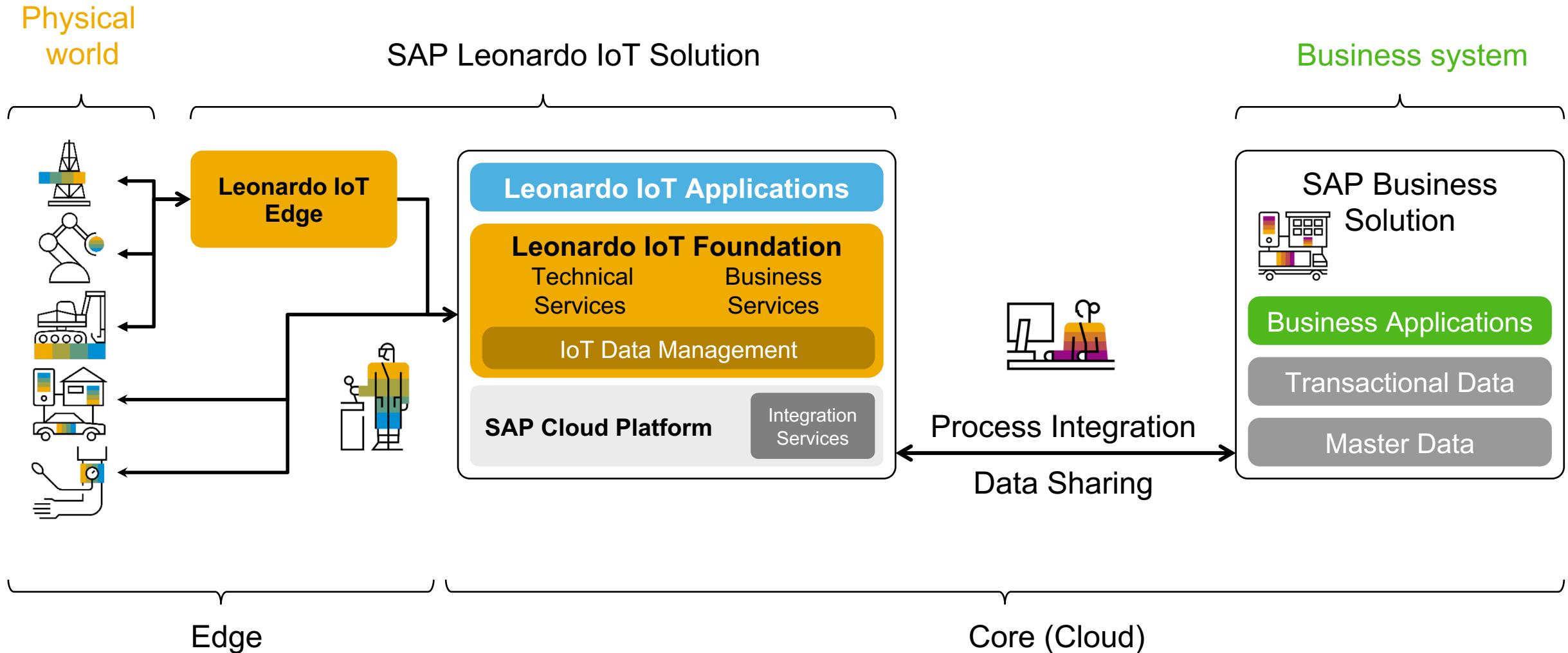
- Compute
- Storage
- Business critical functions

SAP IoT Application Enablement

- Digital twin builder
- IoT app development & mashup
- Data management



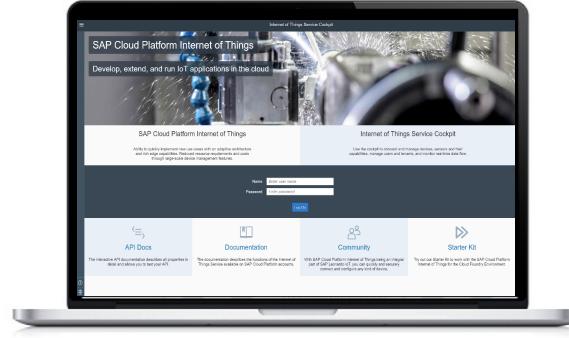
SAP Leonardo Solution Architecture for IoT





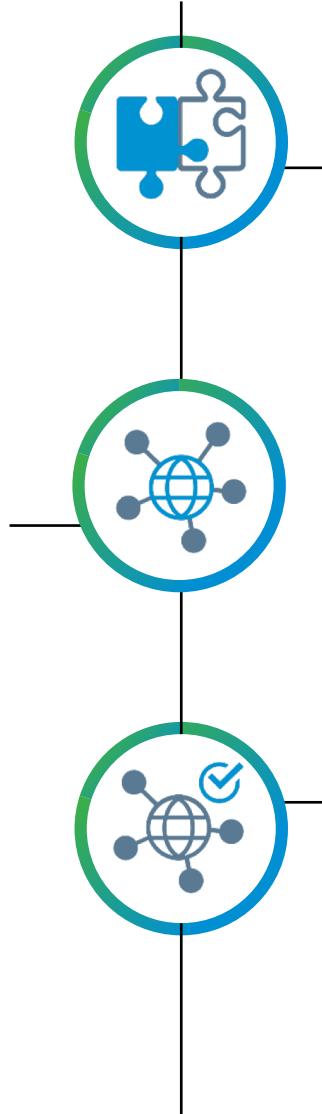
Internet of Things

Connecting things with people and processes to reimagine your business



Connecting Real World Things with SAP Cloud Platform Internet of Things

- Broad IoT protocol support – including adapter SDK
- Device management with mass onboarding and management
- IoT gateway can run in cloud and at the edge (on premises)



Preprocess IoT Data at the Edge with SAP Edge Services

- Compute, store, analyze IoT data already at the edge of your network
- Enabling of critical business functions by directly connecting with SAP applications
- Runs on IoT gateway edge of SAP Cloud Platform Internet of Things

Build Innovative IoT Applications with SAP IoT Application Enablement

- Thing modeler to create digital twins of physical assets
- Wizard based development of IoT applications
- Microservices providing re-usable business semantics for the Internet of Things
- Data management with dynamic data storage



SAP Cloud Platform Internet of Things - Introduction

Connect devices to bring IoT data to SAP Cloud Platform

Read more: [SAP Cloud Platform IoT](#)

Key Capabilities

Lifecycle management at scale for devices from onboarding to decommissioning

Securely connect to remote devices over a **broad variety of IoT protocols**
(HTTP, MQTT, CoAP, SNMP, File, ModBus, Sigfox, OPC-UA)

Collect and **process sensor data** at scale already at the **edge or in the cloud** and store it on SAP Cloud Platform

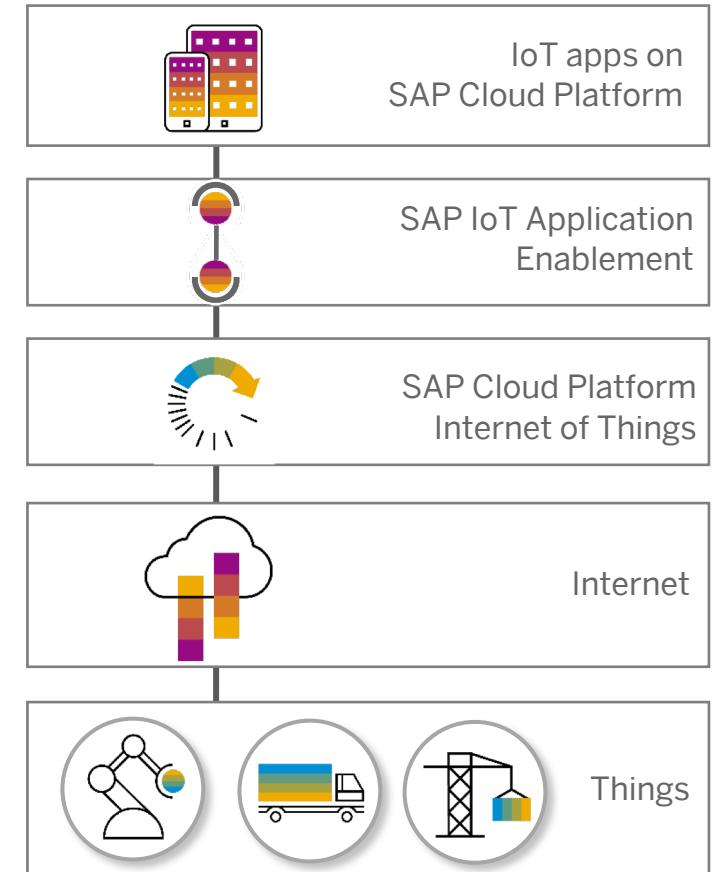
Integral part of SAP Leonardo IoT Foundation & Edge to build and run IoT applications in cloud

Product Innovations

- Integration into SAP IoT Application Enablement in support of rapid development of IoT applications
- Support of SAP Edge Services for advanced processing capabilities on Gateway Edge
- Continuous delivery of further IoT protocol adapters

Key Benefits

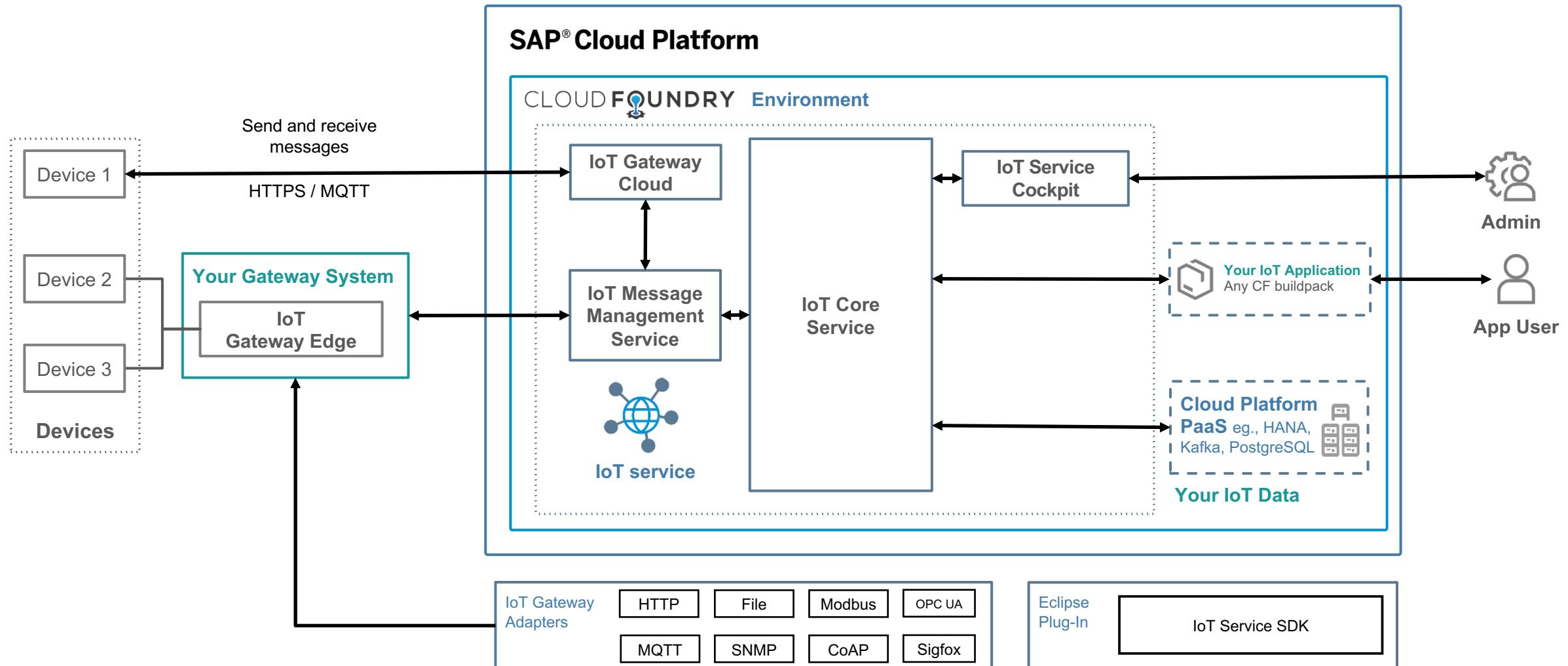
- Flexible deployment options for gateway component
- Certificate-based onboarding and authentication of devices
- Software development kit (SDK) for development of custom protocol adapters and custom filters (interceptors)



SAP Cloud Platform Internet of Things

Architecture Overview

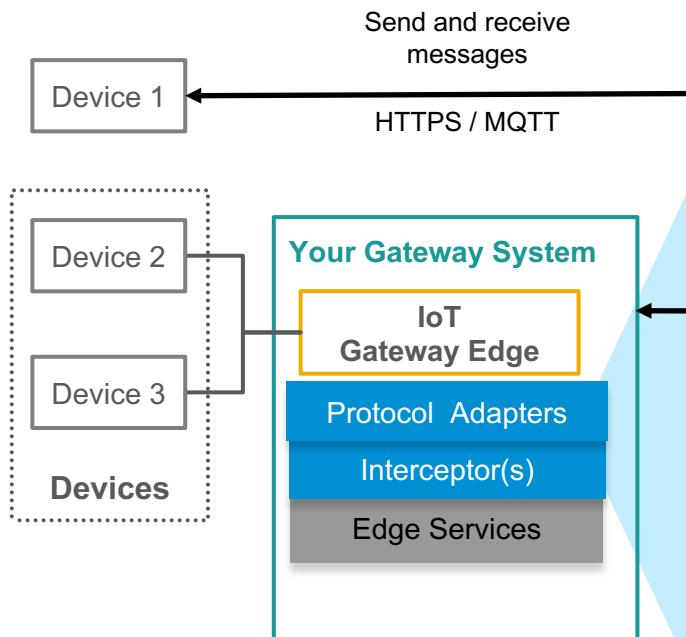
 Not SAP Cloud Platform IoT scope



SAP Cloud Platform Internet of Things

The Edge

 Not SAP Cloud Platform IoT scope

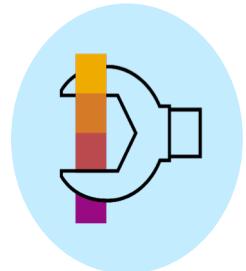


The **IoT Service SDK** enables developers to extend the IoT service



Adapters

- Design your own adapter for Internet of Things Gateway
- Introduce new functions and reuse existing logical blocks to achieve seamless integration
- Use existing templates, examples and tutorials to swiftly go through these activities



Interceptors

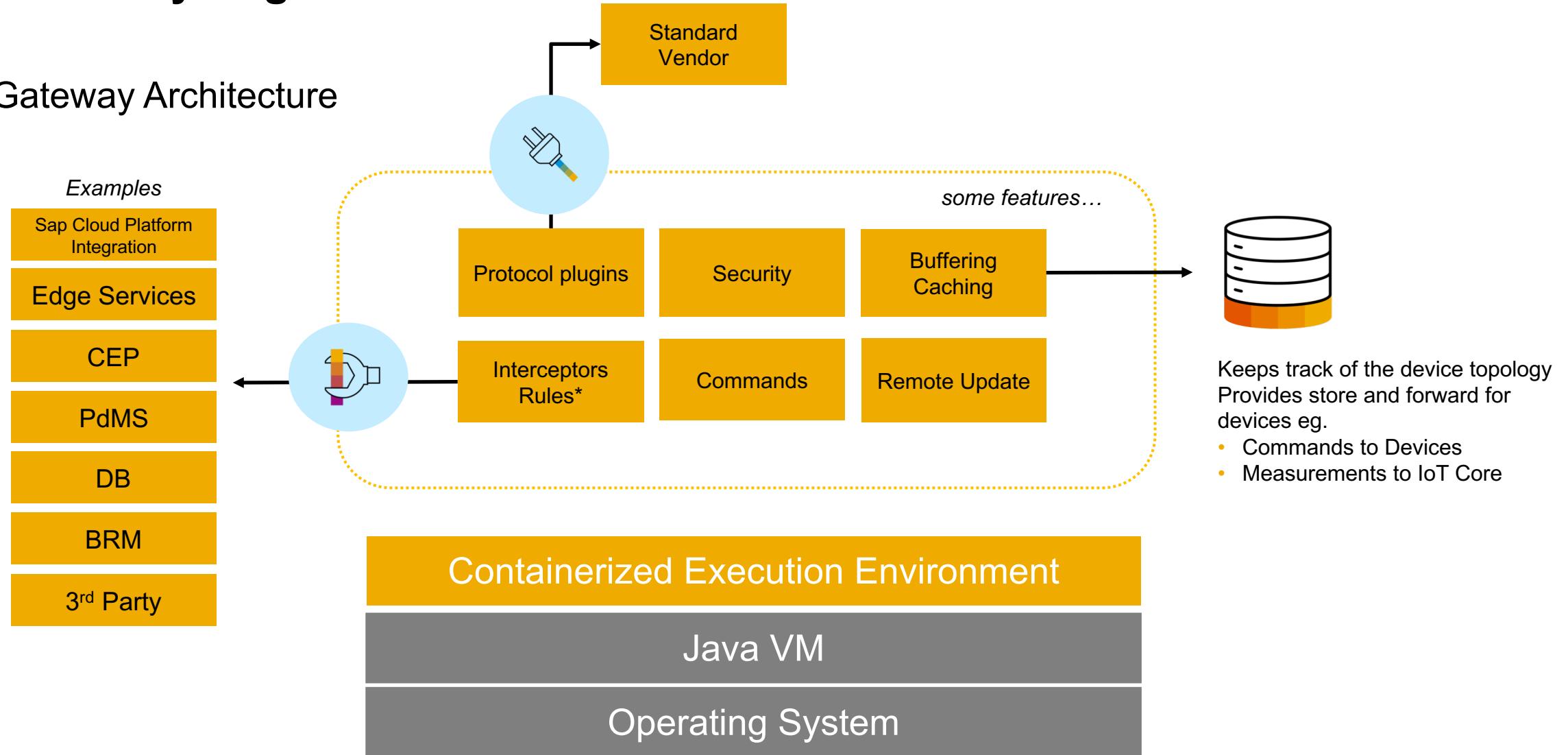
- Intercept data flows to enhance data or send it to another application (SCI, Edge Services, PDMS, CEP ...)
- Extend edge computing for gateway: manipulate incoming sensor data and/or outgoing commands to actuators eg data thinning via filters, routing, exception handling, cloud communication ...)
- Get a jump start with simpler and powerful modelling leveraging wizard, sample templates and visual flows

Documentation: [Internet of Things Service SDK](#)

SAP Cloud Platform Internet of Things

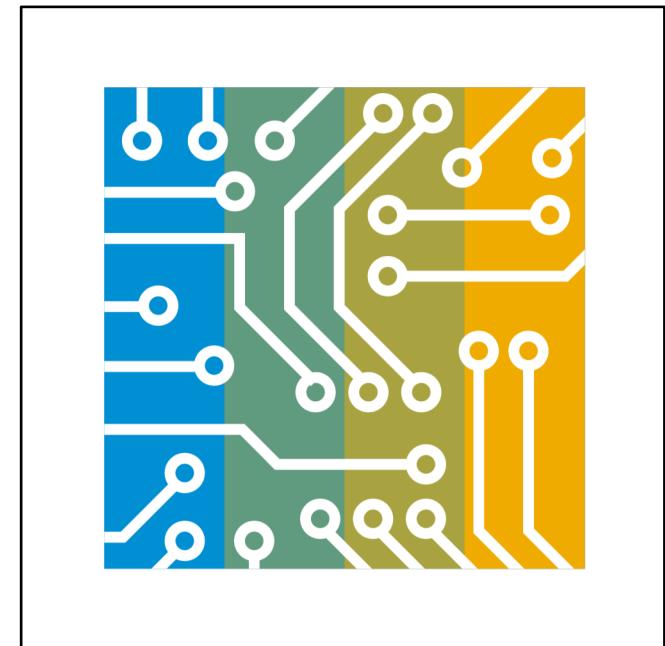
IoT Gateway Edge

IoT Gateway Architecture



Requirements for SAP Cloud Platform IoT Gateway Edge

Source	Release Note , Tutorial
OS	Linux (Ubuntu, Debian), Windows
Application	Java 8 required
Model / Architecture	x86 64-bit
CPU	Min. quad core 1 GHz, x86-64 architecture compatible
Memory	512 MB
Storage	10+ GB
Installation Packages available for Example Devices (e.g. from other customers)	ICC Certification , Device List



The table defines **MINIMUM REQUIREMENTS**

The requirements depend on:

- Protocol type
- Number of devices
- Frequency of messages and message size

SAP Cloud Platform Internet of Things

Protocols via IoT Gateway Adapters

[Check for updates](#)

Protocols

HTTP ¹	DDS
Zigbee	BACNET
XBee	LON
ZWave	KNX
6lowPAN	Modbus
BT & BTLE	Profibus
WiFi & LPWiFi	Infibus
IEEE 802.15.4	DLMS/COSEM
MQTT ¹	KSAT (Viasat)
CoAP	PLC(*)
TR069	OPC UA
SNMP	OMA LWM2M(*)
HART & W-HART	Active Message
SIGFOX	SWAP(*)
Semtech LoRa	XMPP
NWAVE UnB	LoRa
	File

Vendors

Agora Energy	Distech Controls	NaelBox	SimpleHomeNet
Agulla	E-Senza	Netcomm Wireless	SITEC
AnyDATA	Ekahau	NETVOX	SmarteoWater
Arduino	Elster	NWAVE	SMARTEX
Asoka	EPISENSOR	Orbiwise	ST Micro
ATIM	Eurotech	Packet Power	Sterela
Axible	Honeywell	PARADOX	Telecom Design
AXIS	Intenses	PIKKERTON	TELIT
B&B Electronics	ITRON	Pulsar	TekPea
CalAmp	Kamstrup	Radiocrafts	TRIDIUM
Cisco	LIBELIUM	RaspberryPI	VIASAT
CloudGate	Marvell	Schneider Electric	WAGO
CPL	MeterSit	Semtech LoRa	Wi-NEXT
Cradlepoint	MICRON	Sensinode	Worldsensing
Dell	Mobile Devices	SIERRA WIRELESS	XIRGO
DiGi	Morey Corp.	SIGFOX	
Digicom			

Create new adapters with IoT Service SDK

Leverage templates based on required connectivity:
UDP, JMS, USB, Custom, CoAP, File, Socket

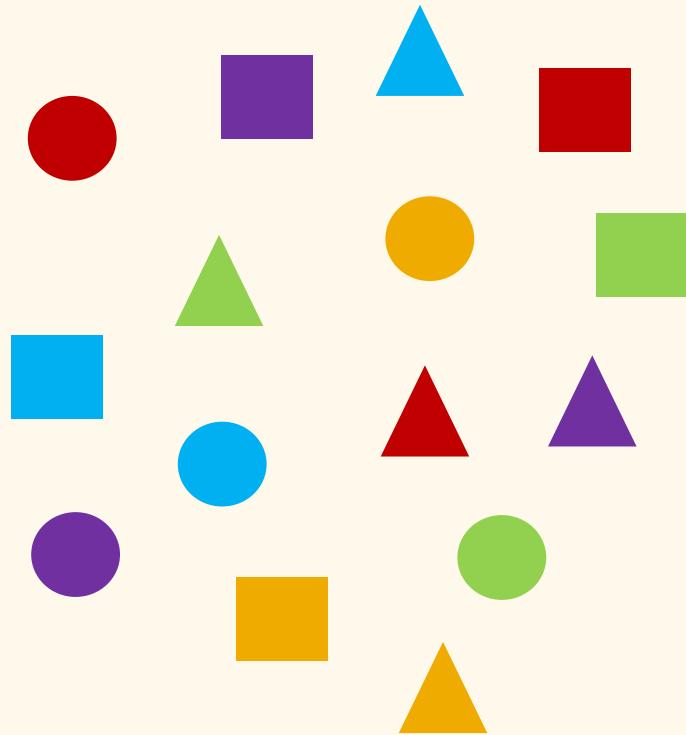
¹ – also device ↔ cloud

*: Limited implantation (**bold = GA**, orange = roadmap)

IoT Gateway Interceptors – Example Use Cases

Field

Device and Sensor data & Protocol specific messages



Gateway component

SAP Cloud Platform IoT Gateway Edge +
Interceptor

- **Message Normalization and Protocol Translation**
- **Custom logic** applied via Interceptor
- **Data dispatch** to IoT Core Service on Cloud

Core component (Cloud)

Output of Relevant data

Filtering



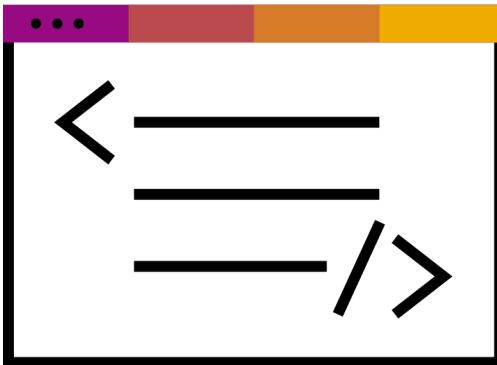
Aggregate



Calculate



IoT Gateway Edge: What can I do via Configurations (in summary)?

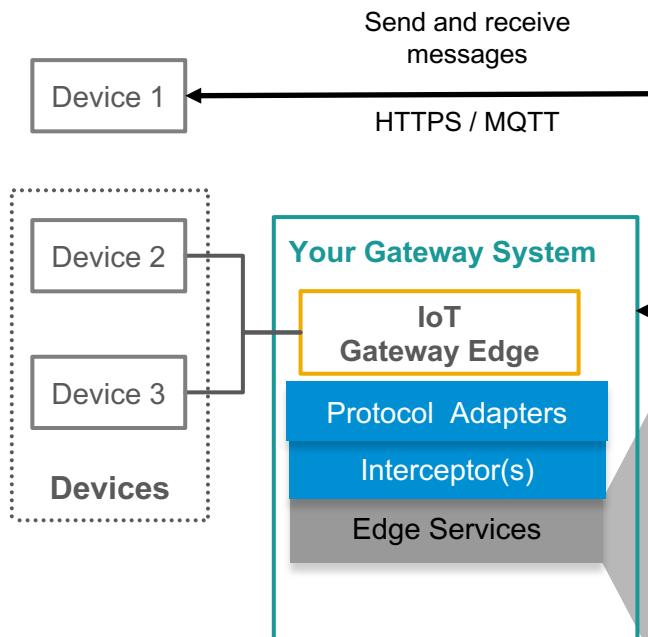


- **Connection to the IoT MMS:** failover support when connectivity is lost.
- **Connection to IoT Core Service:** connect to your instance and ports
- **Configure the IoT Gateway:** unique identifier `gatewayAlternateId` (valid ACSII String)
- **Configure Logging:** define your preferred logging pattern for file based persistence at the edge
- **Security:** choose your desired level of security through secure or unsecure endpoints or via device router
- **Device Auto-Accept:** control operations status (*pending* or *fullyfunctional*) for data acquisition policies and device to platform interaction

SAP Cloud Platform Internet of Things

The Edge

 Not SAP Cloud Platform IoT scope



SAP Leonardo IoT Edge

The programming model for IoT is shifting from being cloud centric to a **distributed edge-cloud** model. IoT data will be stored, processed, analyzed and acted upon at the edge.



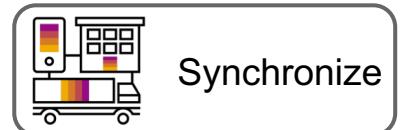
Persist



Analyse



Predict



Synchronize

- **Persistence Service** – locally store IoT data on IoT gateways
- **Streaming Service** – analyze IoT data streams. IoT, finding exceptions and patterns in incoming IoT data stream and creating events and alerts
- **Business Essential Functions** – execute business processes at the edge to provide continuity for critical business functions even when the edge is disconnected from the core (plant maintenance, inventory/materials management)
- **Predictive Service*** – use predictive models for analyzing the IoT data. The predictive algorithm is trained in the core based on all available data. The resulting predictive model is then sent to the edge and applied there
- **Machine Learning Service*** – apply machine learning algorithms at the edge specifically for image and video analysis
- **Visual Analytics Service*** – explore visually IoT data stored on IoT gateways. IoT data analysts can visually inspect the data collected at the edge

IoT Certification by SAP

Integration with SAP Cloud Platform IoT

- Catalog of SAP-certified gateway devices, sensors, Device Clouds and LPWAN*
- In talks with hardware vendors to pre-install // direct link to SAP Edge software components or Cloud backend
- SAP-certified gateway devices, sensors and LPWAN providers shall be showcased along with the Leonardo IoT brand
- Certification shall be extended for all SAP Edge services

Vendors certified

- Dell Gateway 5000 | Dell Gateway 5500 | Dell Embedded PC
- Samsung - Samsung ARTIK Processors
- Eurotech ([Gateways and Sensors](#))
- HPE Edge line series of devices (EL1000, EL2000, ...) ([Gateways](#))
- Janz Tec emIOT series ([Gateways](#))
- Cloudleaf: IoT Supply Chain Visibility ([Device Cloud](#))
- Roambee: Asset monitoring ([Device Cloud](#))
- Q-Loud Universal Gateway ([Gateways](#))

* Work in progress

SAP® Certified

Integration with SAP Applications



Current list of certified IoT devices and integrations: [link](#)

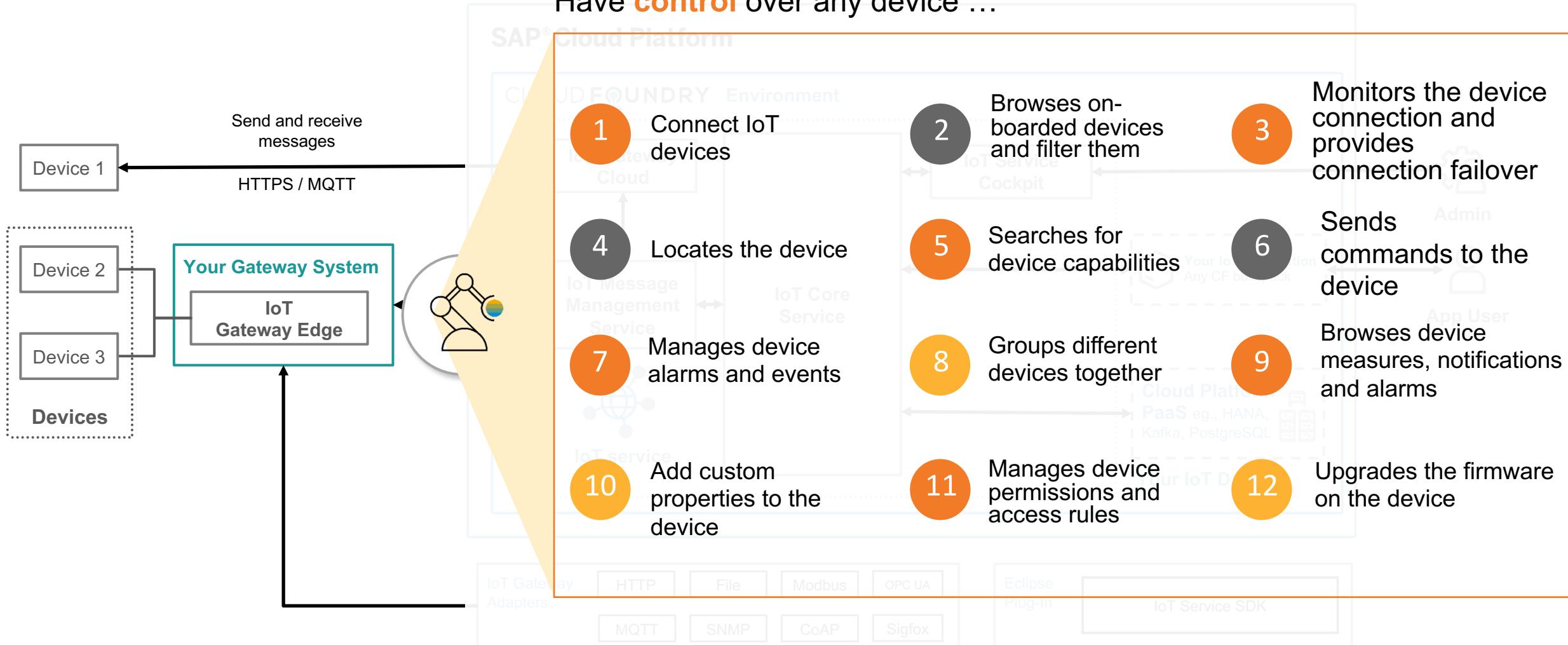
SAP Cloud Platform Internet of Things

Device Management

 Not SAP Cloud Platform IoT scope



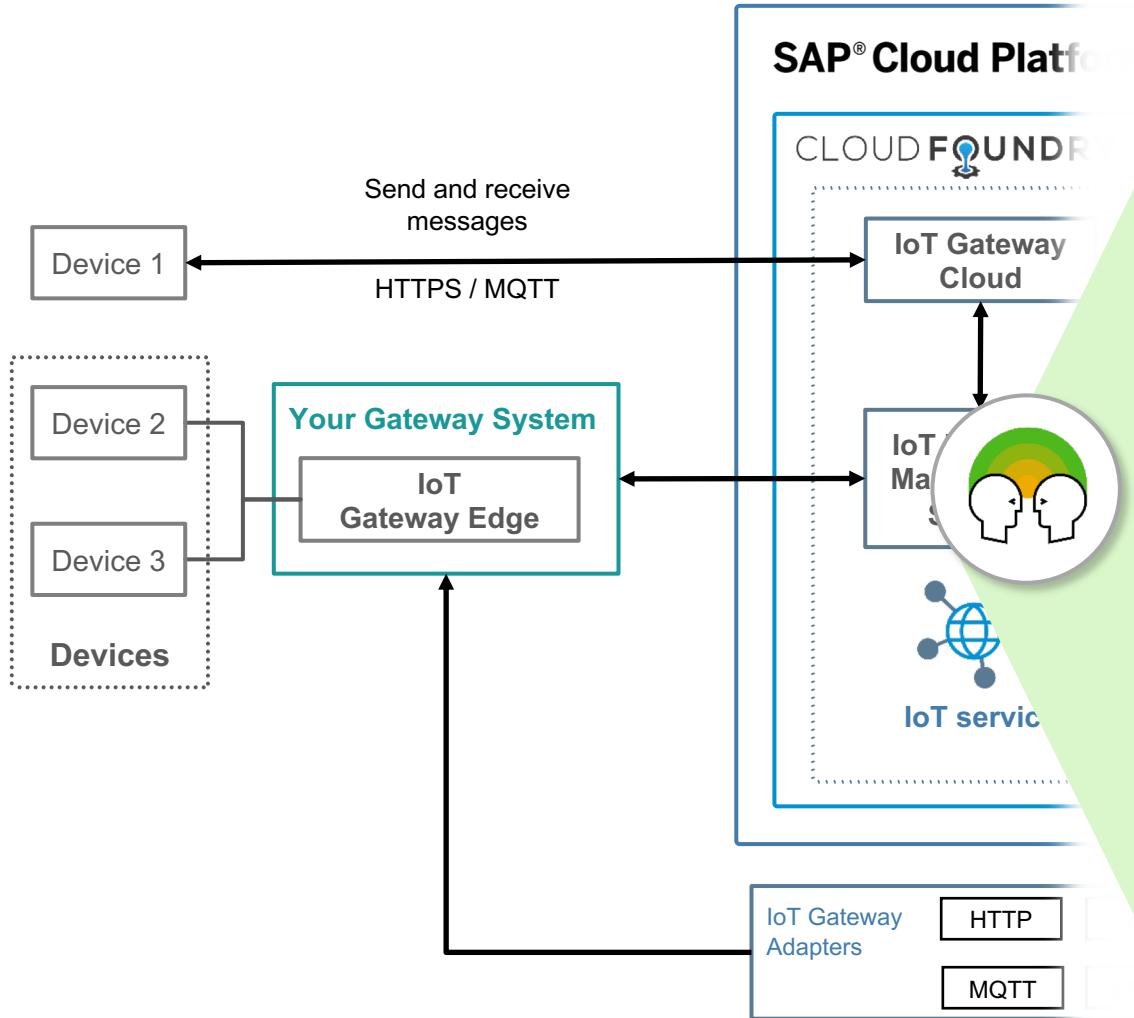
Have **control** over any device ...



SAP Cloud Platform Internet of Things

Core Services

 Not SAP Cloud Platform IoT scope

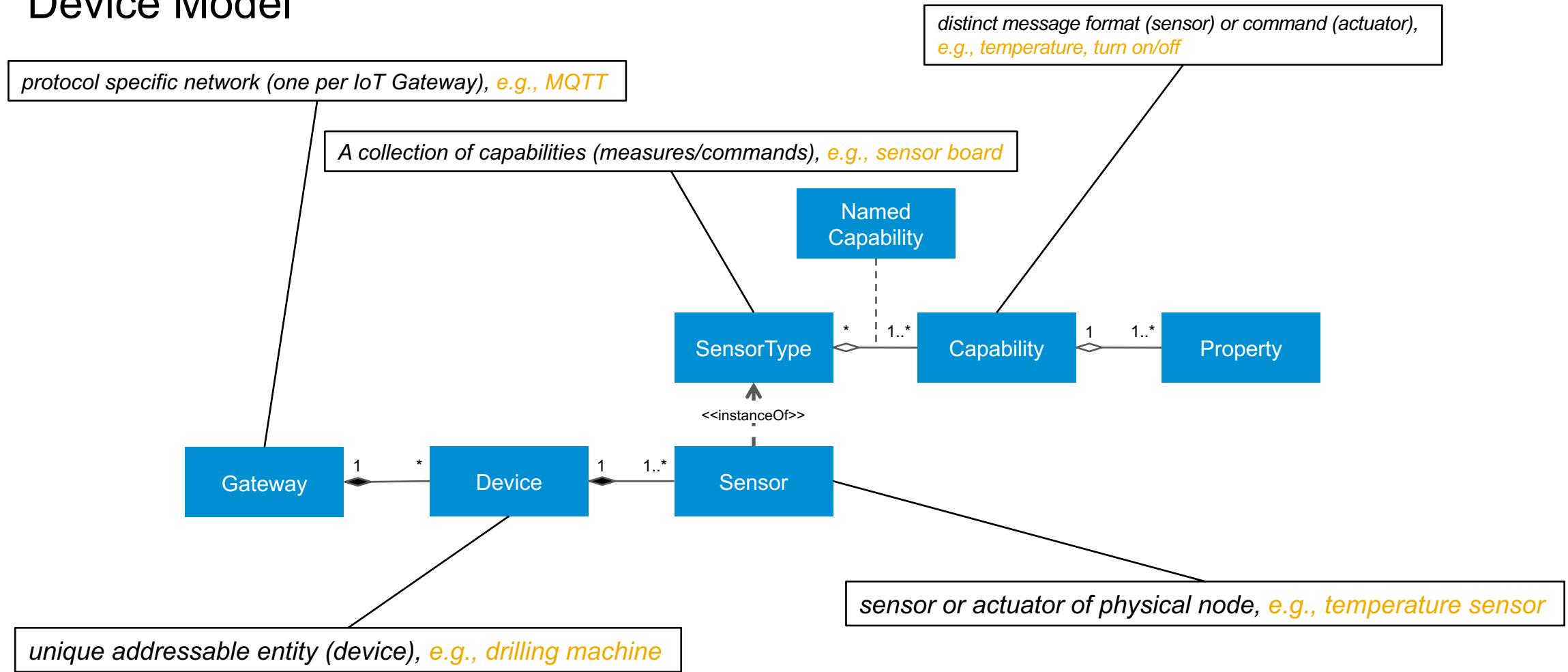


but **WE** go even further to deliver a Device to Data Platform which includes...

-  **Device and Integration Service:** integrate with other Service Delivery Platforms (Device Clouds, Solutions), leveraging an Extendable and Dynamic Data Model
-  **Connectivity:** harness a huge list of protocol adapters and a single contract and connection management point for your mobile network (SAP IoT Connect 365)
-  **Security:** ensure end-to-end enterprise grade security via sophisticated encryption and policy based access control
-  **Message processing:** have control of your Data (database, message broker, http, event stream)
-  **Application Services:** leverage APIs and KPIs for developing future-proof powerful IoT solutions
-  **User Management:** fine-grained access and control of managed resources and data over user base / ecosystem

SAP Cloud Platform Internet of Things

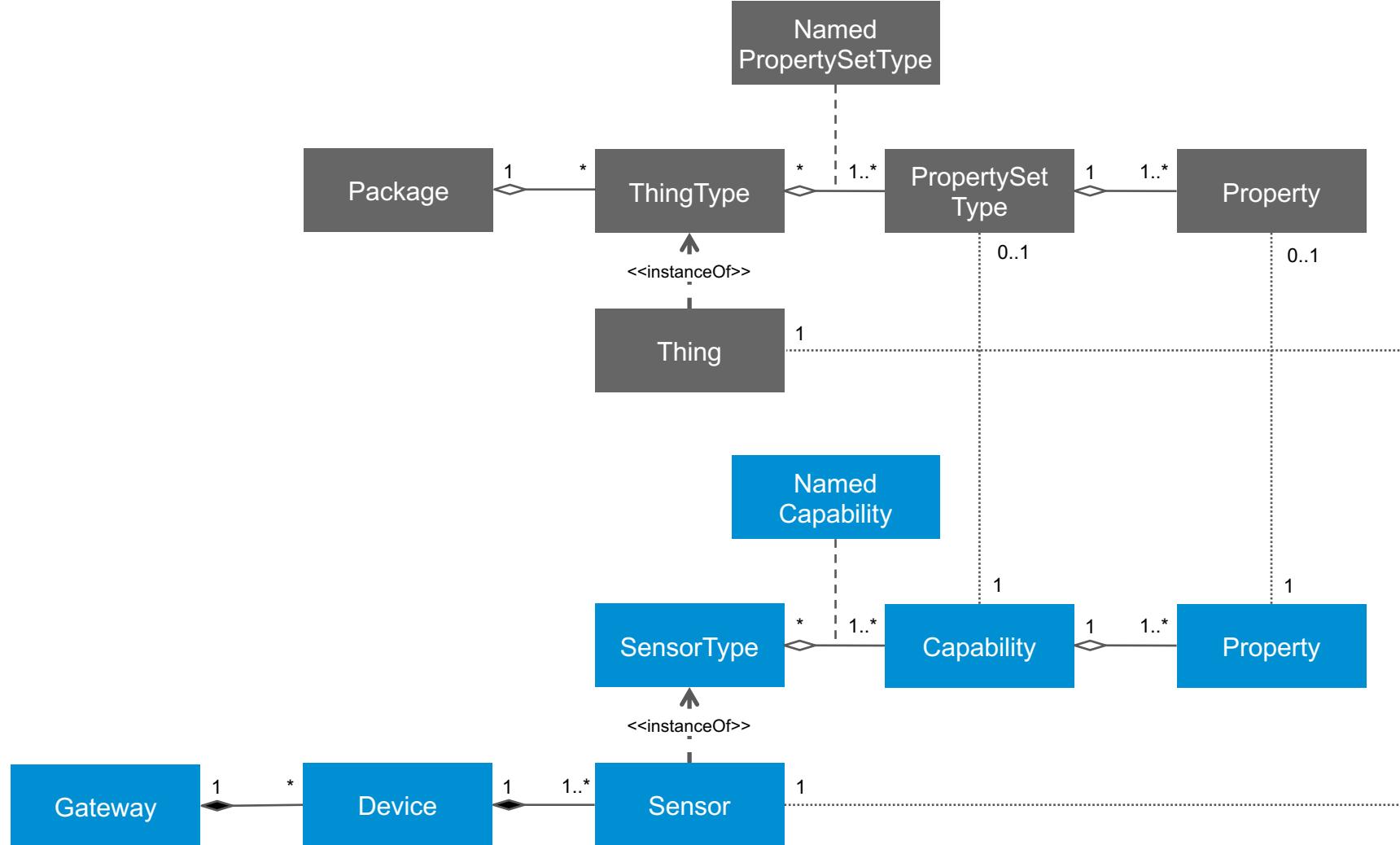
Device Model



Documentation: [Device Model](#)

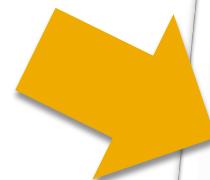
SAP Cloud Platform Internet of Things

Thing Model Mapping with IoT Application Enablement Service



Internet of Things API Service

- The interactive API documentation describes all properties in detail and allows you to test your API.
- Choose from a wide variety of APIs to manage: Devices, Gateways, Sensors, Users, Protocols
- Start creating your own virtual devices and things extending them with Custom Properties
- Develop your IoT Applications through ready to use data sources
- Send commands to the devices and gateways managed

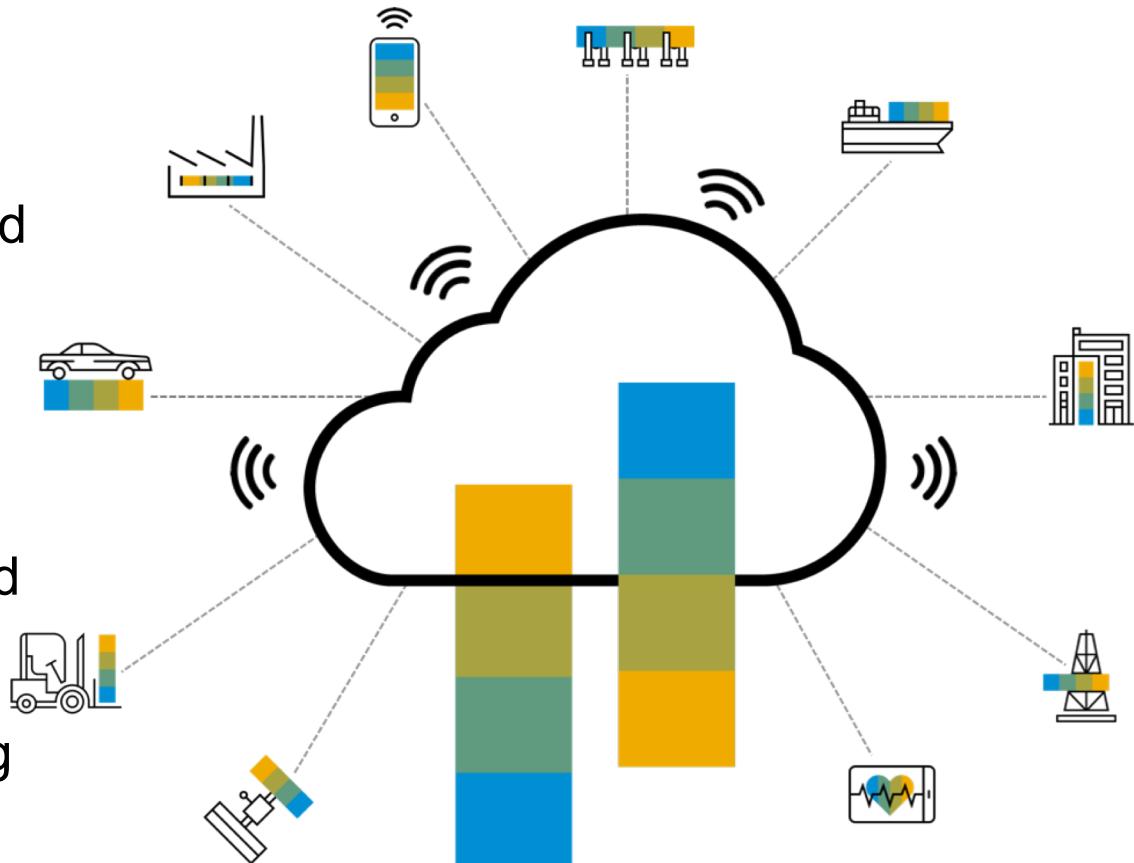


The screenshot shows the SAP API Management interface for the Internet of Things Service API. At the top, it says "Internet of Things Service API Documentation" with a base URL of "trial.canary.sap.iot/core/api/v1". Below that is a "Terms of service" link. A dropdown menu "Schemes" is set to "HTTPS". On the right, there's a green "Authorize" button with a lock icon. The main content area is organized into sections: "About", "Capabilities", "Devices", and "Gateways". Each section lists various API endpoints with their methods (e.g., GET, POST, DELETE, PUT) and descriptions. A large yellow box highlights the "Devices" section, specifically the "POST /devices" endpoint which creates a device. Another smaller yellow box highlights the "Gateways" section, specifically the "PUT /gateways/{gatewayId}" endpoint which updates a gateway. The entire screenshot has a light blue background with rounded corners for each API entry.

Documentation: [Internet of Things API Service](#)

Send Commands ... and be sure they are delivered

- SAP Cloud Platform IoT establishes a **two-way communication** link between the device and the cloud supporting different **data types**;
- Leverage native commands from **specific protocols** eg. MODBUS, OPC UA
- **One API to rule/command them all:** strong command issuing tailored to specific protocol used
- **Security:** specific authorization applies for dispatching commands to devices



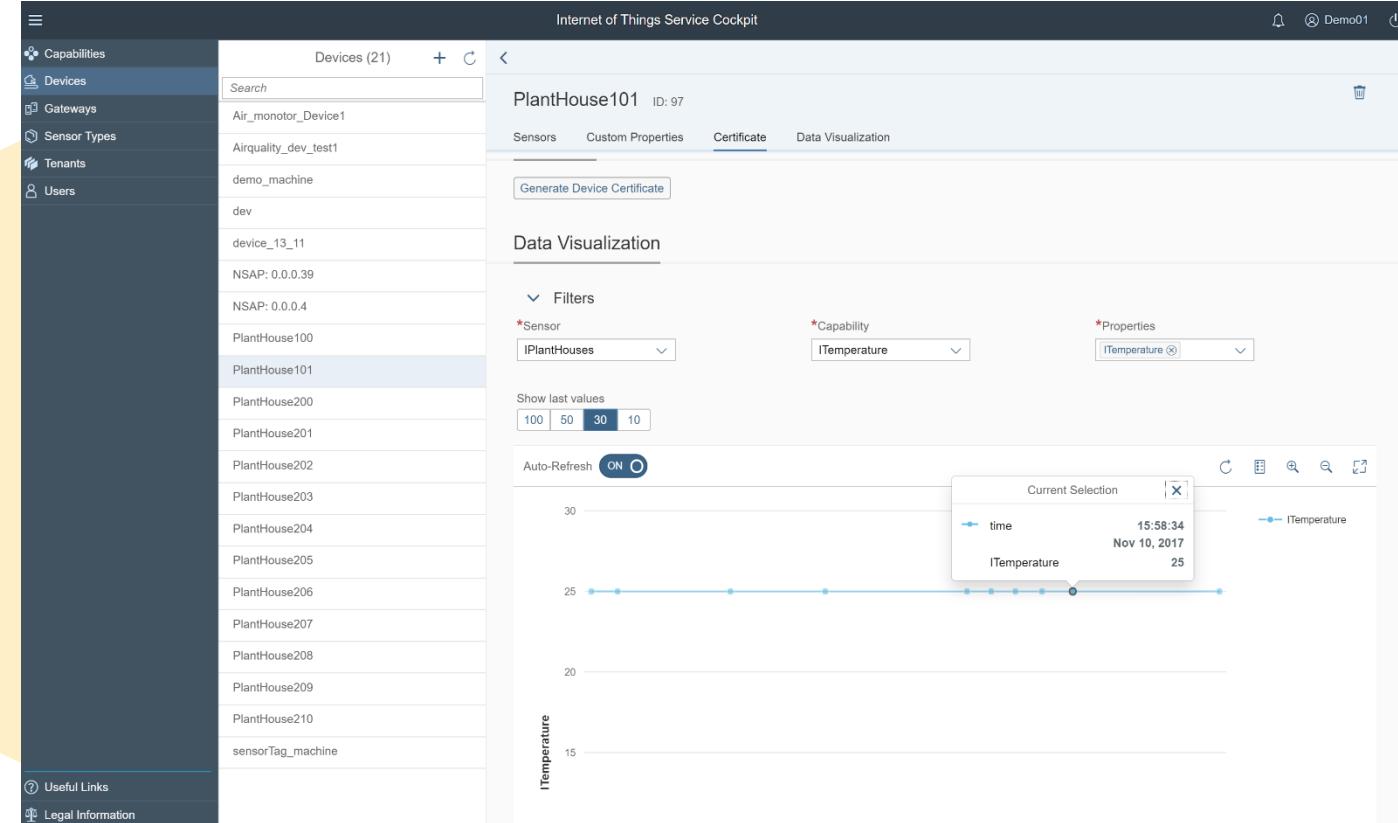
SAP Cloud Platform IoT

IoT Service Cockpit (UI5)



- API Docs
- Documentation
- Community
- Starter Kit

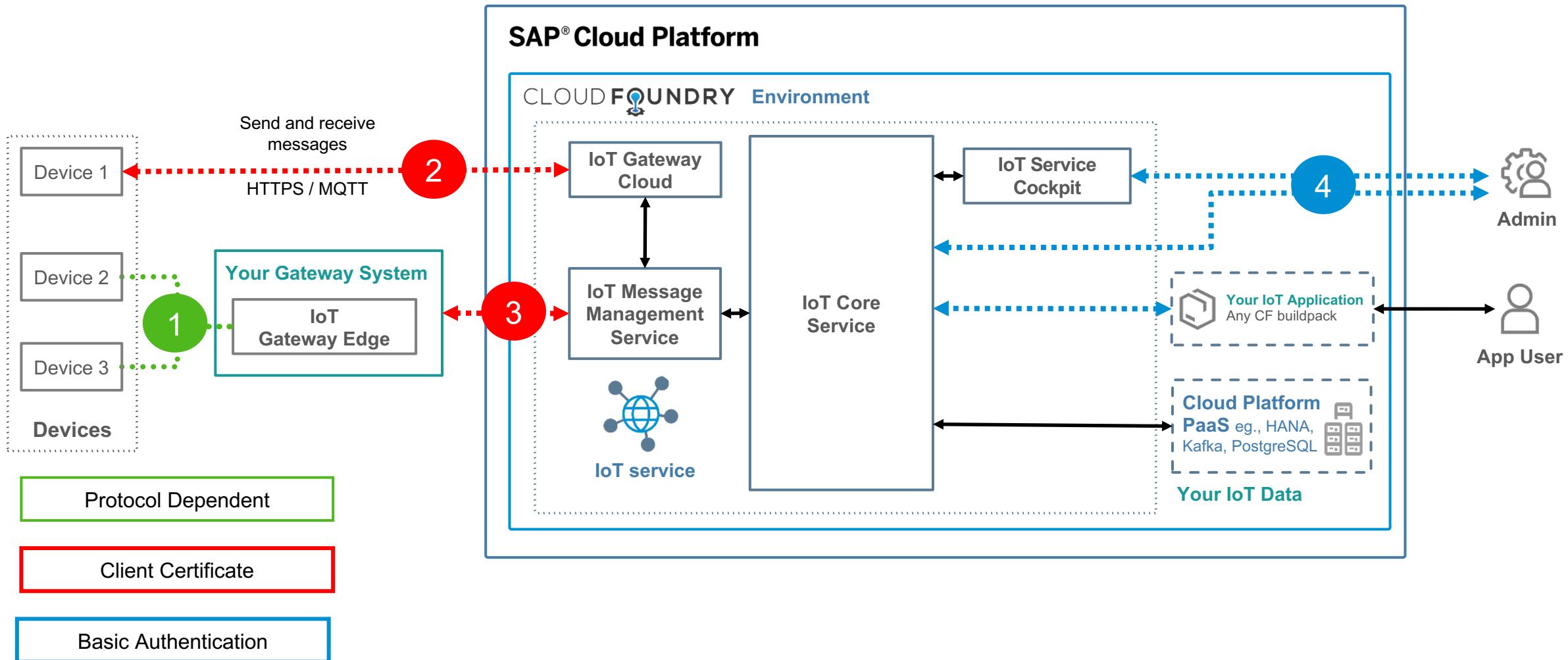
Documentation: [Internet of Things Service Cockpit](#)

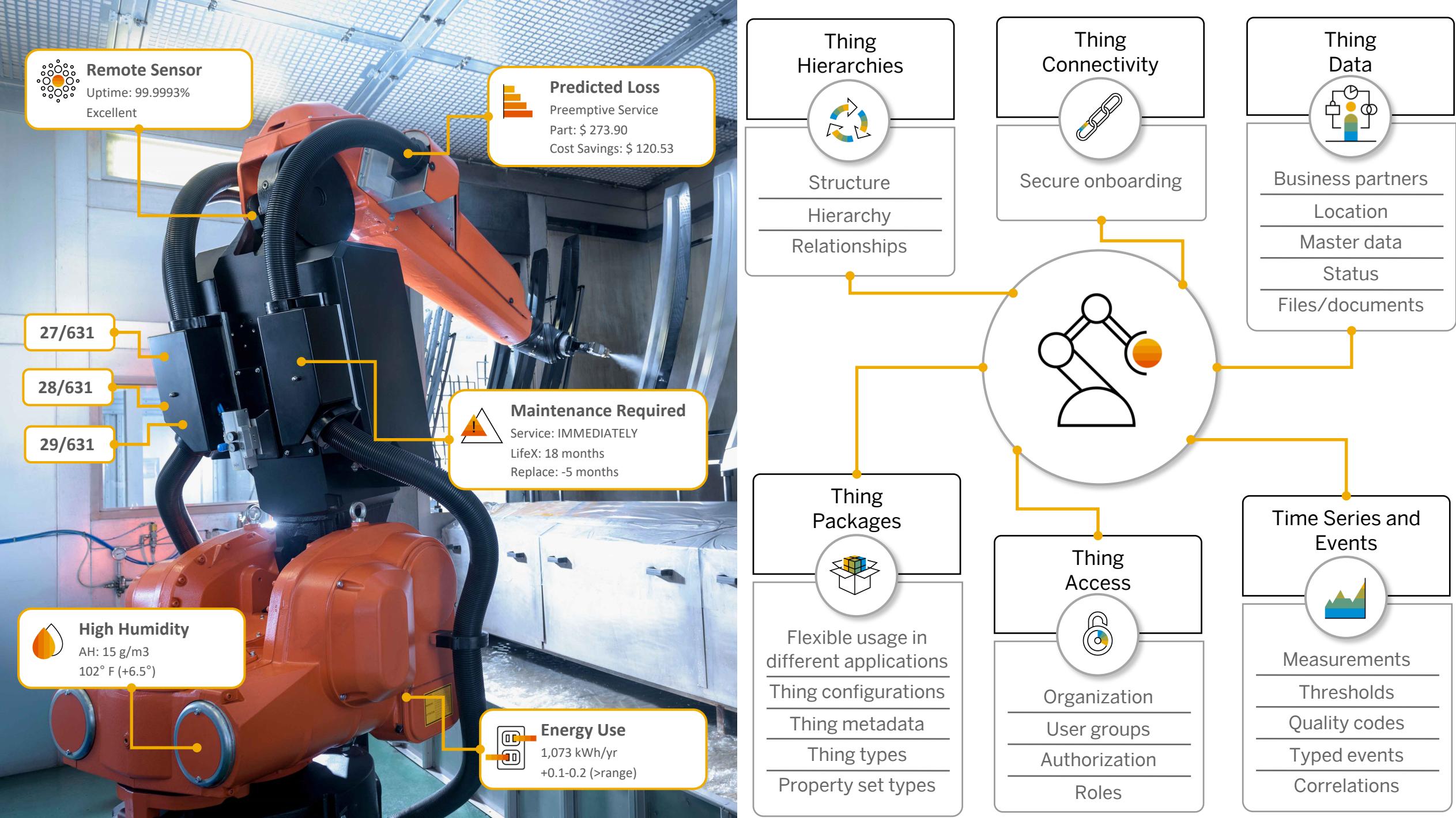


- Take control of your connected devices
- Monitor and visualize operational analytics assessing usage and performance
- Manage access and control policies based on user roles and security strategy

SAP Cloud Platform Internet of Things

Security Overview





SAP Edge Services

Edge Cloud

SAP Edge Services

Edge Services are micro services which can be deployed on edge computing devices.

These services are provided within a secure run-time environment ensuring:

- ✓ Lifecycle management
- ✓ Communication to Things via protocol adaptors
- ✓ Integration to SAP Cloud Platform

Cloud

Edge

Devices

SAP Cloud Platform

SAP Edge Services

Policy Service

Streaming Service

Business Essential Functions Service

Persistence Service

SAP Cloud Platform IoT service

Persistence Service
Streaming Service
Business Essential Functions Service

IoT Gateway Edge

Persistence Service
Streaming Service
Business Essential Functions Service

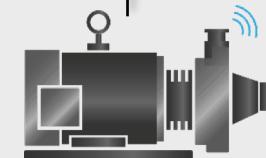
IoT Gateway Edge

Persistence Service
Streaming Service
Business Essential Functions Service

IoT Gateway Edge



Thing



Thing



Thing

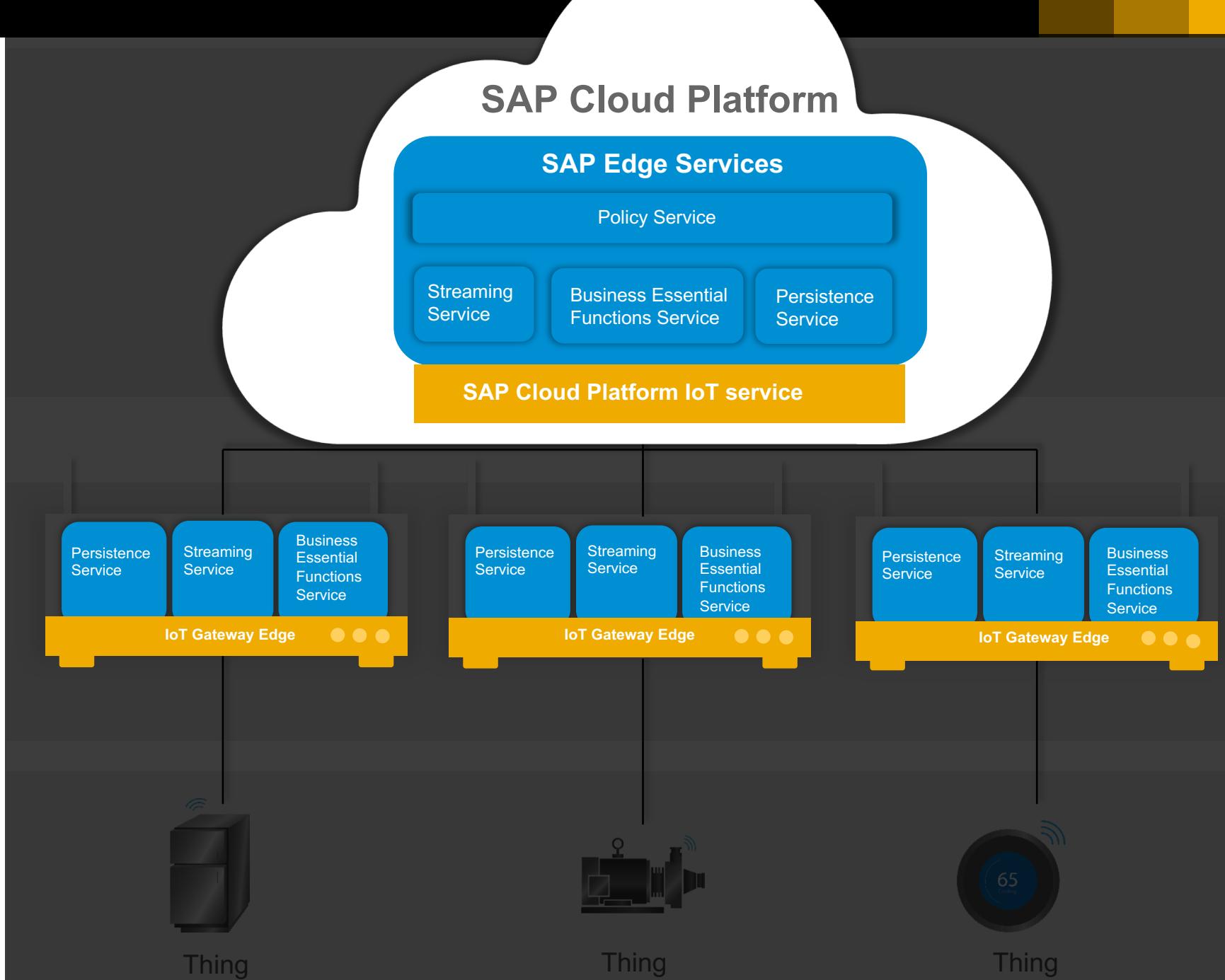
SAP Edge Services

Edge-Cloud

SAP IoT Services Gateway (included in the **SAP Cloud Platform IoT Services** offering) provides device management, connectivity, and lifecycle management at the edge.

SAP Edge Services runs on top of SAP Cloud Platform IoT Services and brings compute (**streaming** micro-services), storage (**persistence** micro-services), and business semantics to the edge for latency sensitive use-cases and deterministic performance of business processes (**business essential functions** micro-service).

SAP Edge Services roadmap foresees adding predictive/machine learning capabilities at the edge.



6 (+1) Smart IoT Tech Foundations To Make the Economics of Things Real

1. **Bridge across legacy M2M Protocols and New IoT Protocols** ✓
2. **Futureproof Applications:** Model around IoT Objects - Not Device Specifics ✓
3. An **Adaptive Platform** with Smart Logic Placement across Edge - Device - Cloud ✓
4. Support streaming real-time architecture end-to-end for **Insights** ✓
5. **Rapid prototyping / evolution** of IoT services must be easy ✓
6. **Multi-tenancy** for Applications and Users with end-to-end role based security ✓
7. **Simplified Integration Business Processes** ↘



To fully capitalize on the benefit of their IoT investments, companies will eventually implement end-to-end IoT business solutions that integrate IoT edge devices, their IoT platform, and core business applications (see "Best Practices for Integrating IoT-Connected Products").

Gartner.



Make sure to check the
[Release Notes](#) which get
periodically updated

Recent innovations



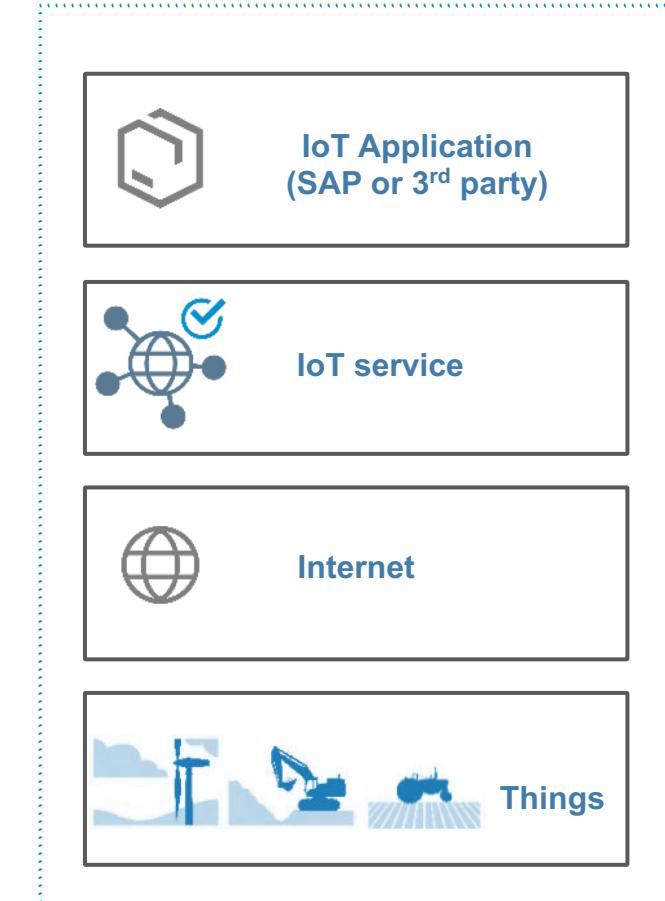
Recent
innovations

SAP Cloud Platform Internet of Things

The IoT service connects devices to the SAP Cloud Platform to further manage and configure the data transmission from and to these devices as required by the respective IoT applications

Key Capabilities

- IoT service cockpit based on the SAP Fiori UX
- REST APIs for device modelling and data consumption
- Certificate-based on-boarding and authentication of devices to IoT Gateway Edge and Cloud
- Device to IoT Gateway Cloud Protocol support - HTTP (REST), MQTT using JSON & protobuf
- Device to IoT Gateway Edge Protocol support - HTTP (REST), MQTT, CoAP, SNMP, File, ModBus, OPC UA and Sigfox
- Provisioning of a software development kit (SDK) for development of custom protocol adapters or agents and custom filters (interceptors) on IoT Gateway Edge
- Integration into the SAP IoT Application Enablement toolkit in support of rapid development of IoT applications through the IoT app builder
- Starter kit including guidelines, tutorials, and code examples on [GitHub](#)
- Multi-cloud data center support (SAP Data Center and AWS)



Read More: [SAP Cloud Platform IoT](#)

Planned innovations – Q3/2018 (1/2)

SAP Cloud Platform Internet of Things



Planned
innovations

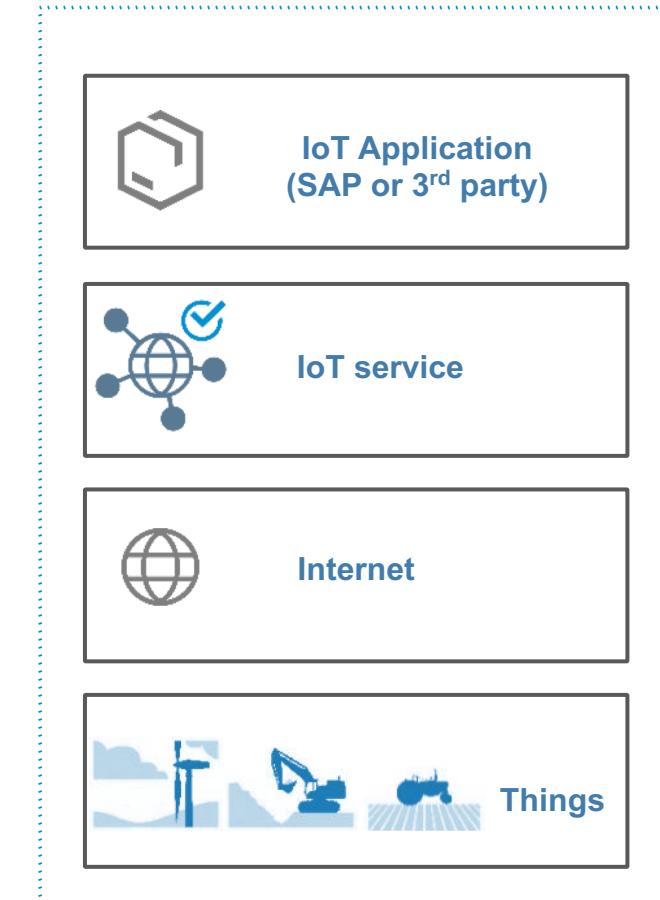
The IoT service connects devices to the SAP Cloud Platform to further manage and configure the data transmission from and to these devices as required by the respective IoT applications

Key Capabilities

- Processing services to configure data forwarding to databases in SAP Cloud Platform or other destinations and support of further SAP Cloud Platform backing services
- Standard Integration with SAP Data Hub
- Support SAP Cloud Platform SAP HANA service
- Integration of Mobile SIM Card Management (CT365)

Benefits

- Extend the integration possibilities with other SAP system allowing to support more complex IoT scenarios
- Leverage the full set of capabilities of SAP HANA e.g. advanced analytics capabilities (predictive analytics, geo-spatial services and time series)
- Mobile SIM Card management through SAP IoT Connect 365, enterprise service simplifies the complex connectivity, scalability, and management of the Internet of Things (IoT) through a single contract and connection to a fully managed, cloud-based solution with global reach, a secure infrastructure, and real-time control



Read more: [SAP Cloud Platform IoT](#)

This is the current state of planning and may be changed by SAP at any time.

Planned innovations – Q3/2018 (2/2)

SAP Cloud Platform Internet of Things



Planned
innovations

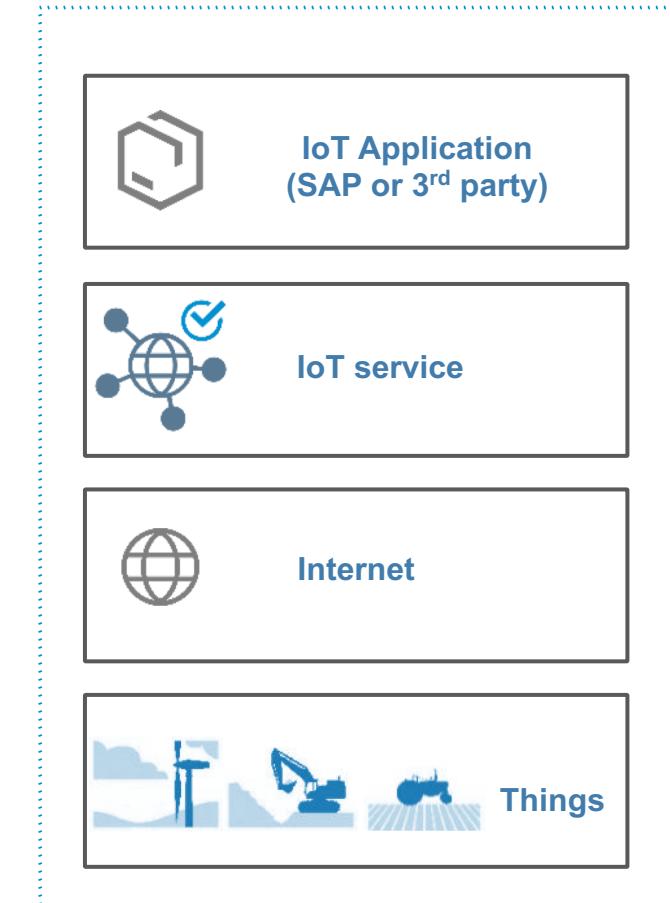
The IoT service connects devices to the SAP Cloud Platform to further manage and configure the data transmission from and to these devices as required by the respective IoT applications

Key Capabilities

- Device location visualization via integrated map view
- Realtime data consumption using WebSocket
- Rules management support

Benefits

- Extending the IoT Cockpit based on the SAP Fiori UX with map integration to directly visualize the device position for devices that are able to send their coordinates
- Immediate consumption of device measures
- Act upon certain condition of IoT data according to user-definable rules



[Read more: SAP Cloud Platform IoT](#)

This is the current state of planning and may be changed by SAP at any time.

Planned innovations – Q4/2018

SAP Cloud Platform Internet of Things



Planned
innovations

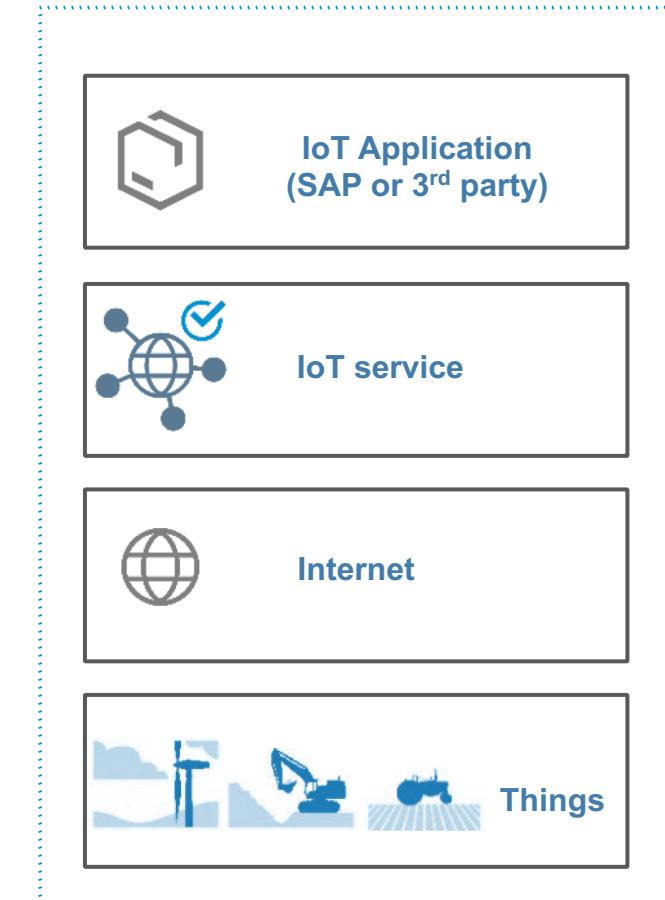
The IoT service connects devices to the SAP Cloud Platform to further manage and configure the data transmission from and to these devices as required by the respective IoT applications

Key Capabilities

- Support for OData access to the IoT core API, yielding improved standard access into business applications and web-based development tools, such as SAP Cloud Platform Web IDE
- IoT Cockpit based on SAP Fiori UX - additional dashboards to intuitively display KPI and interactive charts
- Instantiation of a shadow device methodology (digital twin) to collect, save and display current status information for a device

Benefits

- Enable integration from other business applications with the IoT core components via standardized OData access
- IoT Cockpit based on the SAP Fiori UX applies modern design principles for a completely reimagined user experience and represents a personalized, responsive, and simple user experience across devices and deployment options
- With a shadow device you will be able to get contextual device information for uniquely assigned devices (over MQTT or HTTP) in a combination of its master data and its last status such as payload, connection, position, etc...



Read more: [SAP Cloud Platform IoT](#)

This is the current state of planning and may be changed by SAP at any time.

Related road maps for SAP Cloud Platform Internet of Things

The following roadmaps are considering the IoT service as an integral part of their portfolio

Related product road maps available on sap.com/roadmaps:

Cross Topics

- [SAP Leonardo](#)

Products and Solutions

- [SAP Cloud Platform](#)
- [SAP Leonardo Internet of Things](#)

Learn more

SAP customers and partners

- ▶ [SAP Road Maps](#)
- ▶ [SAP Internet of Things Community](#)
- ▶ [IT Planning Resources](#)
- ▶ [SAP Innovation Discovery](#)
- ▶ [SAP Transformation Navigator](#)
- ▶ [SAP User Groups](#)
- ▶ [IoT service User Documentation](#)
- ▶ [IoT service Capabilities Overview](#)
- ▶ [SAP API Business Hub](#)



Thank you.