Overview and Outlook

Udo Paltzer, Product Manager SAP Cloud Platform Integration Suite
SAP Cloud Platform IoT, Integration, API Management, Open Connectors,
SAP Process Orchestration, SAP Application Interface Framework
November 2018
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Agenda

SAP Leonardo IoT – Overview

SAP Leonardo IoT Foundation
- SAP Cloud Platform IoT
- SAP IoT Application Enablement
- SAP Dynamic Edge Processing

SAP Leonardo IoT Foundation
- Outlook

SAP Leonardo IoT – Additional Information
SAP Leonardo IoT

Overview
THE INTELLIGENT ENTERPRISE features

3 KEY COMPONENTS:

1. Intelligence Suite
2. Digital Platform
3. Intelligent Technologies
SAP’s Vision for an IoT Platform – The fundamental layer for Innovation

Every “Thing” is **Connected**
- Customers and users are more informed and empowered
- 24/7 Data availability

Every “Thing” is **Intelligent**
- Machine Learning
- Artificial Intelligence
- 3D Printing
- Predictive Processes
- Products are Smarter

From Connected Thing to the Internet of **THINGS**

Every “Thing” is in the **Moment**
- Online Ordering
- 2-Hour Delivery
- Real-Time Decisions
- Predictive Analytics

Every Business Process needs to be connected to “everything”
- Every “Thing” is Connected
- Every “Thing” is Intelligent
- Every "Thing" in the Moment
- Every Business Process to Every "Thing"
SAP Leonardo IoT part of overall SAP Leonardo Digital Innovation System

Statement applicable to Cloud

Four Major Building Blocks of SAP Leonardo Digital Innovation System

1. Services (e.g. Design Thinking)
2. Applications (e.g. IoT Applications)
3. Technology (i.e. SAP Cloud Platform)
4. Infrastructure (i.e. SAP, Google, AWS, MS)

SAP Leonardo is open in many dimensions

- Infrastructure
- Opensource
- Big Data Technologies
- Digital Core Integration
- Programming Languages
- Development access to customers, partners, innovators & SAP
- Multiple sales channels
SAP Leonardo Internet of Things capabilities
Full stack of IoT solutions and technologies

SAP Leonardo IoT Bridge

- Connected Products
- Connected Assets
- Connected Fleet
- Connected Infrastructure
- Connected Markets
- Connected People

on SAP Cloud Platform

SAP Leonardo Foundation

- Technical Services
  - Device management
  - Connectivity
  - Messaging

- Data Management
  - Aggregate store
  - Times series store
  - Data archive

- Business Services
  - Thing model (SAP Digital Twin)
  - Application development
  - Reuse UI and APIs

on SAP Cloud Platform

SAP Dynamic Edge Processing
- Streaming
- Persistence
- Business transactions
- Predictive and machine learning*
- Analytics*

*Planned Service

SAP Leonardo Foundation

Business Services

Technical Services

Data Management

SAP Leonardo IoT Bridge
Internet of Things
Connecting things with people and processes to reimage 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
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

*S/4HANA
SAP Hybris
SAP Ariba
and more …

*SUPPORT of SAP Vora planned.
Integration & Orchestration services in SAP Cloud Platform

Supported customers scenarios

- **A2A/B2B integration**
  - Developers: Develops integrations, APIs, workflows or apps

- **Digital processes and apps**
  - Business users: Works with tasks, digital processes and apps

- **Real-time omni-channel access**

- **Intelligent process visibility**
  - Citizen integrators/developers: Develops integrations and apps using APIs with low-code productivity tools

- **IOT and device integration**

- **APIs / Prepackaged content as accelerators**
  - from SAP and partners to accelerate integration and innovation on the platform

- **Microservices**

- **Cloud Integration**

- **Internet Of Things**

- **Workflow**

- **Business Rules**

- **Process Visibility**

*planned


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SAP Cloud Platform Integration Suite
a modular iPaaS to connect the Intelligent Enterprise

- **Cloud Integration**: Seamlessly integrate anything, anywhere (A2A/B2B) in real time.
- **API Management**: Expose your data and processes as APIs and manage their end to end life cycle.
- **Integration Content Advisor**: Accelerate implementation and maintenance of B2B scenarios using machine learning.
- **Internet of Things (IoT)**: Develop, customize and operate IoT business applications in the cloud.
- **Workflows/Business Rules**: Automate business processes and enterprise decisions.
- **API Business Hub**: Jump start integration projects with APIs, packaged integration content and adapters.
- **Enterprise Messaging/Functions**: Support event-driven integrations with messaging and functions.
- **Open Connectors**: Accelerate connectivity to third-party applications.
CIO Guides for Integration
Two Complementary Guides

CIO Guide I:
SAP Vision for Integrating SAP Applications in Cloud and Hybrid
Describes SAP’s long term vision for integration - published in 2017
- Integration Challenges and Use Cases
- API Alignment
- Technology Guidance for Process Integration
- Technology Guidance for Data Integration

CIO Guide II: Process and Data Integration in Hybrid Landscapes
Provides refined guidance based on existing technology portfolio - published SAPPHIRE 2018
- SAP API Strategy
- Integration Solution Advisory Methodology (ISA-M)
- Refined Technology Guidance for Process and Data Integration
- B2B Integration
- Integration Automation
- S/4 HANA Transition Guidance
SAP Leonardo IoT Foundation

SAP Cloud Platform IoT
SAP Cloud Platform Internet of Things - Introduction

Connect devices to bring IoT data to SAP Cloud Platform

**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 Leonardo Solution Architecture for IoT

Physical world

Leonardo IoT Edge

SAP Leonardo IoT Solution

Leonardo IoT Applications
Leonardo IoT Foundation
Technical Services
Business Services
IoT Data Management
SAP Cloud Platform
Integration Services

Core (Cloud)

Business system

Process Integration
Data Sharing

SAP Business Solution

Business Applications
Transactional Data
Master Data

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SAP Leonardo IoT Foundation – Technical Services
SAP Cloud Platform Internet of Things

Key capabilities
- Bi-directional data exchange: Receive device data and send commands to remote devices
- REST APIs for device modelling and data consumption
- Certificate-based on-boarding and authentication of devices
- Guaranteed Delivery Edge to Cloud
- Buffering When Not Connected
- Scheduled / Batched Delivery
- Device Firmware upgrades for devices that support it
- IoT Gateway protocol support
- Notification management (alerts / rules / events)
- SDK for development of custom protocol adapters and custom filters (interceptors)
- Start quickly using guidelines, tutorials, and code examples coming with the Starter Kit for the SAP Cloud Platform IoT publicly available on GitHub
SAP Cloud Platform Internet of Things
Architecture Overview

Your Gateway System

Device 1
Device 2
Device 3

IoT Gateway Edge

Send and receive messages
HTTPS / MQTT

IoT Gateway Cloud

IoT Message Management Service

IoT Core Service

IoT Service Cockpit

Your IoT Data

Cloud Platform
PaaS eg., SAP IoT Application Enablement
REST, HANA, Kafka, PostgreSQL,

App User

IoT Gateway Adapters
HTTP, File, Modbus, OPC UA

MQTT, SNMP, CoAP, Sigfox

Eclipse Plug-In

IoT Service SDK

Not SAP Cloud Platform IoT scope

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# SAP Cloud Platform Internet of Things
Protocols via IoT Gateway Adapters

## Protocols

<table>
<thead>
<tr>
<th>HTTP⁺</th>
<th>Zigbee</th>
<th>XBee</th>
<th>ZWave</th>
<th>6lowPAN</th>
<th>BT &amp; BTLE</th>
<th>WiFi &amp; LPWiFi</th>
<th>IEEE 802.15.4</th>
<th>MQTT⁺</th>
<th>CoAP</th>
<th>TR069</th>
<th>SNMP</th>
<th>HART &amp; W-HART</th>
<th>SIGFOX</th>
<th>Semtech LoRa</th>
<th>NWAVE UnB</th>
<th>Formats</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DDS</td>
<td>BACNET</td>
<td>LON</td>
<td>KNX</td>
<td>Modbus</td>
<td>Profibus</td>
<td>Infibus</td>
<td>DLMS/COSEM</td>
<td>KSAT (Viasat)</td>
<td>PLC(*)</td>
<td>OPC UA</td>
<td>OMA LWM2M(*)</td>
<td>Active Message</td>
<td>SWAP(*)</td>
<td>XMPP</td>
<td>LoRa</td>
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</tbody>
</table>

### Vendors

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

1 – also device <> cloud  
*: Limited implantation (bold = GA, orange = expected soon)

Create new adapters with IoT Service SDK

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

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SAP Cloud Platform Internet of Things
IoT Gateway Edge

IoT Gateway Architecture

Examples
- Sap Cloud Platform Integration
- Edge Services
- CEP
- PdMS
- DB
- BRM
- 3rd Party

OSGi Execution Environment
- Java VM
- Operating System

Standard Vendor

Protocol plugins
- Interceptors
- Rules*

Security
- Commands

Buffering Caching
- Remote Update

some features...

Keeps track of the device topology
Provides store and forward for devices eg.
- Commands to Devices
- Measurements to IoT Core

Examples
- some features…
SAP Cloud Platform Internet of Things

The Edge

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](#)
Gateway Interceptors – Example Use Cases

**Field**
- Device and Sensor data & Protocol specific messages

**Gateway component**
- **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

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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)
- Cluodleaf: IoT Supply Chain Visibility (Device Cloud)
- Roambee: Asset monitoring (Device Cloud)
- Q-Loud Universal Gateway (Gateways)

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

* Work in progress
Certified Hardware from **Dell, Samsung** and more for IoT Edge of SAP Cloud Platform IoT available on website

![SAP Certified Solutions Directory](image)

**12 Solutions Found**

<table>
<thead>
<tr>
<th>Selection: &quot;iot&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imprint IoT Connector for SA...</td>
</tr>
<tr>
<td>Dell Edge Gateway 3000</td>
</tr>
<tr>
<td>Dell Edge Gateway 5100</td>
</tr>
<tr>
<td>Dell Embedded Box PC 5000</td>
</tr>
<tr>
<td>Geckopit 1.0</td>
</tr>
<tr>
<td>msg Internet of Things Analyzer...</td>
</tr>
<tr>
<td>OIS iField 1.0</td>
</tr>
<tr>
<td>Samsung ARTIK 530</td>
</tr>
<tr>
<td>Samsung ARTIK 710</td>
</tr>
</tbody>
</table>

*Date: November 13, 2017*
SAP works with many IoT relevant standards bodies across the world

Managing on the steering board

Contributing in workstreams and projects

Using in products

Standards

Open Source
# Requirements for SAP CP IoT Gateway Edge

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

The table defines **MINIMUM REQUIREMENTS**
The requirements depend on:
- Protocol type
- Number of devices
- Frequency of messages and message size
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

Documentation: Internet of Things API Service
Hilti is the leading company in designing leading-edge technology, software and services, which power the professional construction industry.

With SAP Application Enablement Hilti differentiates by offering new digital services to its customers, getting insights into customers’ usage patterns and subsequently being able to innovate new business models – all that integrated into their core business systems.

Hilti enables their customers to realize real-time transparency on last-known locations of assets. Assets lost or stolen gets minimized by geo-fencing based alerts and notifications. Based on real-life evidence Hilti is able to improve machine designs. Continuous revenue streams from new services will be realized.
ifm is a leading sensor manufacturer with extraordinary quality and reliability and providing unequalled customer service.

ifm develops new business models by providing new cloud-based services to their customers. In future (go live spring 2018) ifm customers can connect their sensors directly to the cloud for sensor parametrization, firmware update and all kinds of advanced analytics based on the collected sensor data.

Today, installation, parametrization and operation of sensor networks requires high amount of working hours onsite. The planned cloud services will reduce the time needed onsite significantly, hence reducing production costs for ifm customers or allow more precise monitoring, leading to improved product quality.
Digital Transformation through the SAP® Cloud Platform

When digitalization transforms the market, enterprises may choose to wait and see what happens – or, like dormakaba, they can expand and optimize their portfolios. In collaboration with its daughter company Poksundo and SAP®, dormakaba is developing innovative Cloud solutions for access control as well as time and device management.

Before: Challenges and Opportunities
- Digitize product portfolio
- Provide customers with a cutting-edge SaaS and IoT solution
- Replace the monolithic isolated application with a modular Cloud solution
- Quick rollout for the new product

Why SAP
- SAP’s worldwide network for partners, sales, and services
- SAP’s HR solutions and Cloud infrastructure are a perfect match for dormakaba’s systems
- Extensive scalability with highly secure SAP data centers worldwide
- SAP CEM partner program enables Poksundo to create its own solutions, including support for market approach, marketing, and sales

After: Results
- Portfolio expanded quickly and in line with the company’s aims
- dormakaba set itself apart from the competition with its own Cloud solution
- Its customers enjoy greater security and transparency for a smaller price

“A successful digital transformation requires close partnership. SAP and dormakaba’s collaboration combines the two companies’ strengths and creates added value for every customer.”

Peter Hauser, CEO, Poksundo GmbH
Boosting Investments in Renewable Energies with SAP® Leonardo

Energy technology provider Kaiserwetter Energy Asset Management developed its ARISTOTELES platform using SAP Leonardo IoT capabilities and other SAP solutions. This IoT platform revolutionizes investments in renewable energy for Kaiserwetter's customers, including investment funds, private equity investors, financing banks, and supranational institutions.

Before: Challenges and Opportunities
- Catalyze investments in renewable energies for customers around the world
- Meet the ambitious energy targets related to the Paris climate agreement
- Succeed in an industry with opaque markets and investments
- Integrate technical and financial data in one IT solution

Why SAP
- Market presence of SAP and reliability of SAP Cloud Platform
- Full scalability with high-security data warehouses around the globe from SAP
- IoT and predictive analytics portfolio, as well as future possibilities with machine learning and blockchain
- Customer-as-a-partner model (OEM), which allows customers to build their own solution with go-to-market, sales, and marketing support

After: Value-Driven Results
- Automated aggregation of technical and financial data from each kind of energy-generating asset, as well as climate factors, using Big Data mining and smart data analytics
- Supported executive-level dashboards with automatic KPI calculations
- Simplified the organizational structures with much higher efficiency
- Allowed for a global approach with geographical independence

“ARISTOTELES, built with SAP solutions, is the answer to force capital investments in renewable energy on a global basis by maximizing returns and minimizing risks.”

Hanno Scholklisch, CEO and Founder, Kaiserwetter Energy Asset Management GmbH
Starting Small and Thinking Big with SAP® Cloud Platform Internet of Things

delaware is a fast-growing global company that delivers advanced professional solutions and services to organizations striving for a sustainable competitive advantage. The company is leveraging SAP Cloud Platform to transform and shape its clients’ businesses, and its own, to seize the opportunities arising from rapid technological change in the area of machine learning and the Internet of Things (IoT). As an SAP partner, delaware won an SAP Pinnacle Award in 2017 for its SAP S/4HANA® Cloud enablement experience, and the company was selected to be a member of the SAP Partner Advisory Council for Innovation.

Before: Challenges and Opportunities

- Increase equipment effectiveness of machinery and avoid manual maintenance and control work
- Visualize health status of machines in one central control center that allows for prescriptive action and optimization of logistics and production
- Offer a platform that enables companies to easily and securely integrate cloud applications

Why SAP

- Sophisticated IoT data processing options, either at the edge or in the cloud
- Enterprise-grade lifecycle management for IoT devices, from onboarding to decommissioning
- Rich IoT protocol support to securely connect with physical things, devices, and machines
- User-friendly applications, including mobile apps and the responsive SAP Fiori user experience

After: Value-Driven Results

- Enables delaware and its customers to start small on their business transformation journey and scale out their IoT scenarios over time on the same platform
- Innovates with the Internet of Things, artificial intelligence, and machine learning
- Provides real-time data and live-streaming analytics based on connected sensor and device data
- Facilitates easier onboarding and management of millions of IoT devices and gateways
- Offers user-friendly data visualization and reporting with SAP Fiori apps

“I’m a true believer that Big Data is the new gold of the future. It will generate a lot of business and revenue.”

Bruno Mommens, Global Internet of Things Solution Lead, Delaware Consulting International CVBA

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SAP Cloud Platform
Usage scenario: Internet of Things

Fully managed platform, with device and connectivity management, data management, application development, and more

Intelligently Connected
with the help of SAP Cloud Platform IoT
we can onboard and manage our SPS Robots from Mitsubishi Electric in a fast and efficient way

Enables our customers to connect ANY machine or device of ANY protocol

Build great IoT applications fast and efficiently to drive scale and consistency and achieve value faster

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“With the help of SAP Cloud Platform Internet of Things we can onboard and manage our SPS Robots from Mitsubishi Electric in a fast and efficient way. In particular the immediate visualization of the sensor data without any coding, the secure communication from devices to the cloud and also tight and smooth integration of relevant data into any backend application via the SAP Cloud Platform are key advantages of the IoT service.”

Thomas Lantermann
Senior Solution Consultant FA EMEA, Factory Automation, European Business Group, Mitsubishi Electric
SAP Leonardo IoT Foundation

SAP IoT Application Enablement
SAP Leonardo for IoT Innovation Portfolio
Full IoT solution and technology stack

- SAP Leonardo IoT Bridge
- SAP IoT Application Enablement

Connected Products
Connected Assets
Connected Fleet
Connected Infrastructure
Connected Markets
Connected People

SAP Leonardo Edge Computing
- Streaming
- Persistence
- Business transactions
- Predictive and machine learning*
- Analytics*

Technical Services
- Device Management
- Connectivity
- Messaging
*Planned Service

SAP IoT Application Enablement

Data Management
- Aggregate store
- Times series store
- Data archive

Business Services
- Thing model (SAP Digital Twin)
- Application development
- Reuse UI and APIs

*Planned Service

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SAP IoT Application Enablement provides a wizard-based approach for accelerated enterprise IoT application development

Build IoT applications fast and efficiently to drive **scale and consistency** and **achieve value faster**

- Powerful tools and capabilities for fast time to value
- Templates and wizards to rapidly build connected solutions
- Re-usable components and extension capabilities for IoT applications from SAP and partners
- SAP supports scalable enterprise-grade, end-to-end IoT solutions
- Thing Model and Hierarchies
- Roles, authorizations and business network enablement
A Digital Twin is a live digital representation of a physical object

**Digital Twin concepts** will become increasingly relevant

- Facilitate digital end-to-end processes across different lines of business or enterprise departments
- Involve business partners and service providers in the business network with access to digital twin data
- Build a foundation for new business models (e.g. product-as-a-service)

A Digital Twin represents a product or asset **along the lifecycle**

- Includes physical manifestation, business context, and live condition
- Populated during design and engineering, production and construction, delivery and change of ownership, operations and usage, maintenance and service, recycling or disposal – from the network of business partners
- Built with a business outcome purpose, not a plain data collection

SAP Leonardo IoT solutions provide the **digital twin** backbone

- SAP Leonardo IoT foundation and edge (for live data collection and sharing)
- SAP Asset Intelligence Network (for collaborative asset modeling and master data sharing)
- SAP Digital Twin for structural analysis* (former FEDEM, for physics-based modeling)
SAP Leonardo IoT Foundation

SAP Dynamic Edge Processing
SAP Leonardo Internet of Things capabilities

Full stack of IoT solutions and technologies

SAP Leonardo IoT Bridge

Connected Products
Connected Assets
Connected Fleet
Connected Infrastructure
Connected Markets
Connected People

SAP Leonardo Foundation

Technical Services

Device management
Connectivity
Messaging

Data Management

Aggregate store
Times series store
Data archive

Business Services

Thing model (SAP Digital Twin)
Application development
Reuse UI and APIs

SAP Dynamic Edge Processing

Streaming
Persistence
Business transactions
Predictive and machine learning*
Analytics*

on SAP Cloud Platform

on SAP Cloud Platform

*Planned Service
Drivers for Edge Computing

- Data Volume & Bandwidth Capacity
- Intermittent Connectivity
- Real-Time Decision Making

SAP’s offering

**Edge Services**
- **Integrated cloud-edge** automation
- **Thing-based** with many inputs, owned and managed by cloud
- **Platform**: SAP Cloud Platform / Cloud Foundry, Linux
- **LOB**: Multiple
- **Extends** SAP Cloud Platform IoT service with orchestration and local processing of sensor data

**SAP Dynamic Edge Processing**

- Transaction Availability for Remote Sites (TARS)
- Dynamic Edge Processing

**Edge Services**
SAP Dynamic Edge Processing
Cloud-driven Enterprise IoT at the 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**
- **Analyze**
- **Predict**
- **Synchronize**

**SAP Leonardo IoT Edge**

- **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
SAP Leonardo IoT Foundation

Outlook
Key Roadmap Elements – SAP Leonardo IoT

Digital transformation: Faster time to business value
- Deeper integration of Leonardo IoT foundation with business systems, business processes, and business networks – and vice versa (e.g. digital twin, SAP Asset Intelligence Network, SAP MES, SAP TM)
- New work environments for operational and business users (e.g. SAP Leonardo IoT Bridge)
- Enablement for new business models (e.g. metering, hybris Billing, consumption-based pricing)

Intelligent enterprise: IoT as key enabler and driver
- Deeper integration of analytics, ML, and IoT as part of SAP Cloud Platform portfolio of services
- Extension of generic and domain-specific data science and ML technology for ready-to-run and custom-built scenarios (e.g. model management)
- Common data pipeline and processing engines based on SAP Data Hub / SAP VORA to extend beyond time series (e.g. for unstructured data)

Intelligent edge: Distributed IoT
- Distributed data pipeline, storage, programming models, and intelligence between edge and cloud
- Deeper cloud-to-cloud/edge integration with partners
- Trusted people-to-thing and thing-to-thing interactions at the edge (e.g. using blockchain)
SAP Cloud Platform Internet of Things
Product road map overview

Key capabilities
- IoT Cockpit based on the SAP Fiori UX
- Device to IoT Gateway Edge Protocol support (HTTP, MQTT, CoAP, SNMP, File, ModBus, OPC-UA and Sigfox)
- Provisioning of a software development kit (SDK) for custom protocol adapters or agents and custom filters (adapters and interceptors)
- Integration with SAP IoT Application Enablement
- Starter kit including guidelines, tutorials, and code examples on GitHub
- Multi-cloud data center support (SAP Data Center and AWS)

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
- Integration with SAP Data Hub
- Support SAP Cloud Platform SAP HANA service
- Integration of Mobile SIM Card Management (CT365)
- Device location visualization
- Realtime data consumption using WebSocket
- Rules management support

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

Key capabilities
- IoT Cockpit based on SAP Fiori UX - additional dashboards to intuitively display KPI and interactive charts (cont’d)
- Instantiation of a shadow device methodology to collect, save and display current status information for a device (cont’d)
- …

1. This is the current state of planning and may be changed by SAP at any time without notice.
Planned innovations (1/3)
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
- 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 (2/3)
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
- 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 (3/3)
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

- 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.
SAP Leonardo IoT Foundation

Additional Information
SAP Cloud Platform Internet of Things – Information Package & Links

External SAP Cloud Platform Internet of Things service Sites

- SAP Cloud Platform Internet of Things on cloudplatform.sap.com: official Website where the Solution Brief can be downloaded
- SAP Cloud Platform Internet of Things on SAP Enterprise Architecture Explorer: SAP EA Explorer focuses on specific IT areas such as user experience, landscape architecture or Internet of Things (IoT) and provides valuable insights for enterprise architects and others interested in driving IT decisions and improving their enterprise.
- SAP Innovation Discovery: the online roadmap tool to immediately check which product innovations are available in the pipeline (choose “Product” from the left-hand navigation panel → then “Technology Platform” → then select “SAP Cloud Platform Internet of Things for the Cloud Foundry Environment and/or “SAP Cloud Platform Internet of Things”
- SAP Leonardo on sap.com: SAP Leonardo Solution Brief – See how SAP Cloud Platform fits into the SAP Leonardo offering as part of the IoT Foundation (Technical Services) and SAP Leonardo IoT Edge
- Open SAP course: https://open.sap.com/courses/cp1_2
- Licensing options for partners via SAP Partner Edge Program
- SAP Leonardo IoT Foundation, express edition
- Feature requests for SAP Cloud Platform IoT: See SAP note 2679064

TECHNICAL DOCUMENTATION: covering end-user and configuration information, security guides, IoT service SDK information and tutorials

- SAP Cloud Platform Internet of Things for Cloud Foundry Environment (new version integrating PLAT.ONE’s offering)
- SAP Cloud Platform Internet of Things for Neo Environment

TESTIMONIALS:
- Mitsubishi using IoT service on news.sap.com
- Delaware Consulting video interview on cloudplatform.sap.com

TRIAL AND LEARNING
- Starter kit for the SAP Cloud Platform Internet of Things for Cloud Foundry on GitHub which includes samples, examples, etc.
- Tutorials: part of the technical documentation for Cloud Foundry Environment (see above)
- Trial system: Contact Udo Paltzer @ udo.paltzer@sap.com

RELATED TECHNICAL
- SAP IoT Ecosystem Integration and Certification Center (ICC): certify your Hardware for SAP IoT Gateway Edge from SAP Cloud Platform Internet of Things – go to Hardware Certification paragraph and select IoT Certification

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COIL Partner Offering

Co Innovation Lab supports partners to Build and Enable IoT apps with SAP IoT Application Enablement

Partners get at a fixed package price for three month:

▪ Support in IoT use case definition and refining of initial ideas of partners ideally with their customers
▪ Provisioning powerful microservices and development tools to build IoT applications
▪ Immediate project start due to availability of a preconfigured system landscape
▪ Knowledge transfer and support of partners in case of questions
▪ Providing partners tips and tricks how to organize data with an extensible thing data model
▪ Collecting feedback from our partners for further product improvement

For more information get in contact with coil.dresden@sap.com
IoT Developer Enablement – SAP Developer Center

- Developer Product Information
- Resources
- IoT Community
- Tutorials
- IoT Tools and Platform Access

https://www.sap.com/developer/topics/iot-application-enablement.html
Enablement and Learning – IoT Tutorials
Get Started, Learn and Build IoT with SAP

- IoT Tutorials
- Free access to platform and tools

Open Enterprise IoT Developer Communities

Github: Open Source IoT SAP Starter Kit
https://github.com/SAP/iot-starterkit

Supported IoT Service versions

- SAP Cloud Platform Internet of Things for the Neo Environment (as covered in the IoT Starter Kit since May 2015)
- SAP Cloud Platform Internet of Things for the Cloud Foundry Environment (initial coverage in the IoT Starter Kit since June 2017)

hackster.io: Enterprise IoT Community Projects
https://www.hackster.io/sap
Achieving Scale and Reach for our Ecosystem – SAP App Center

https://www.sapappcenter.com/home
SAP Integration and Certification Center for **SAP Leonardo IoT certifications**

https://www.sap.com/partner/certify-my-solution.html - Date: November 13, 2017
Thank you.

Contact information:

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