Industry 4.0 and Cloud Computing

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27.04.2017

Agenda

Who am I?

Big Picture

Central Device the Cloud IoT Gateway

Data Collection and Analysis Platform

Security and Data Privacy

Summary

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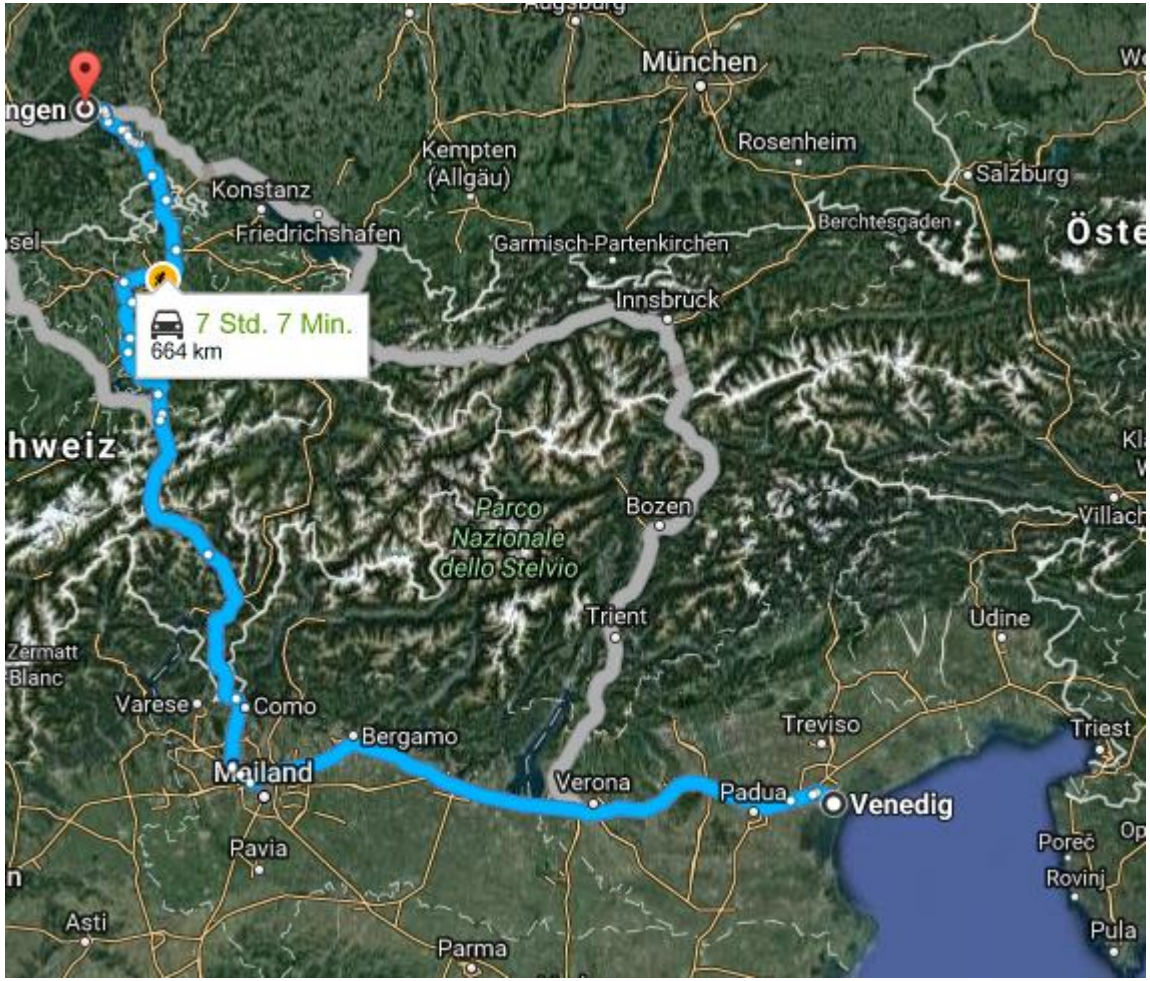
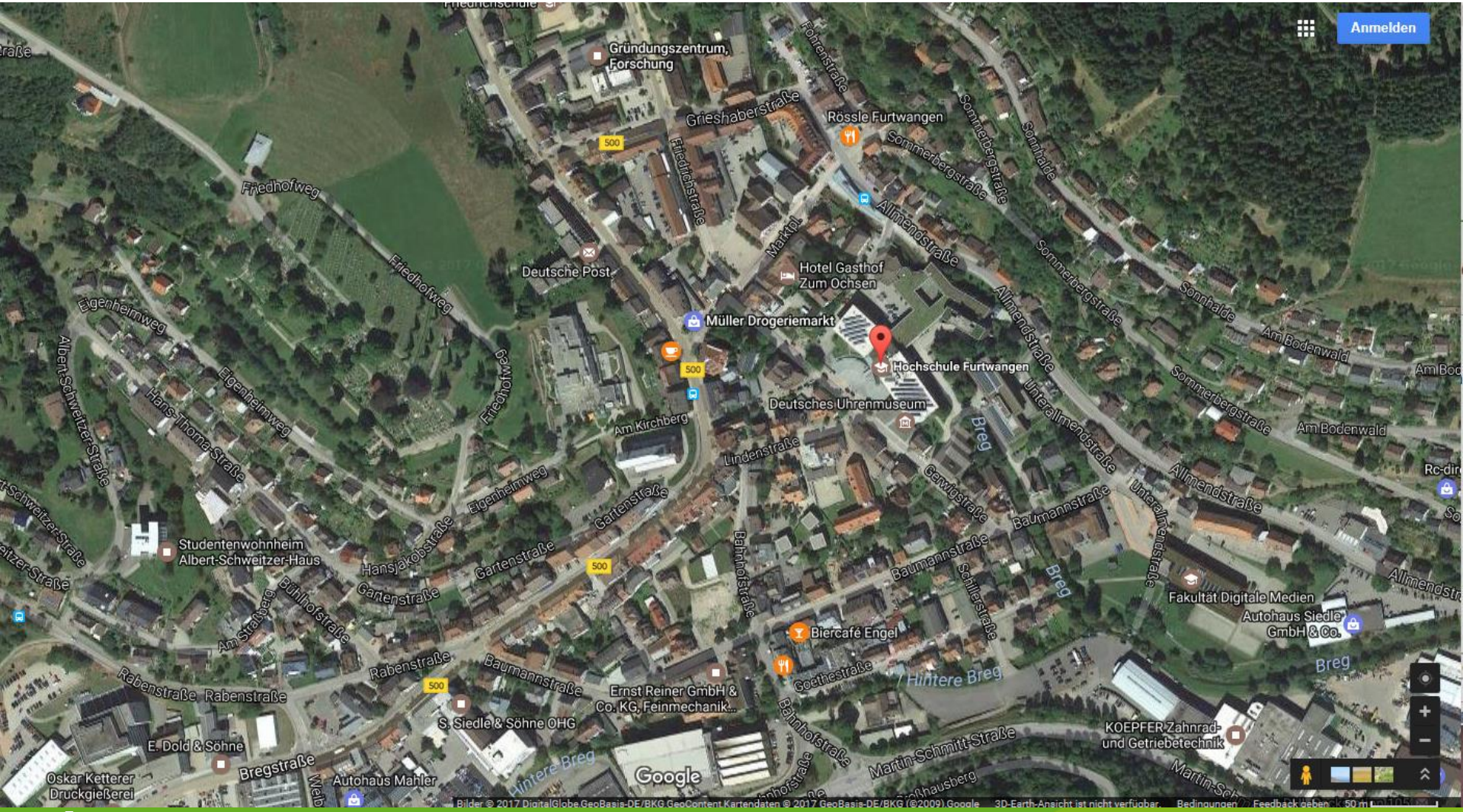
Summary

Furtwangen University of Applied Science, Germany
664 km away from Venice, Italy



Furtwangen University of Applied Science



Furtwangen University of Applied Science

HOCHSCHULE FURTWANGEN UNIVERSITY | HFU


26.04.2017

Institut for Cloud Computing and IT-Security (IfCCITS)

- since 2009 research in Cloud Computing and IT-Security
- *Head:*
  Prof. Dr. Christoph Reich
- *Faculty:* Computer Science
- 6 PhDs, 4 Masters,
  6 Bachelors
- www.wolke.hs-furtwangen.de

- ***Research Area:***
  - Distributed Systems
  - Cloud Computing
  - IT-Security
  - IoT/Industry 4.0 (IT-Security, Data Privacy, Data Analysis)

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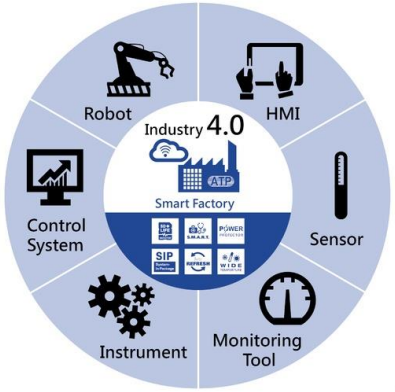
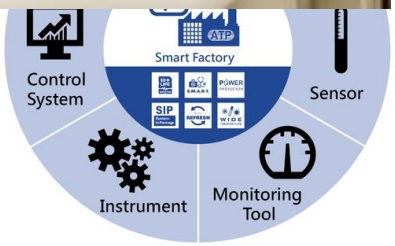
Internet of Things Application Areas

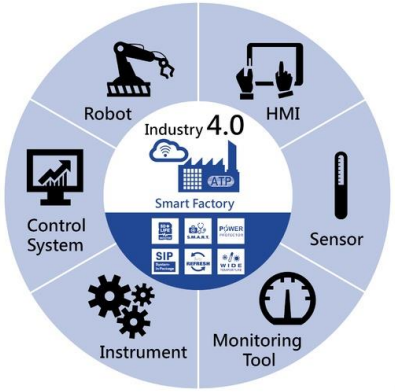



VATTENFALL


22°C
NORMAL


Smart Factory
Control System
Sensor
Instrument
Monitoring Tool

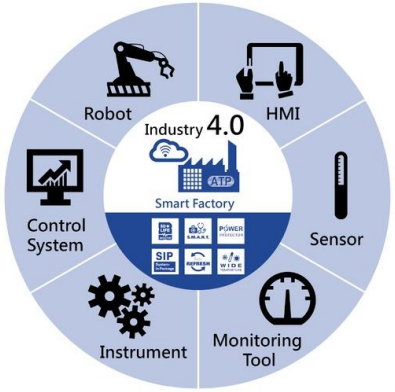
Internet of Things Application Areas




REMOTE HOME CONTROL
ONLINE HOME AUTOMATION
22°C
ECO MODE
NORMAL


Instrument
Monitoring Tool

Internet of Things Application Areas




REMOTE HOME CONTROL
ECO MODE
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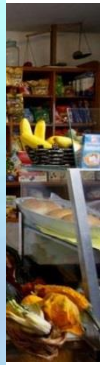
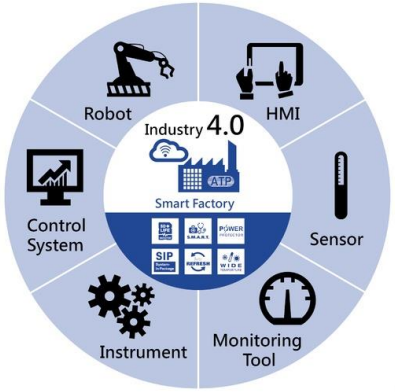


Internet of Things Application Areas




REMOTE HOME CONTROL
ECO MODE
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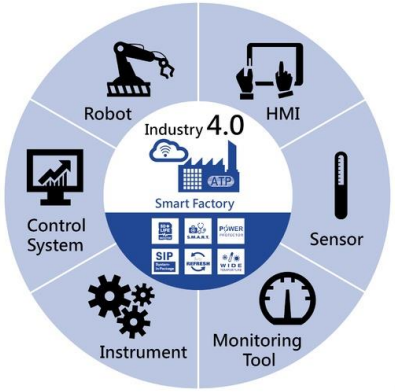
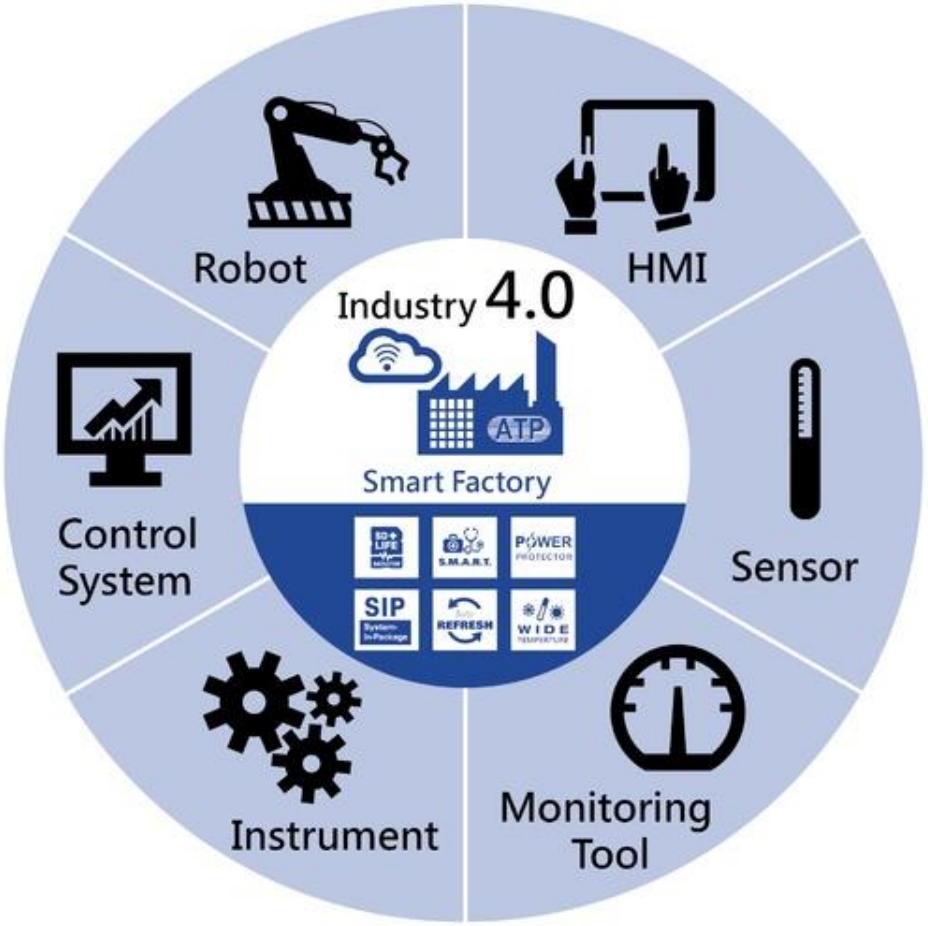



Robot
HMI
Industry 4.0
ATP
Smart Factory
Control System
Sensor
SIP
Instrument
Monitoring Tool


REMOTE HOME CONTRO
22°C

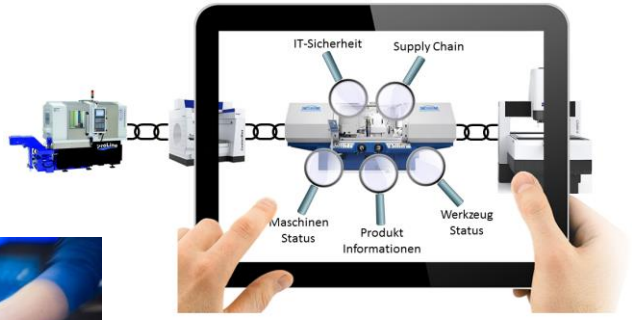
Industry 4.0 Use Cases

Manufacturing:
- Monitoring
- Self-diagnosis; Maintenance
- Flexible, lot size one
- Process optimization
- Human machine cooperation

Smart product:
- Tracking
- Quality optimization

Smart Tools:
- Quality optimization
- Maintenance prediction

Chris Smell



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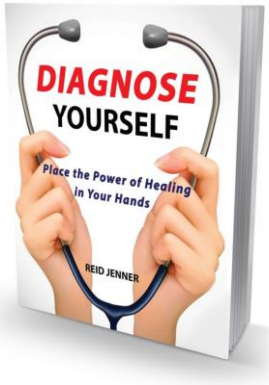
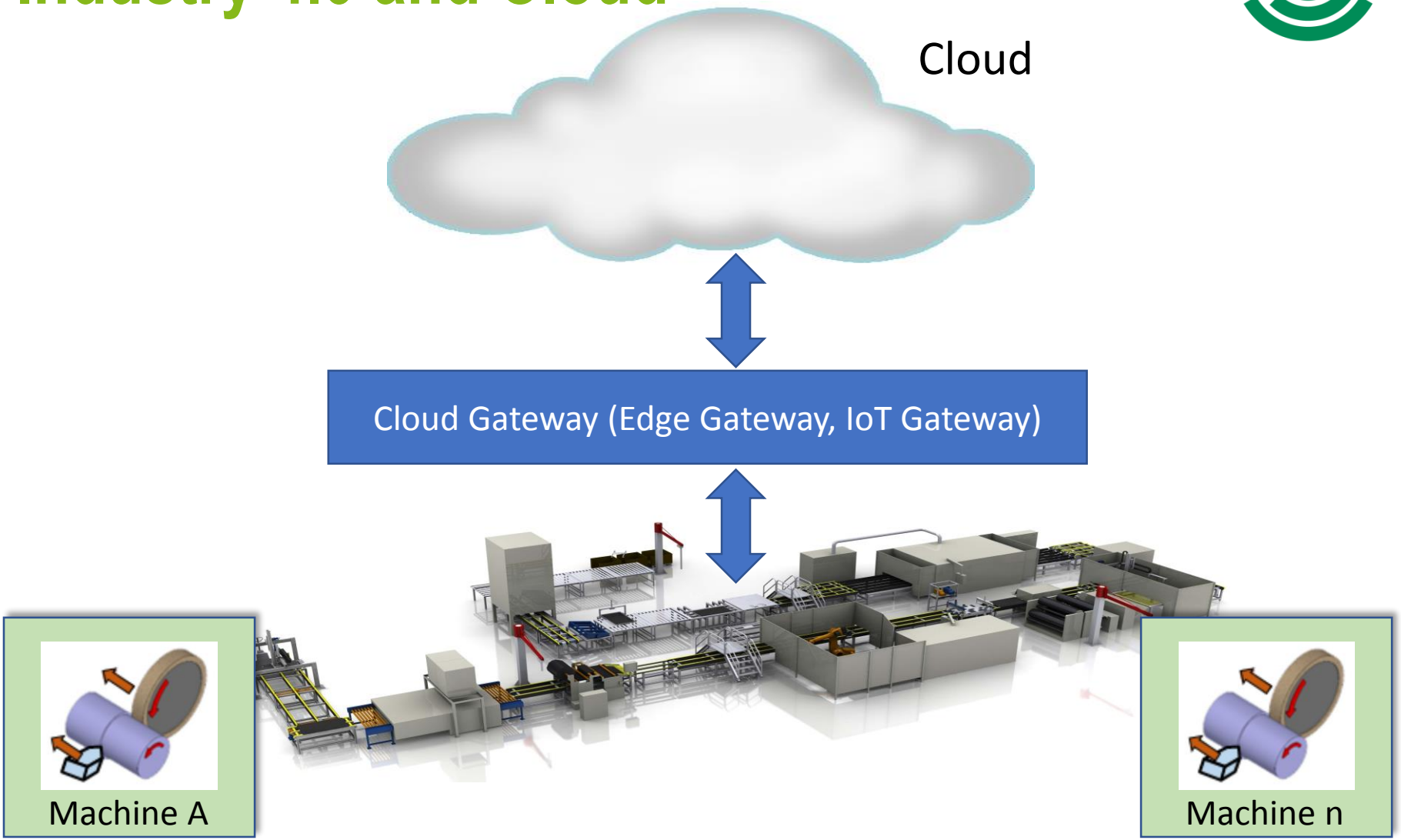


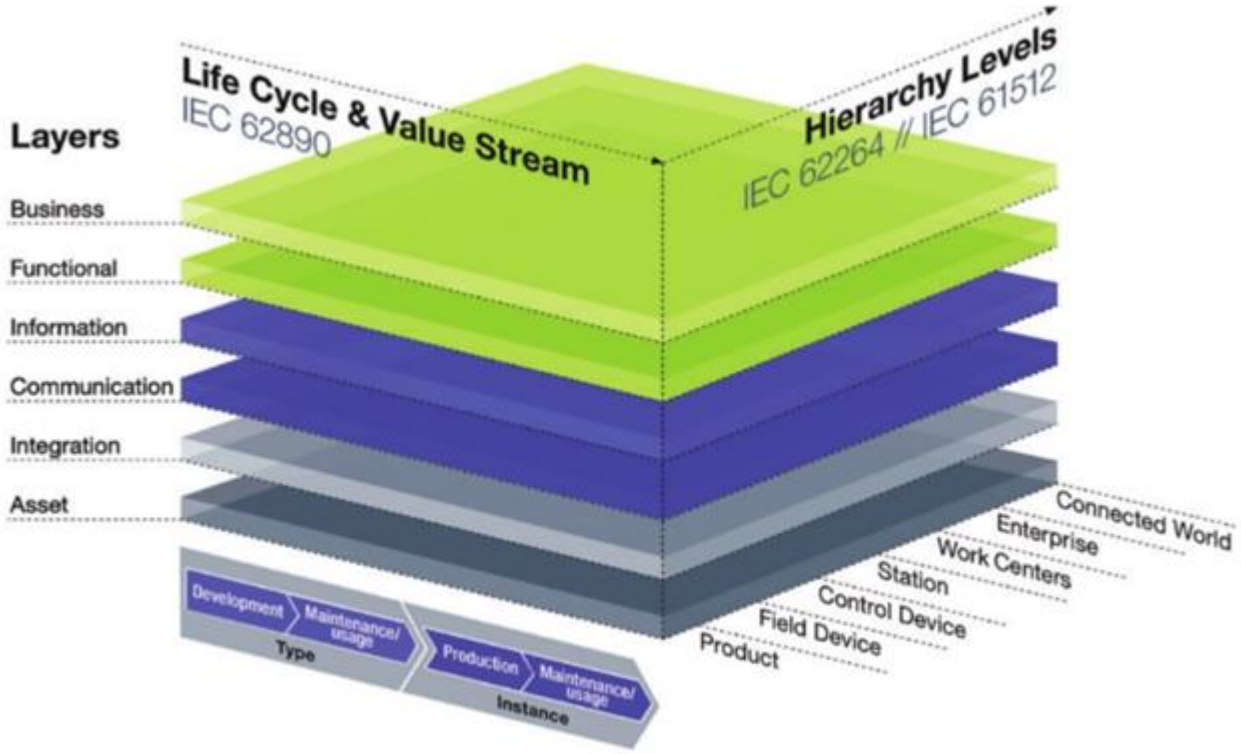
Present and Future Production Lines
Smart Factories

Production line in the new bodywork production of the sports car maker Porsche in Leipzig.
Source: http://www.fnp.de/nachrichten/wirtschaft/Bewerber-ueberrennen-Porsche;art139,497229

Industry 4.0 and Cloud



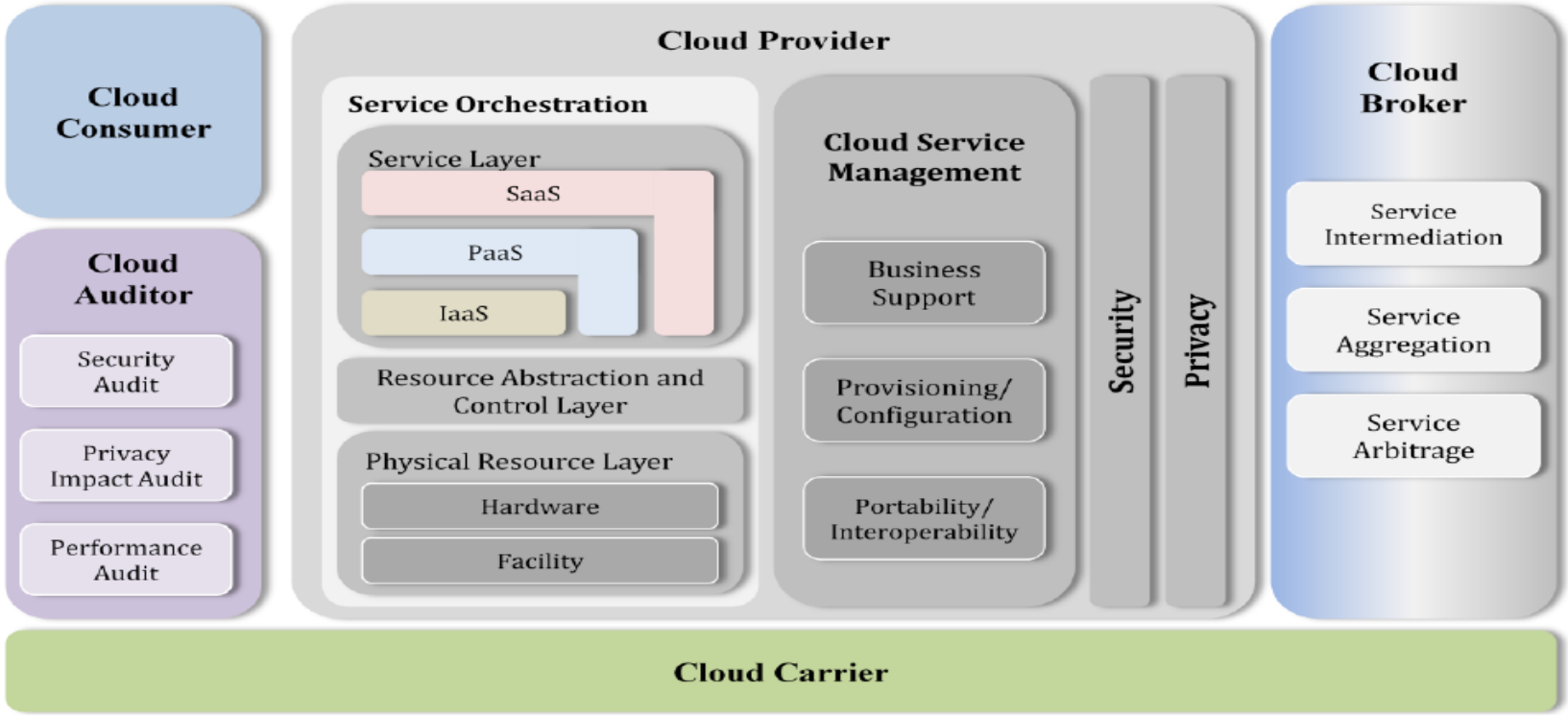
Reference Architecture Model (RAMI) 4.0



Das Referenzarchitekturmodell RAMI 4.0
© Plattform Industrie 4.0

Source: ZVEI - Zentralverband Elektrotechnik- und Elektronikindustrie e.V.

NIST Cloud Computing Reference Architecture



"Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This Cloud model promotes availability [...]."


Research Challenges

Industry 4.0 Cloud

external services/ information

Condition Monitoring | Process-Control and Monitoring | Maintenance Prediction | ... | Product-quality

Application Services

Info-Extractor | Machine Learning | domain knowledge | ... | Simulation

System Services

Smart Factory as a Service (communication, deploy on demand, scalability, …)

Virtual Resources
(Machines, sensors, actors, PLC, SCADA, MES, ERP, ….)

Cloud Gateway

Chanllenges:
System Architecture

interoperability

- Reference model
- API standardisation -> interoperability
- Realtime requirements
- Data management of provider chains
- Domain specific services for car, machine, etc. industry
- Integration of new sensors and actors seamlessly, ready for semantically interpretation, without warranty loss
- Integration of third-party provider services

Industry 4.0 Cloud Security

A

A

external services/ information

A

Condition Monitoring

Process-Control and Monitoring

Maintenance Prediction

Product-quality

Application Services

A

Info-Extractor

Machine Learning

domain knowledge

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A

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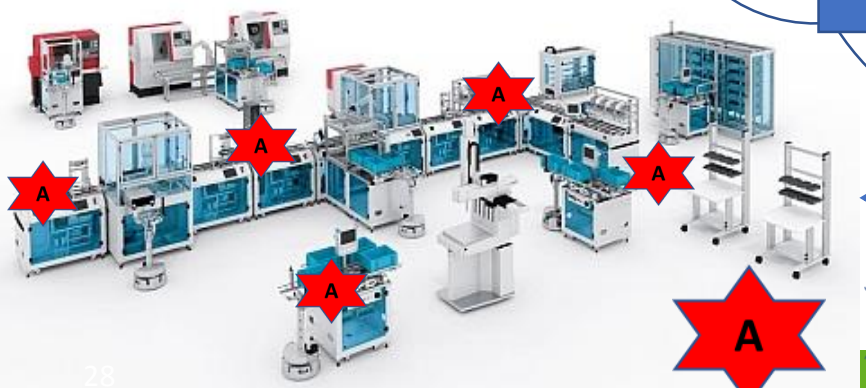
A



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Cloud Gateway

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Challenges: Network and Protocols

performance: large bandwidth

relibility: critical infrastructure

Real time: Control of machine

Network & Protocol

virtualized: SDN

Addressing: Milliard of devices (IPv6)

IP-Protokoll: light

lightweight cryptography

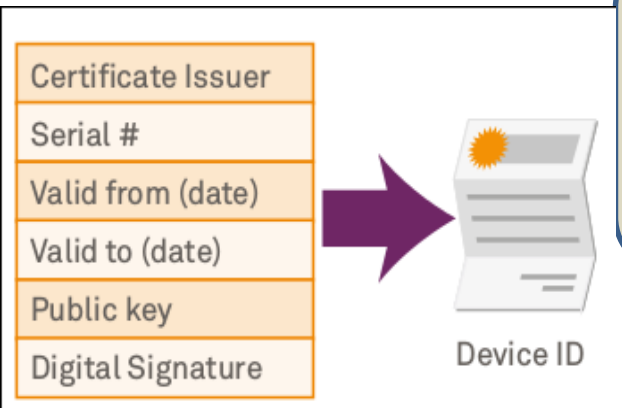
Challanges: Identity Management

Identität

Integration in IAM

New devices ⇨ new key

Risik modelling



PKI: Provisioning of certificates

Privacy: Share critical data of devices

Most important component: IoT gateway

Physical Access Control System (PACS)

Cloud Security Alliance; Identity and Access Management for the Internet of Things

Research question: IT security in highly connected distributed systems

- How can security policies be defined considering the huge number of devices and small critical information?
- How can security polices monitored?
- Which protection measures are useful?
- Evidence collection and post processing of IT security incidences?
- How can the collected evidence be used to improve protection measures?
- Privacy by Design

Challanges

Lightweight communication protocol for CPS devices

Identity must be unique (global?) and lightweight.
X.509 vs ID-number

Robust/durable APIs and interoperability is essential for success.

Security (crypted communication, …)

Privacy and Policies

Standards?

	Lightweight communication protocol	MQTT, CoAP, XMPP, DDS, AMQP
	Identity	XRI, UUIDs, etc.
	APIs, access and interoperability	SOA/Cloud orchestration, API standardization (AMQP, MQTT, OData)
	security	KMIP, SAML, XACML/JSON, PKCS11, CloudAuthZ
	Privacy and policy	PMRM, PbDSE, Personal Data Stores

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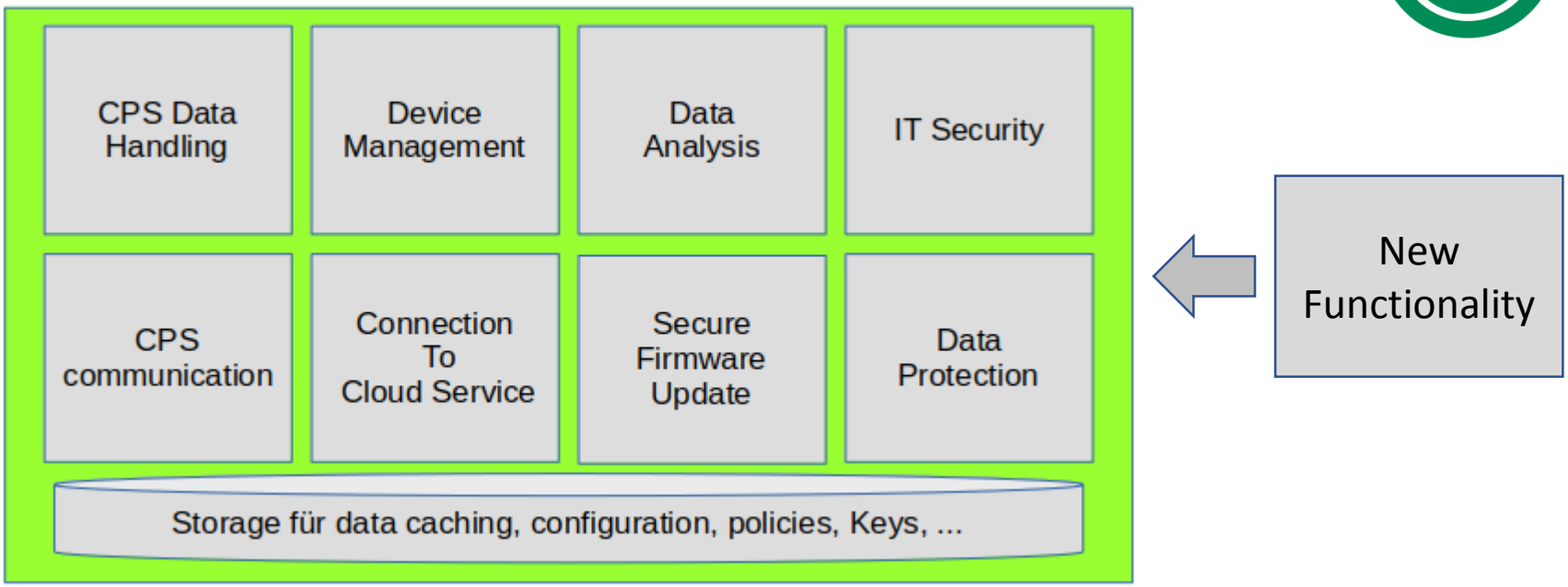
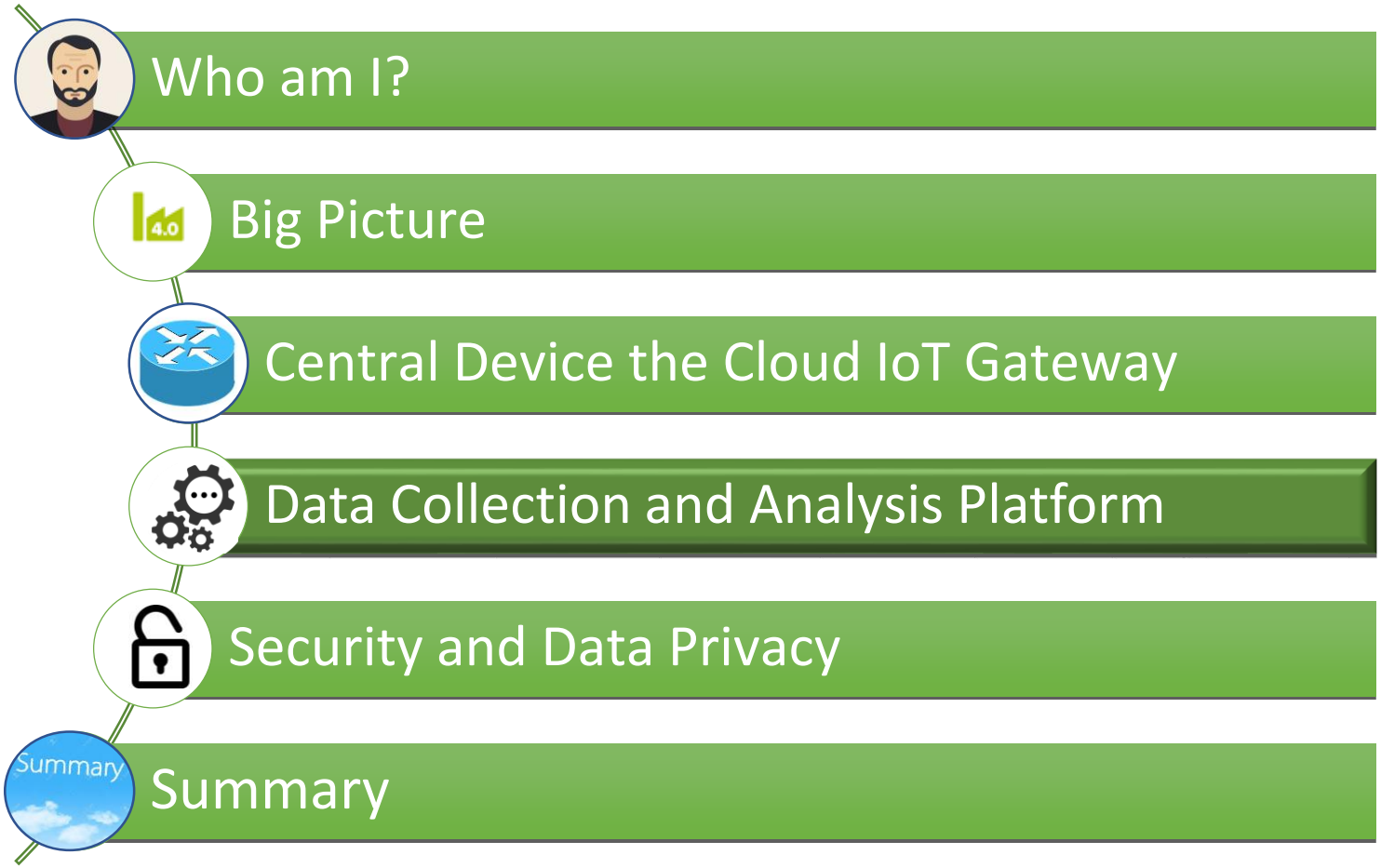
Cloud Gateway



- Challenge 1: real time data handling
- Challenge 2: scalable device management and identity management
- Challenge 3: dynamic functional extension
- Challenge 4: HA of firmeware update
- Challenge 5: security and data protection -> anomaly detection

Agenda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SeMa - Sequence Management for autonomous vehicles

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DAIMLER

See: http://en.hs-furtwangen.de/welcome/the-university/central-services/institute-for-applied-research/research-institutes/institute-for-cloud-computing-and-it-security-ifccits/current-projects/data-analysis-of-autonomous-vehicle-driving-information.html

Mercedes Autonomous Driving

Source: http://blog.caranddriver.com/heres-johnnycab-mercedes-plans-dramatic-expansion-of-drive-pilot-semi-autonomous-driving/

SeMa – Project requirements

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DAIMLER

The projects goal is to create a data analysis infrastructure in which developers can further develop their autonomous driving algorithms. Therefore, the platform has to collect and process car driving sections automatically and provide virtual machines for processing.

- Fast data transmission between vehicles and platform
- Replicated data storage
- Plausibility checking of incoming data with SPARK infrastructure
  - Missing value check, data quality check, data plausibility check, etc.

Motivation

Charlie Chaplin in the movie:
»Moderne Times«

In case of failure!

High losses

TRINATIONALE METROPOLREGION OBERRHEIN
REGION METROPOLITAINE TRINATIONALE DU RHIN SUPERIEUR
Wissenschaftsoffensive Offensive Sciences
Baden-Württemberg
MINISTERIUM FÜR WISSENSCHAFT, FORSCHUNG UND KUNST
HOCHSCHULE FURTWANGEN UNIVERSITY HFU
WISSENSCHAFT SCIENCES

HALFBACK Project Goal

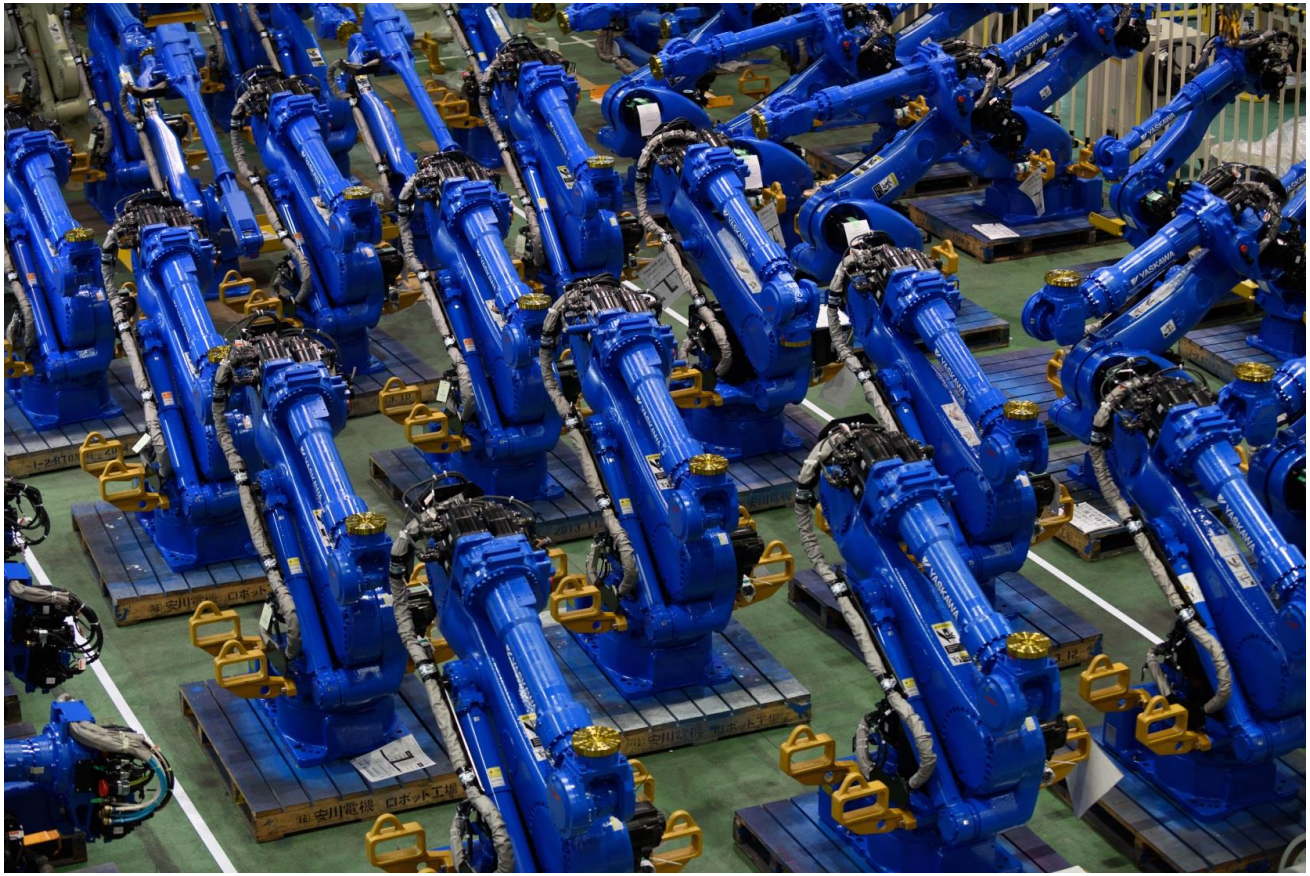
Guarantee of

Highly Available

Manufacturing Processes

Project web page: http://halfback.in.hs-furtwangen.de/

Solution: Machine Standby?



Manufacturing Process

Resources

Machines

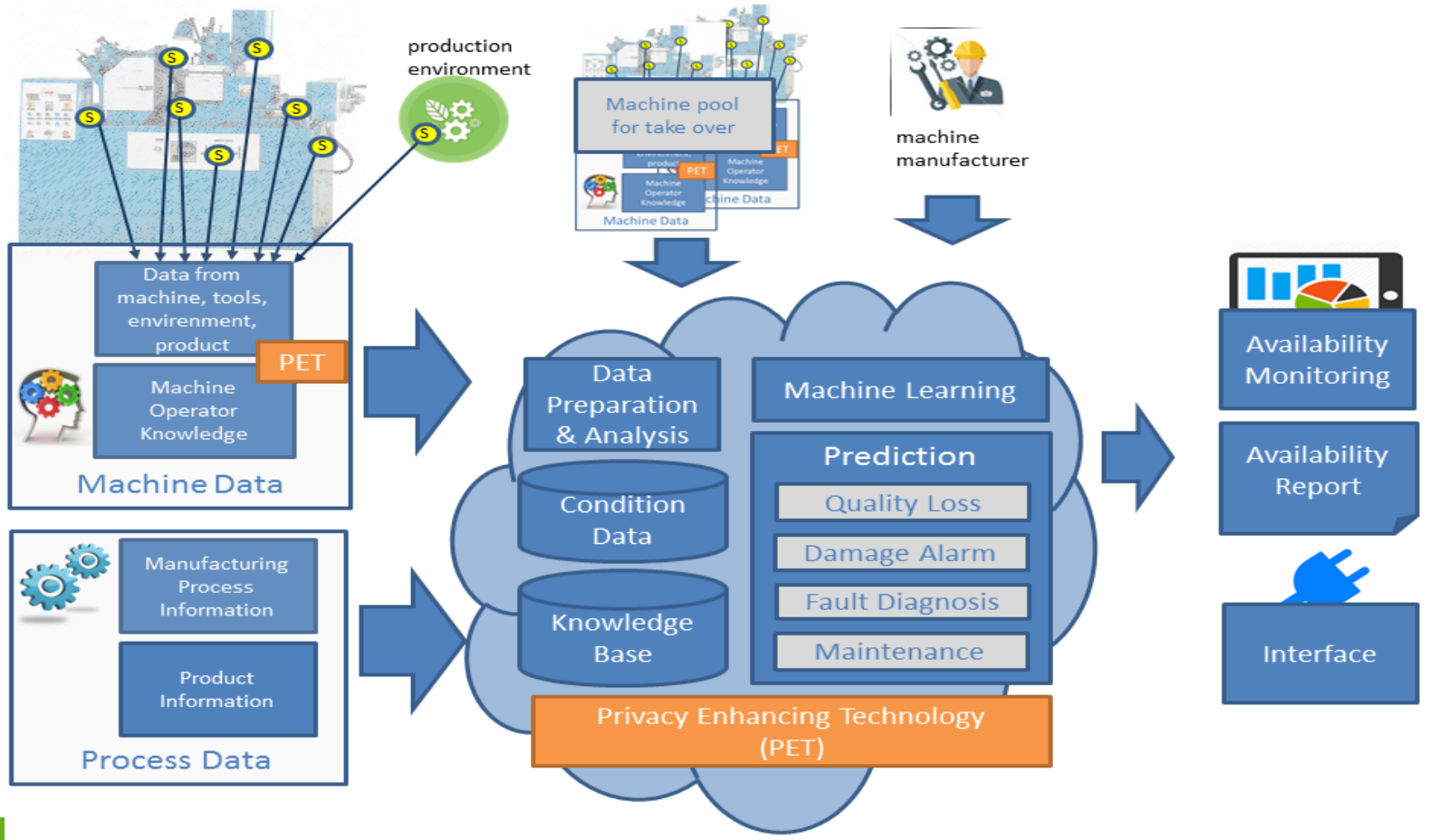
Availability: Manufacturing

Processes

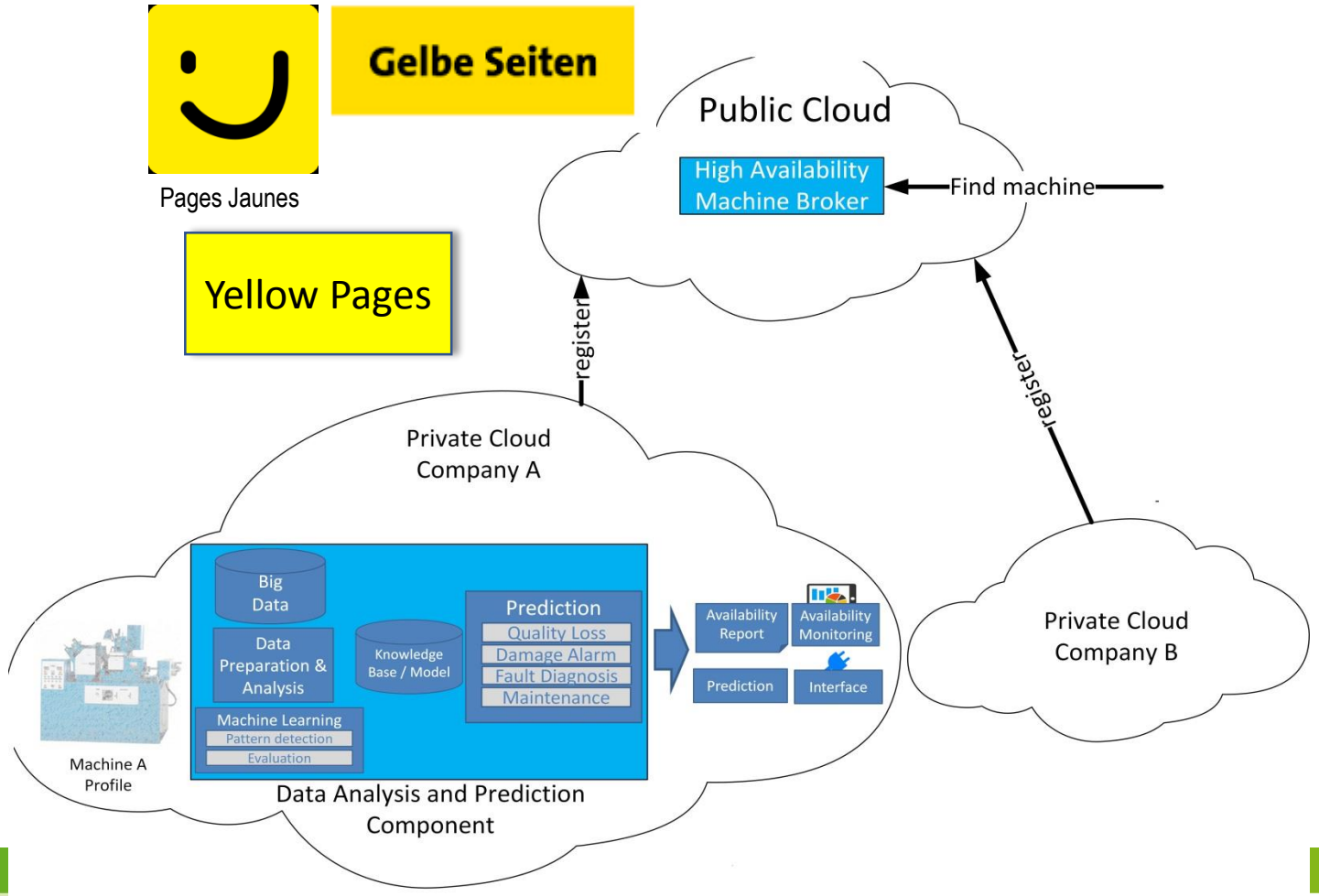
Product Quality

Tools

Local Solution Approach: HA Machine



Transnational Solution Approach: Broker



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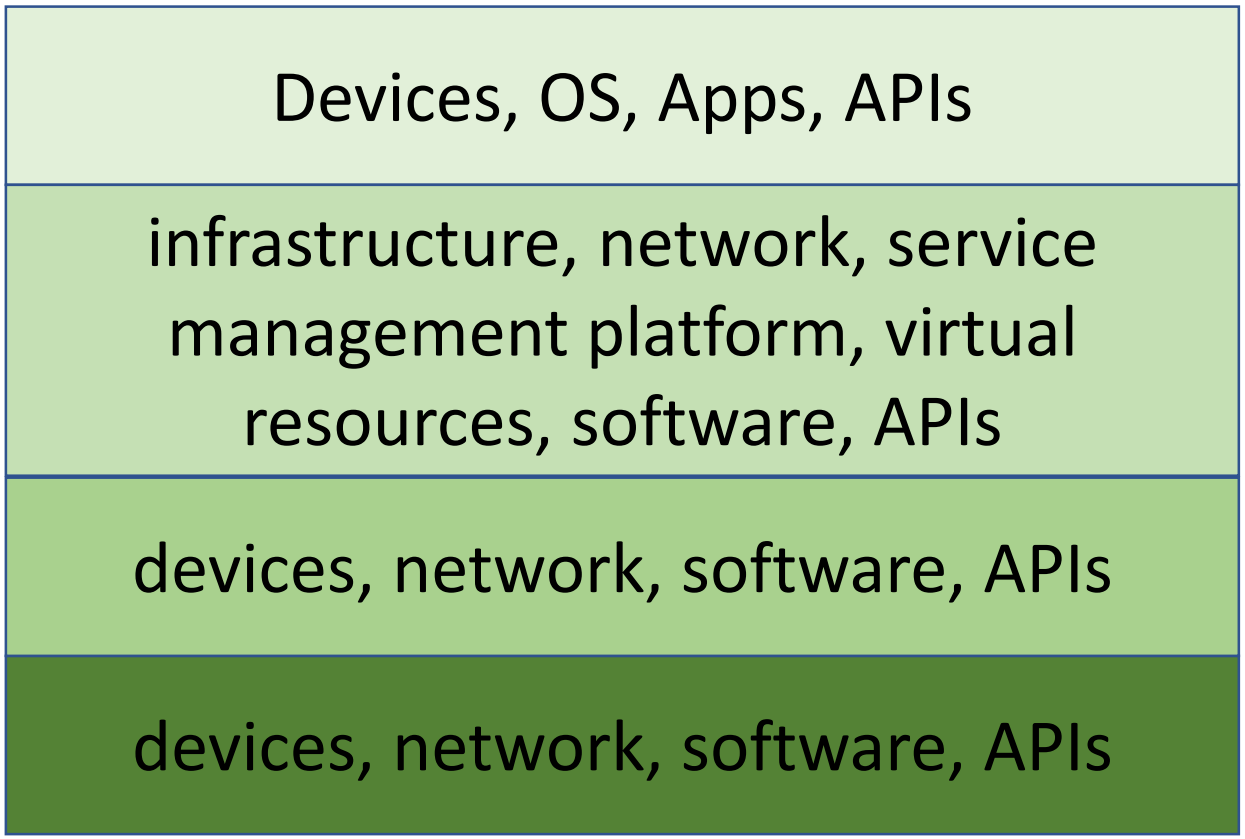
Security OWASP Top 10 Vulnerabilities from 2014 for IoT

Rank	Title
I1	• Insecure Web Interface
I2	• Insufficient Authentication/Authorization
I3	• Insecure Network Services
I4	• Lack of Transport Encryption/Integrity Verification
I5	• Privacy Concerns
I6	• Insecure Cloud Interface
I7	• Insecure Mobile Interface
I8	• Insufficient Security Configurability
I9	• Insecure Software/Firmware
I10	• Poor Physical Security

Source: https://www.owasp.org/index.php/Top_IoT_Vulnerabilities

Security and Data Privacy

Holistic Appraoch has to be taken and all elements of the Industry 4.0 Cloud Archtiecture need to be considered:



Mobile

Cloud

Cloud Gateway

Cyber Physical System

Industry 4.0 and Cloud Computing

external services/ information

Condition Monitoring | Process-Control and Monitoring | Maintenance Prediction | ... | Product-quality

Application Services

Info-Extractor | Machine Learning | domain knowledge | ... | Simulation

System Services

Smart Factory as a Service (communication, deploy on demand, scalability, ...)

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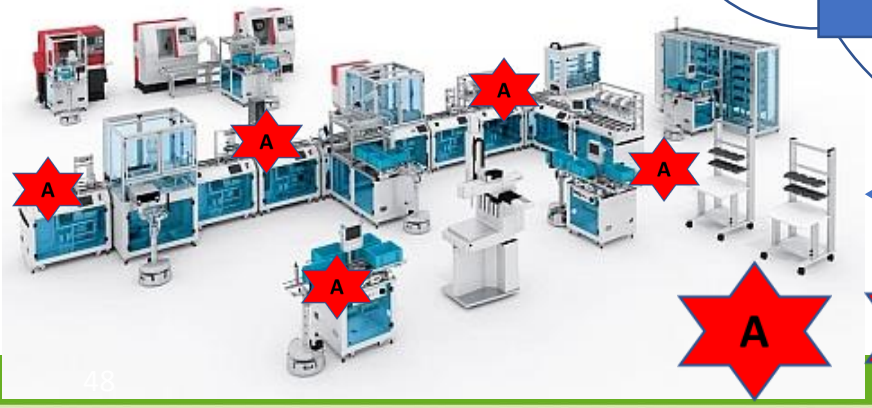
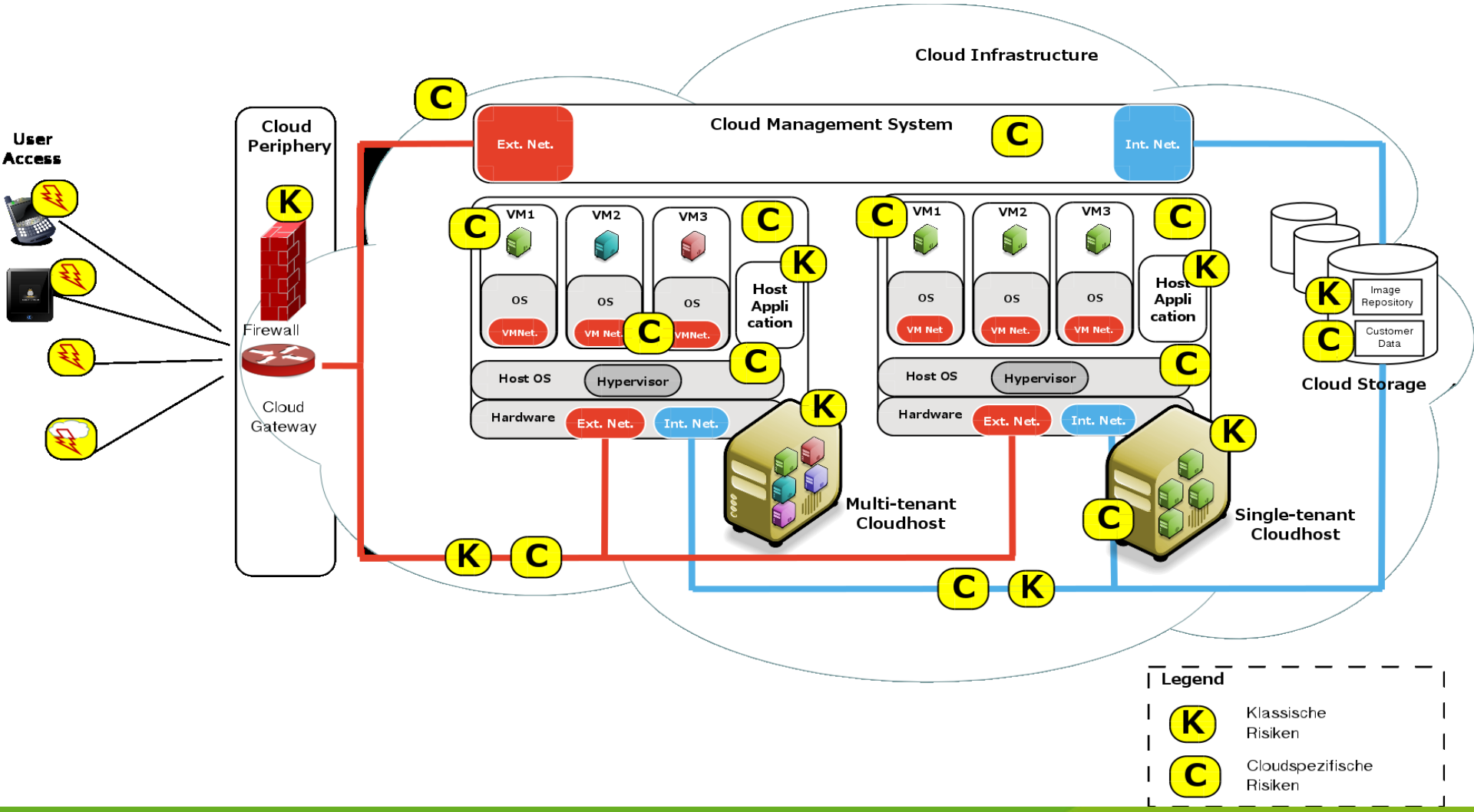


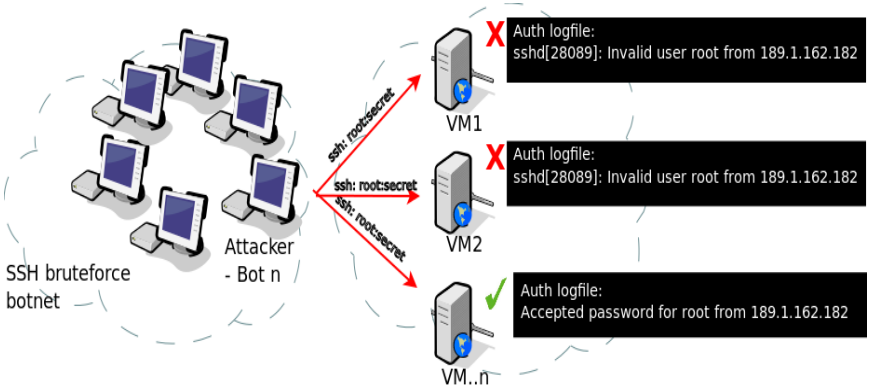
Cloud Gateway

Security Analysis of the Cloud Infrastructure

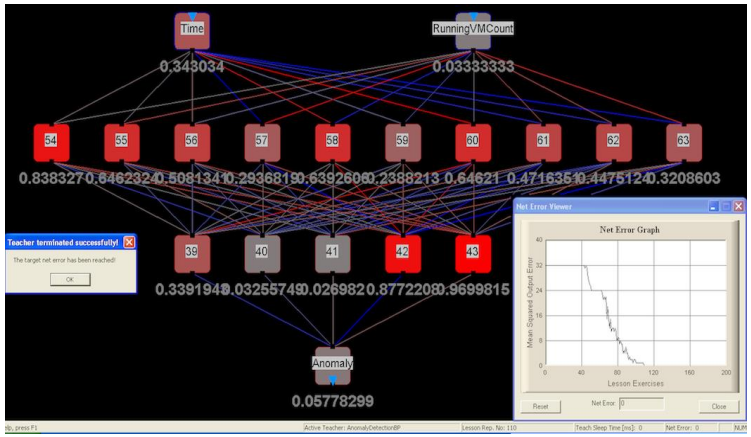


BMBF SAaaS: Detection of Security Incidences

Anomaly Detection by



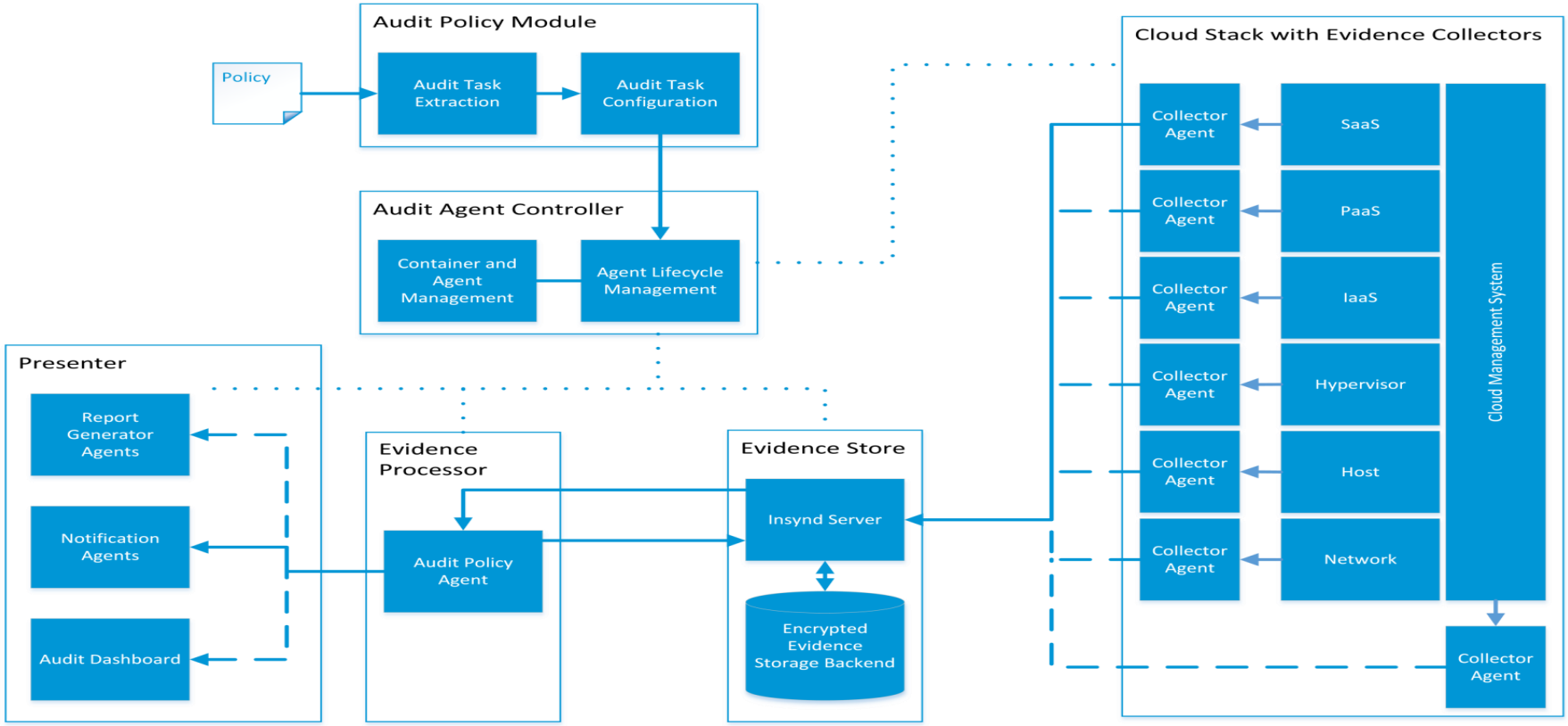
- Rule based approach



- Machine Learning approach

Frank F. Dölitzscher, M. Knahl, C. Reich, N. Clarke: Anomaly Detection in IaaS Clouds. IEEE International Conference on Cloud Computing Technology and Science (IEEE CloudCom), 2.-5. Dezember 2013, Bristol, doi: 10.1109/CloudCom.2013.57, S. 387-394

FP7 A4Cloud: Evidence Collection to prove accountability in Couds



Ruebsamen T., Pulls T. and Reich C., "Secure Evidence Collection and Storage for Cloud Accountability Audits", in Proceedings of the 5th International Conference on Cloud Computing and Services Science, Page(s): 321-330, 2015, Lisbon, Portugal.

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Security and Data Protection

Summary

Summary (I)

- There are a lot of research challenges in Industry 4.0 analysing the data in the Cloud
  - *Cyber physical system topics:* lightweight protocols, lightweiht cryptography, identity management, software updates
  - Edge Gateway topics: functional extention, reliability, scalability, anomaly detection

Summary (II)

- *Cloud Computing topics:* automatic scaling horizontal/vertical, security, privacy
- *Data analysis topics:* maintenance prediction, process optimization, tracking, data privacy

Thanks for your attention

For further information please contact:

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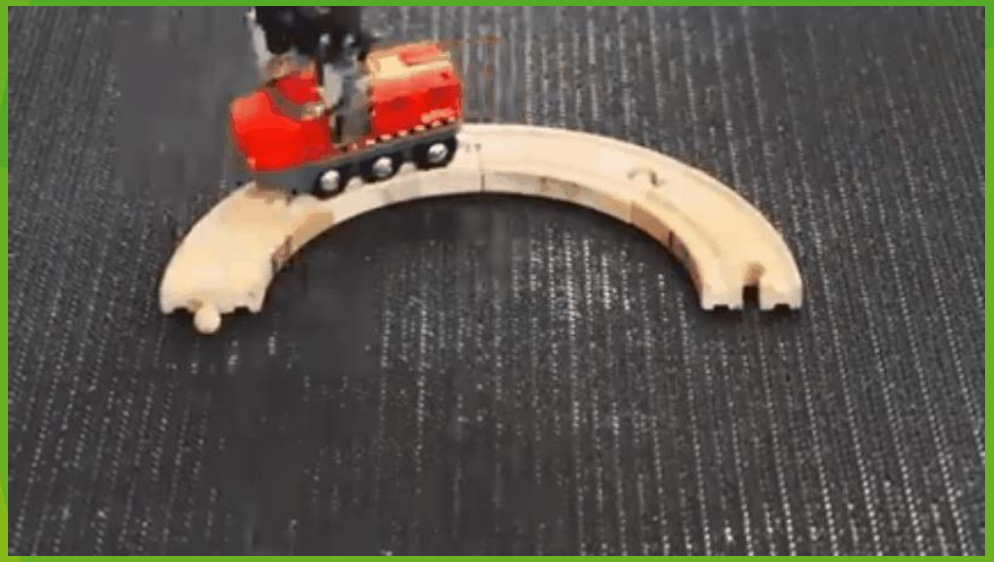

Source: http://gizmodo.com/wait-for-it-1794483896