Future (inter-) network communication in Industry 4.0

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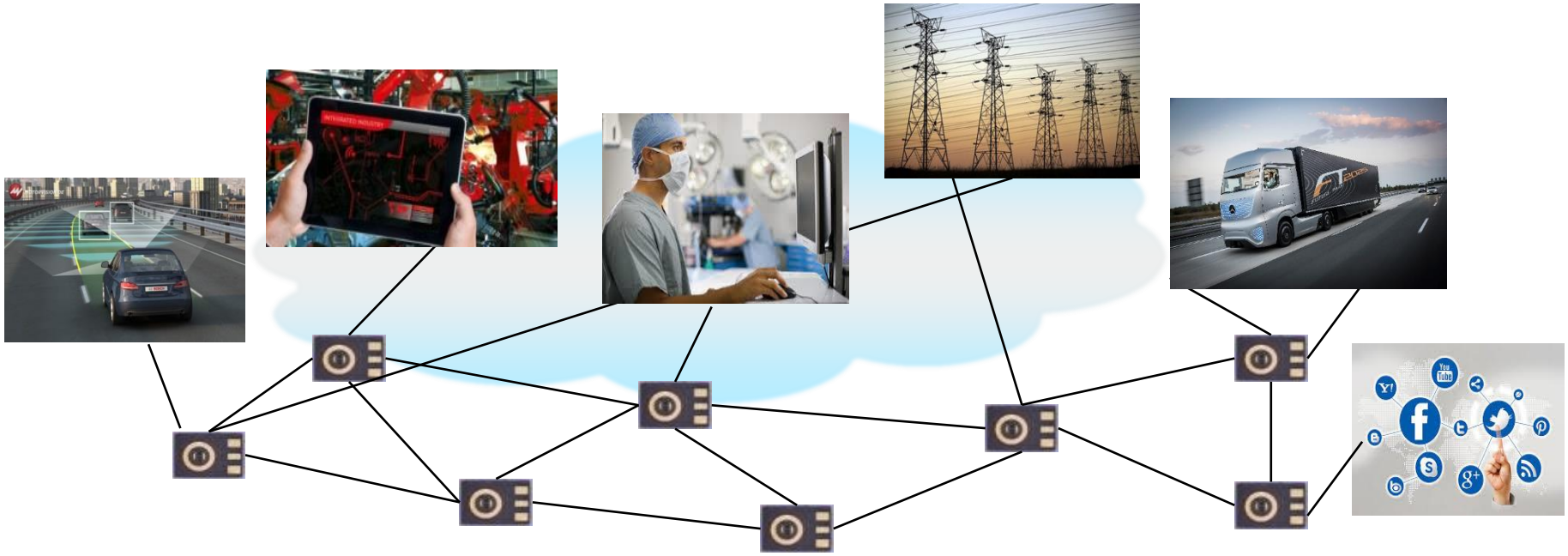
Agenda

1. Connected Eco-Systems
2. Industry 4.0: Characteristics
3. Security Risks: Examples
4. Industry 4.0: Security Challenges
5. Security Research
6. Take Home Message

Industry 4.0: Connected Eco-Systems

- Connection of industrial IT and business IT
- Communication across companies
- Communication from sensors into the cloud



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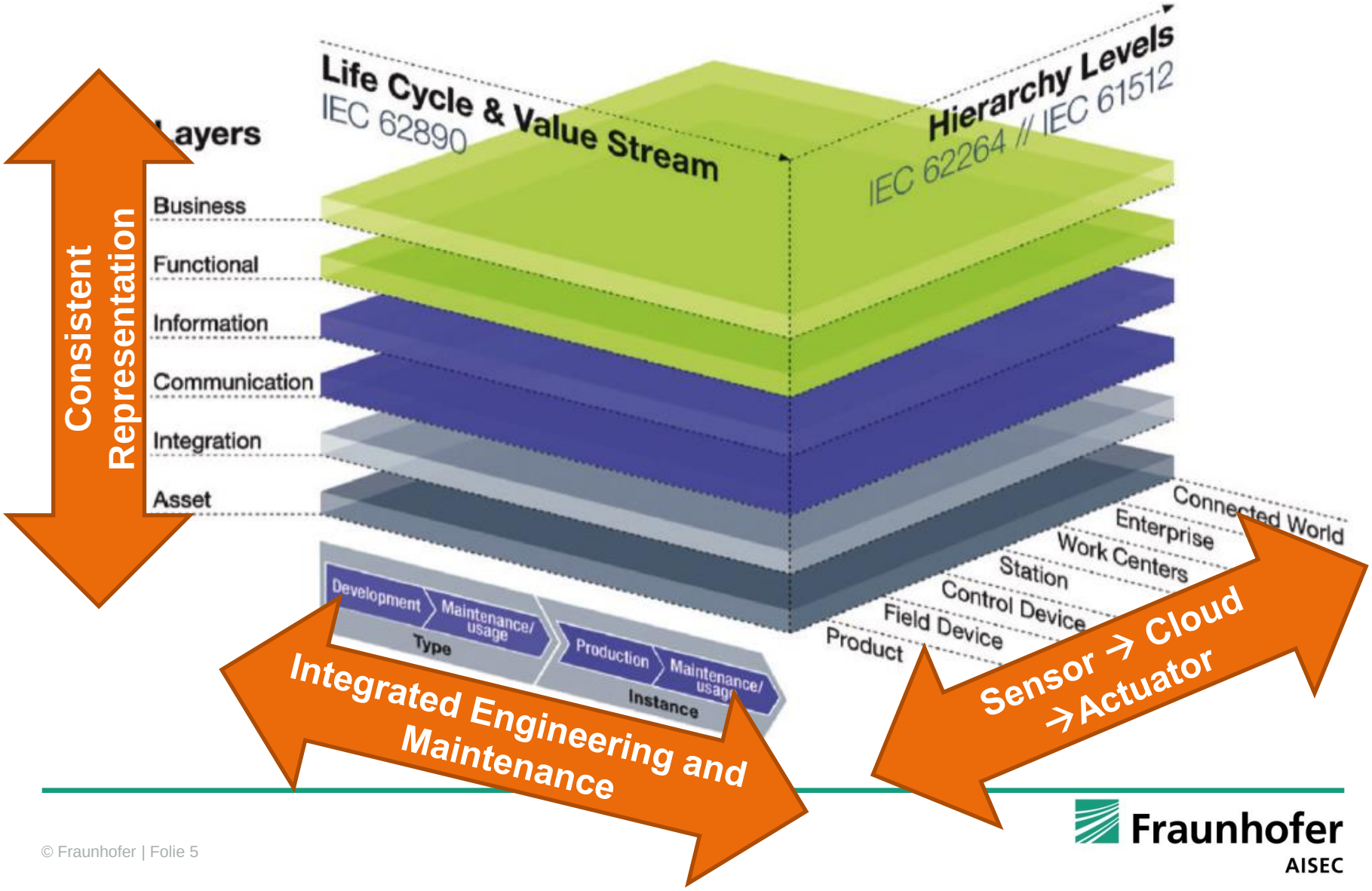
Reference architecture model RAMI 4.0



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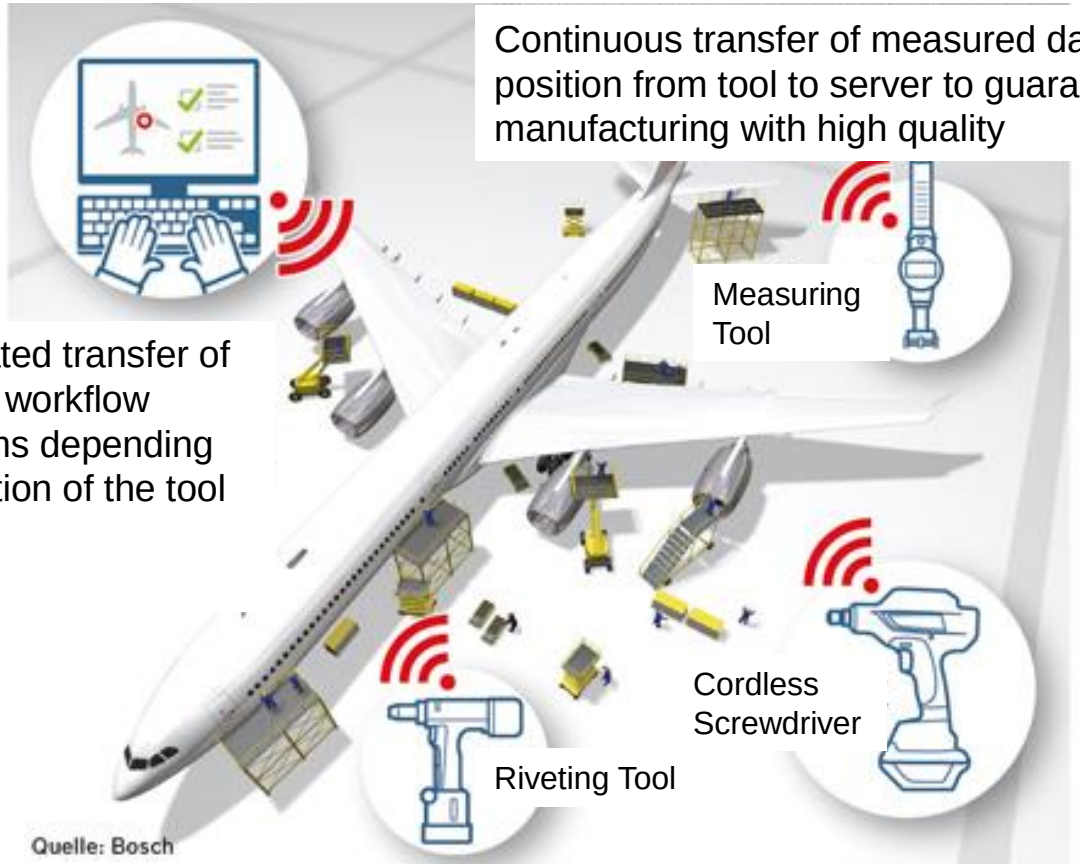
Interaction between hierarchy levels

- Smart products & tools: Decentralized production
  active parts in assembly control their own production

Example:

Airbus

Assembly



Source Bosch/Rexroth

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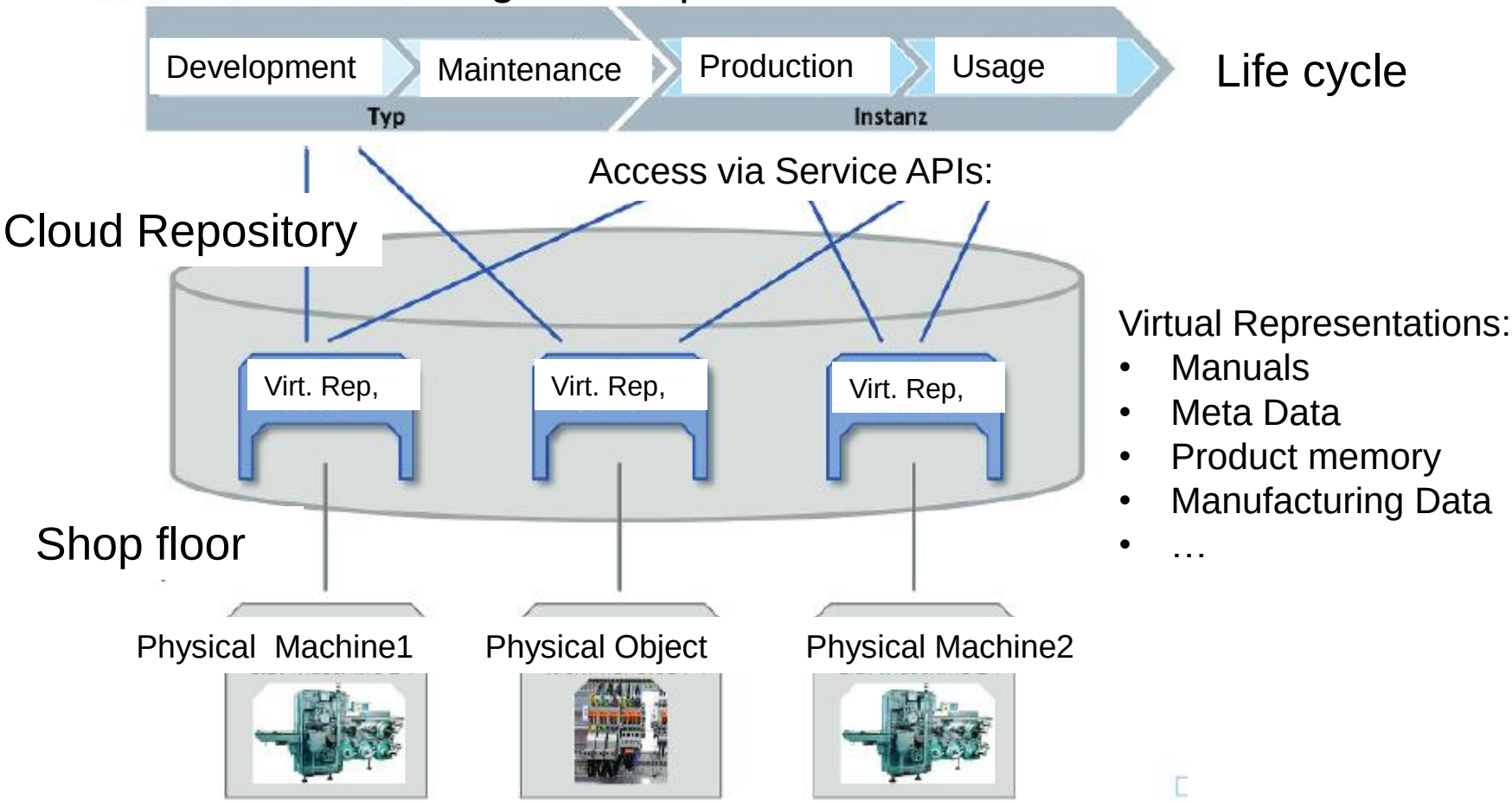
Interaction between layers

- Cloud-based collaboration cross-domain:
  access controls: heterogeneous policies, roles, IDs



Virtual Representations:
- Manuals
- Meta Data
- Product memory
- Manufacturing Data
- …

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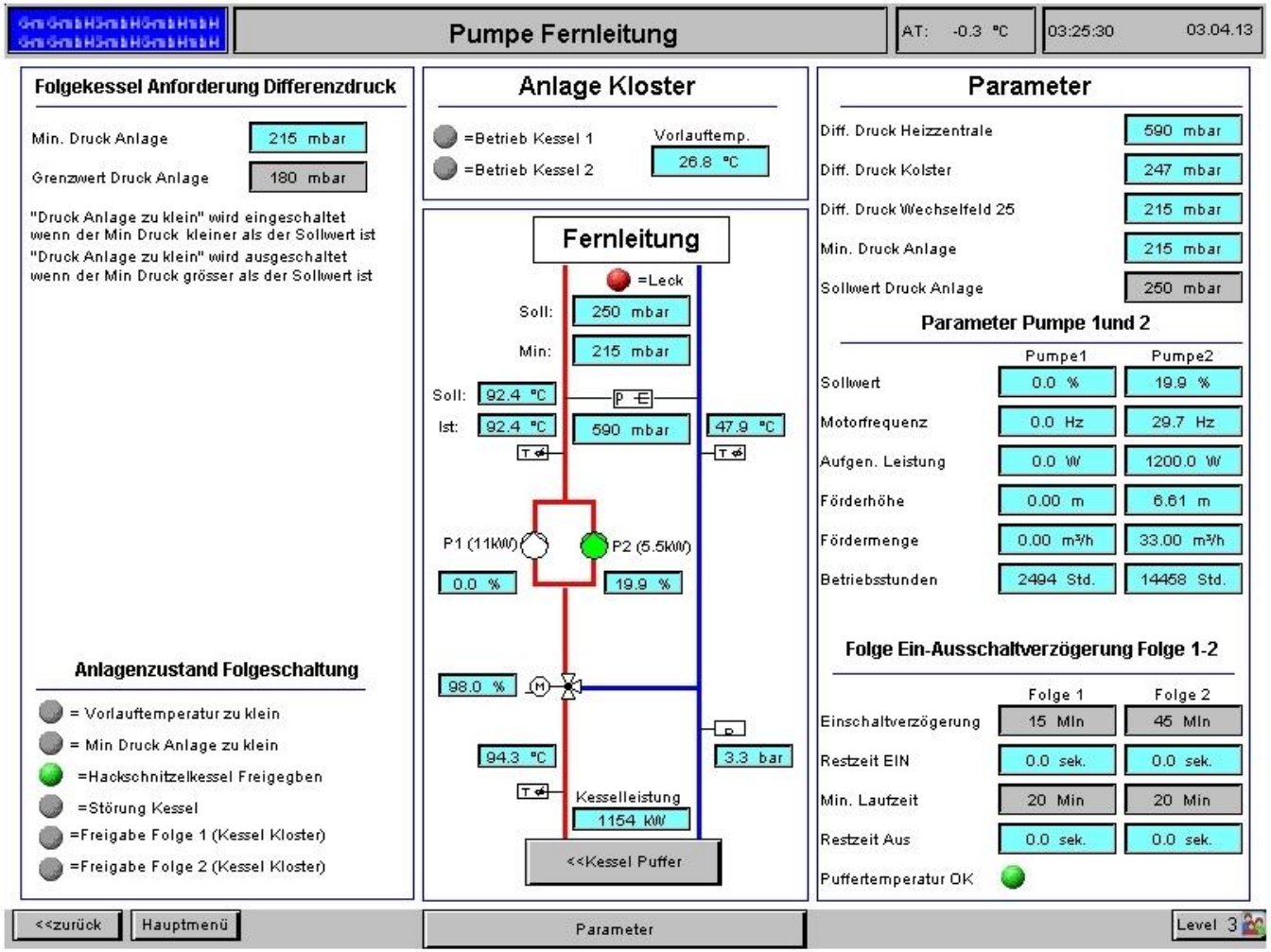
Security Risks

Internet access to control-units in power station



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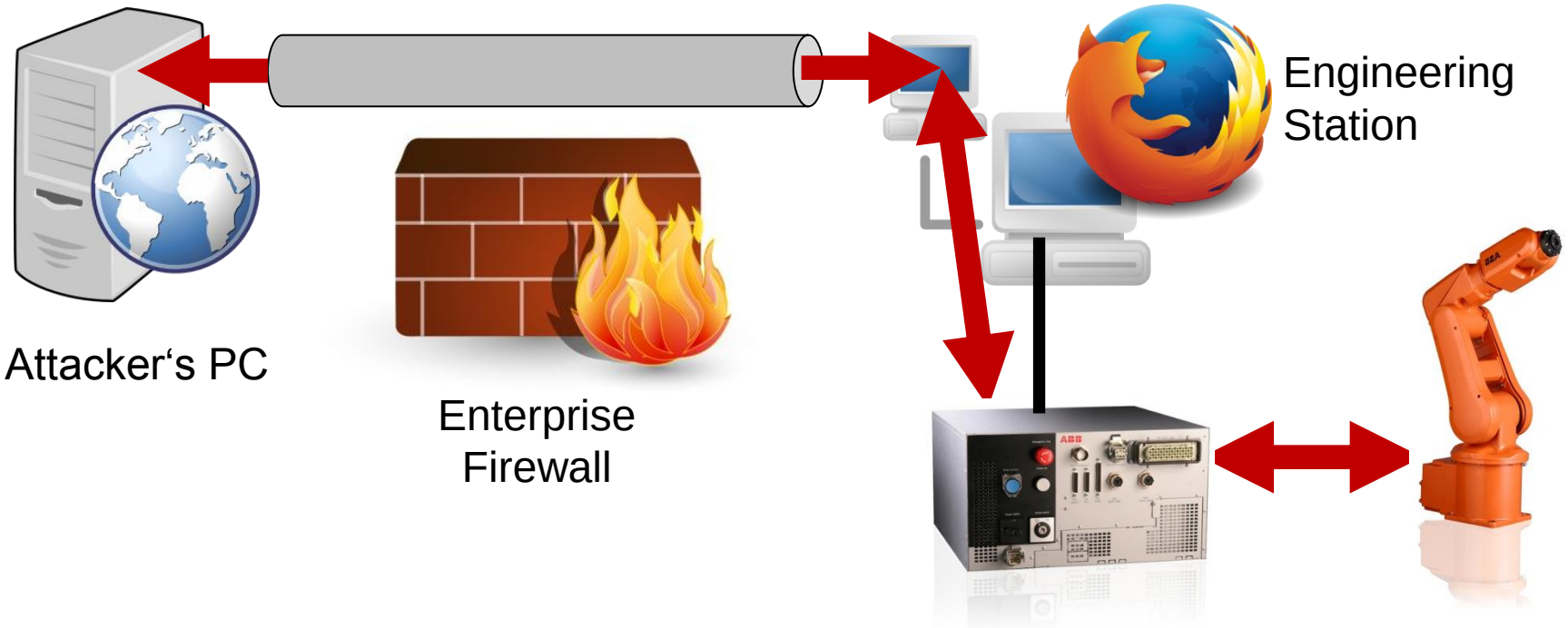
Security Risks

Hacking a standard industrial robot

- Exploiting classical Web vulnerabilities to connect the attacker PC and the Engineering Station
- Activation of debug-interface of VxWorks: full control



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Security Challenges

Challenges derived from Characteristics:

1. Smart, connected products, tools, machines

⇒ Secure M2M communication, product integrity

2. Cloud-based cross-domain collaboration

⇒ Identity & Access management, confidentiality


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Security Challenges

Challenges derived from Characteristics:

3. Service-orientation, Data Analytics

⇨ Data owner-ship, trustworthy platforms, integrity

4. Software-based configuration, individualization

⇨ App Security, secure communication, availability


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Security Challenges

Challenges derived from Characteristics:

5. Human-Machine collaboration

➡ trustworthy robots, safety implications, privacy

6. Connected Eco-System

➡ trustworthy mobile devices, protected networks

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Protect the chips: Biometry of silicon chips

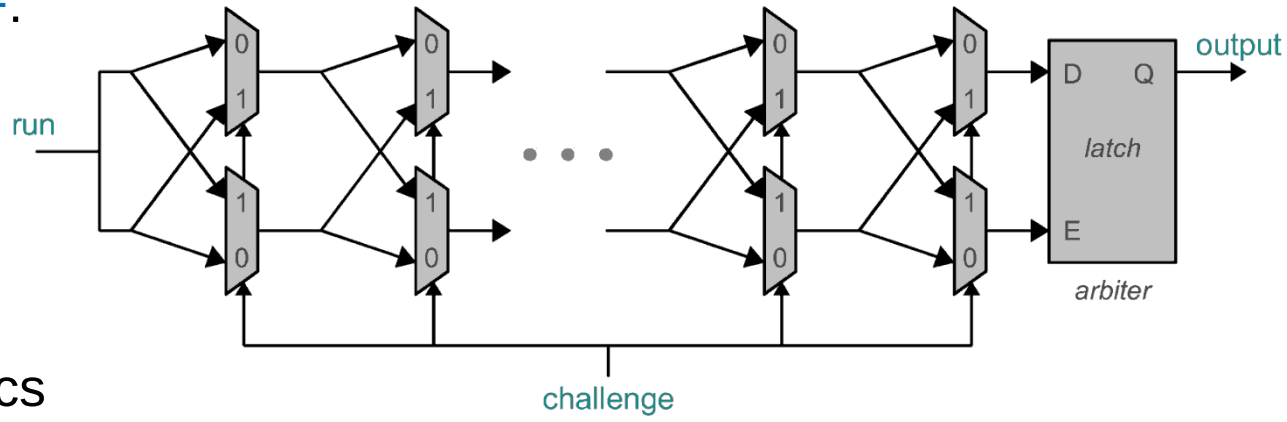
Unclonable Object ID: Biometry of objects

- Physically Unclonable Function (PUF)

Concept: Physical characteristics of integrated circuits define unclonable PUF behavior: extraction of secrets

Example: Arbiter PUF:

- 1-bit output,
- Input signal: race through the two delay paths
- Delay characteristics define PUF behavior



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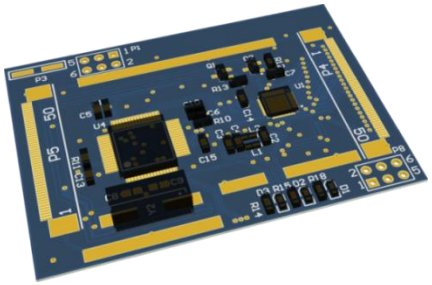
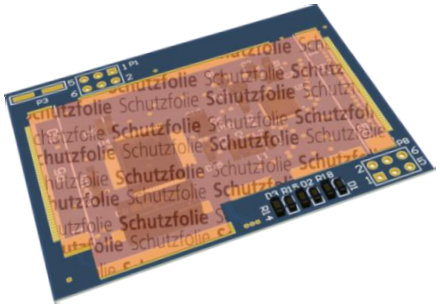
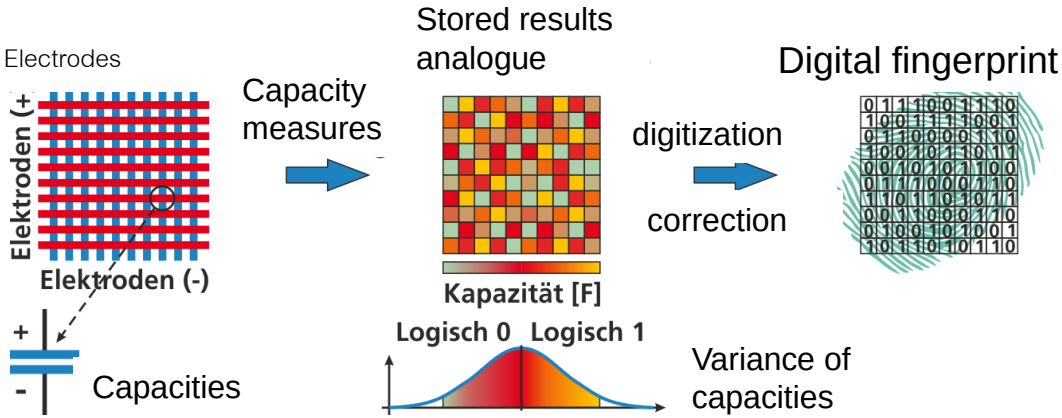
Protect the parts: Product Protection Foil

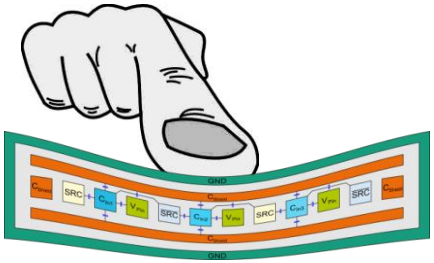
Smart foil (PUF): protecting component

- PUF: capacity measurements
- Material defines digital fingerprint
- Keys K derived from PUF, no storage
- Firmware encryption with K
- Manipulated foil: key K is lost









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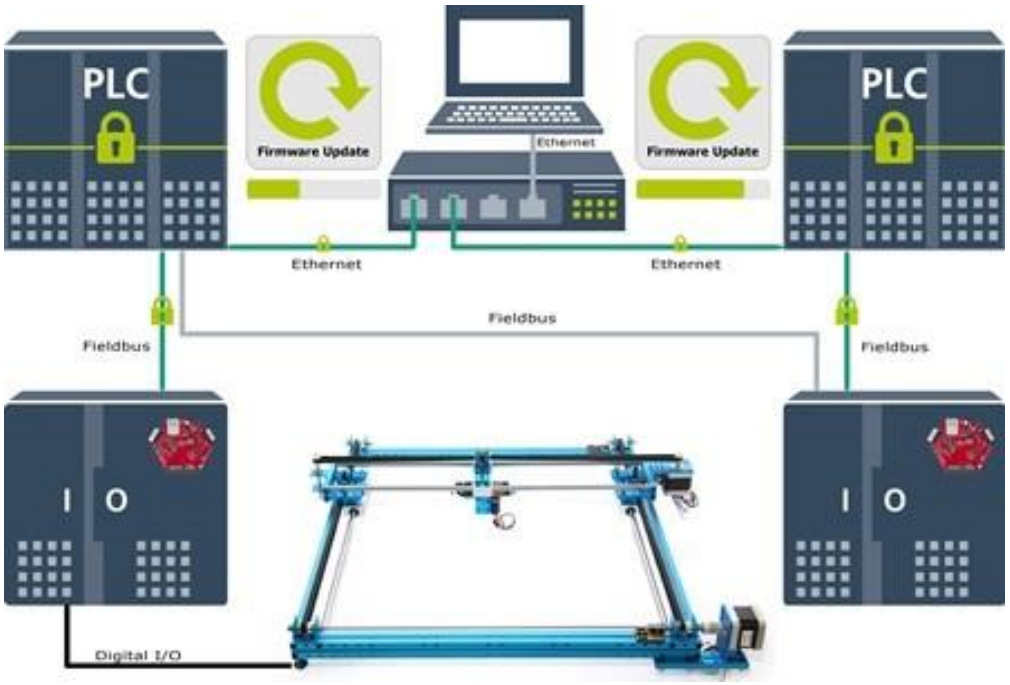
Protect the machines

Authentication in Industrial control systems:

- Integrating Secure Elements in PLC: plug & trust
- PLC-Authentication, certificates, PKI
- Controlled access
- Encrypted PLC Firmware
- Signed Code
- Secure Updates



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Protect the networks

Controlling Flexible Industrial Networks:

SDN: Decouples network logic from physical devices

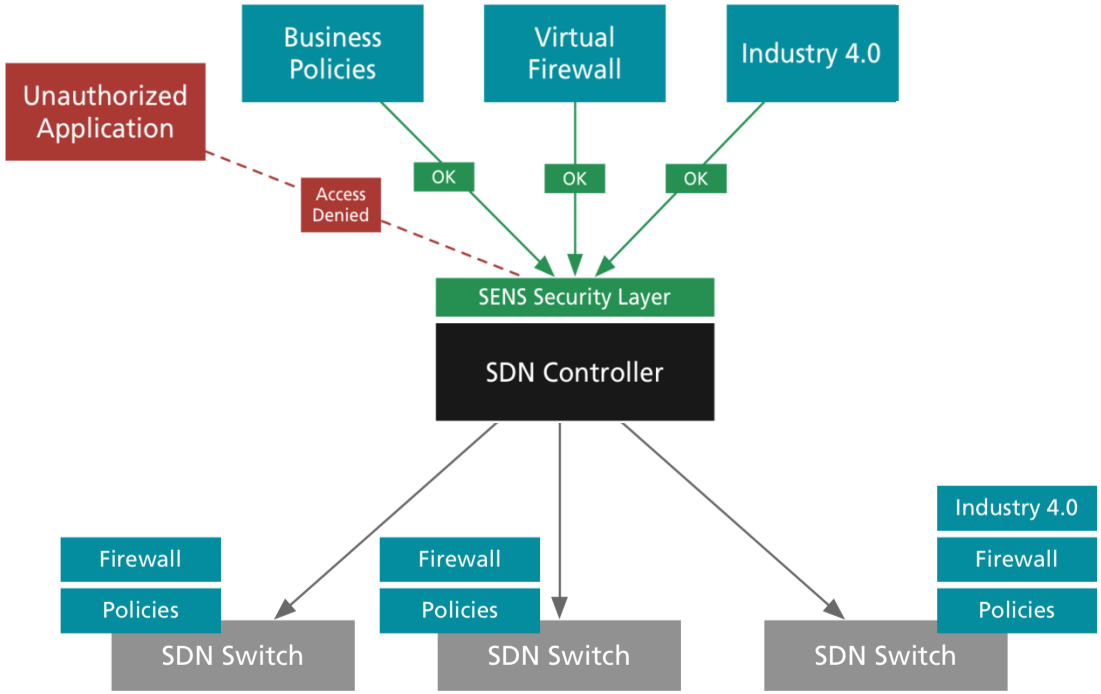
- Decision making in software → flexible
- Packet handling / forwarding in hardware → fast

SDN Controller:

- API to SDN applications

Protected Access → SENS

- Access permissions
- Authenticated access



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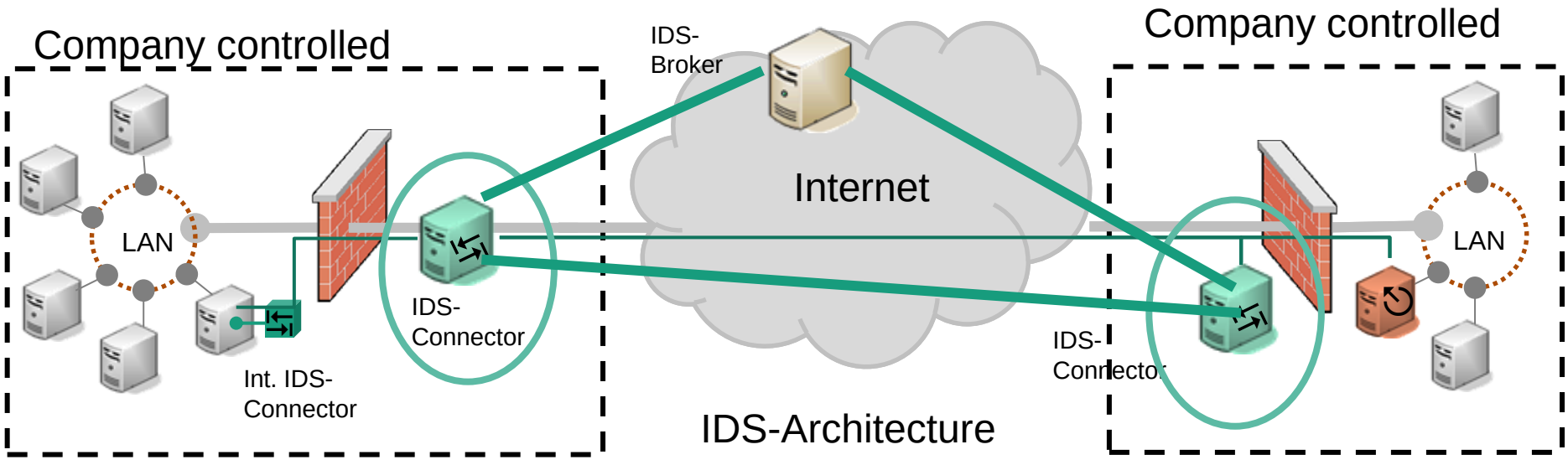
Protect the data

Security architecture for IDS (Industrial Data Space)

Connector as central component; Different Security Levels:

- L0 (secure connection),
- L1, L2,
- L3 (integrity and authenticity of receiver and provider, reliable accounting, data usage control)



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Take home message

- Industry 4.0
  - Individualized
  - Connected
  - Data driven

- Security needs
  - Authentication of every Thing
  - Integrity over all representations
  - Secure communication over all hierarchies
  - Trusted data exchange

Thank You for Your Attention

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