Chair of Network Architectures and Services
Department of Informatics
Technical University of Munich

Leveraging Secure Multiparty Computation in the Internet of Things

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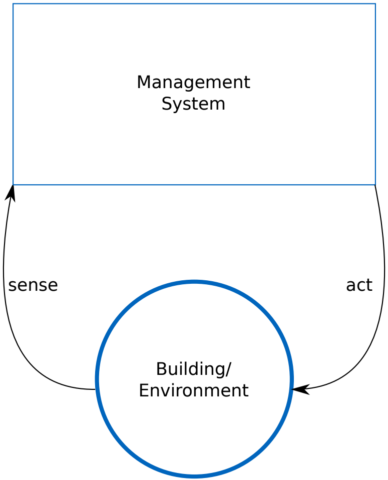
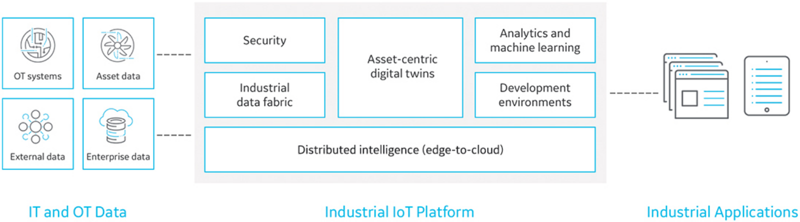
Smart Buildings – Industrial State of the Art

https://www.siemens.com/innovation/en/home/pictures-of-the-future/infrastructure-and-finance/smart-cities-smart-buildings.html

Smart Buildings: Model

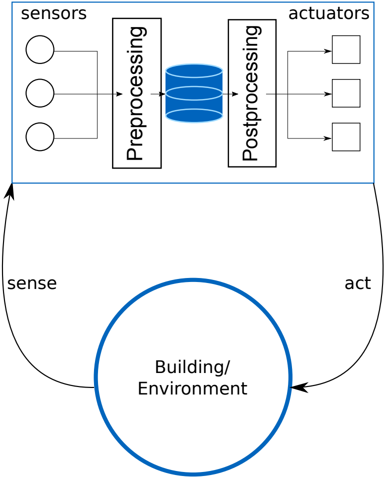


Smart Buildings – Industrial State of the Art



https://www.ge.com/digital/predix-platform-foundation-digital-industrial-applications

Smart Buildings: Model



Smart Buildings: Privacy Criticality

Types of Sensors

- Brightness
- Temperature / Humidity
- CO_2 concentration
- Motion
- Weight (on floor)
- Device usage
- Power consumption
- ...

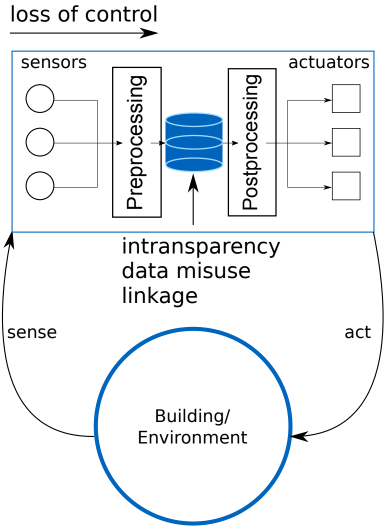
Privacy-criticality

- Location
- Behavioral patterns (cf. [8])

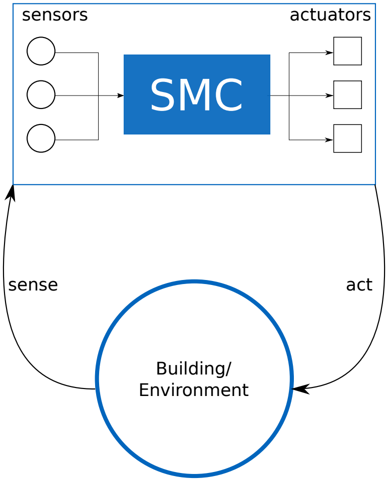
Threats (cf. [5])

- Intransparency of data usage
- Data misuse (other purpose)
- linkage (combination of data for more insights)
- Loss of control (data subjects)

Smart Buildings: Privacy Criticality



Smart Buildings: Application for Secure Multiparty Computation



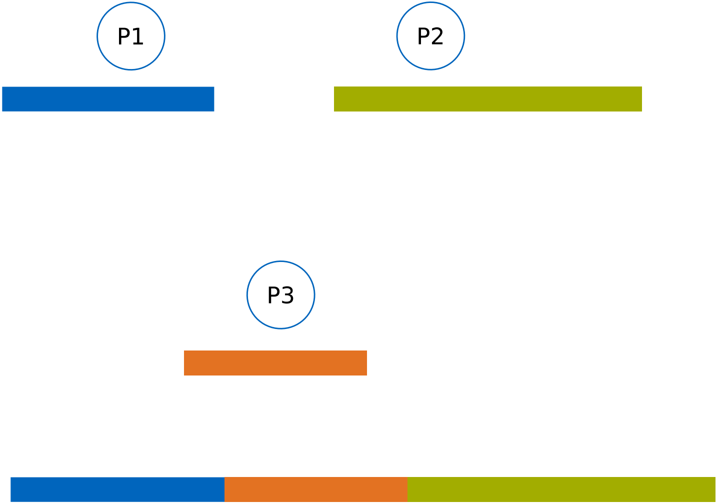
Secure Multiparty Computation

Definition (cf. [6])

Given n parties $P_1, \ldots, P_n$. Each party P_i holds a secret value x_i.
Secure Computation of $y = f(x_1, \ldots, x_n)$ is performed if two conditions are satisfied:

- Correctness: the correct value of y is computed
- Privacy: y is the only new information that is released

Secure Multiparty Computation: Example



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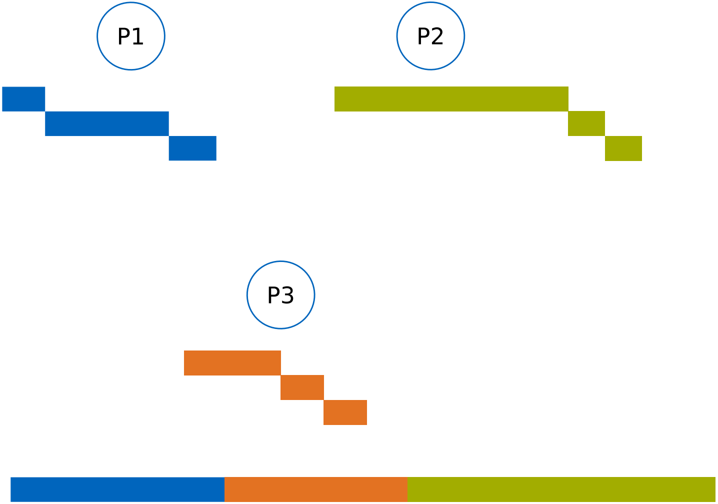

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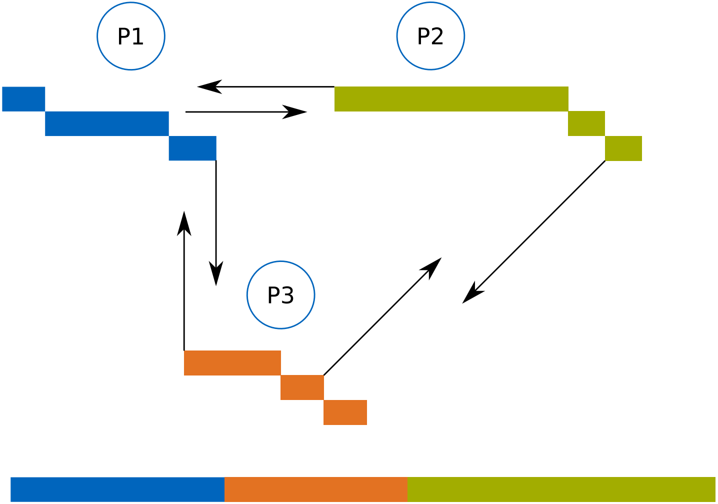

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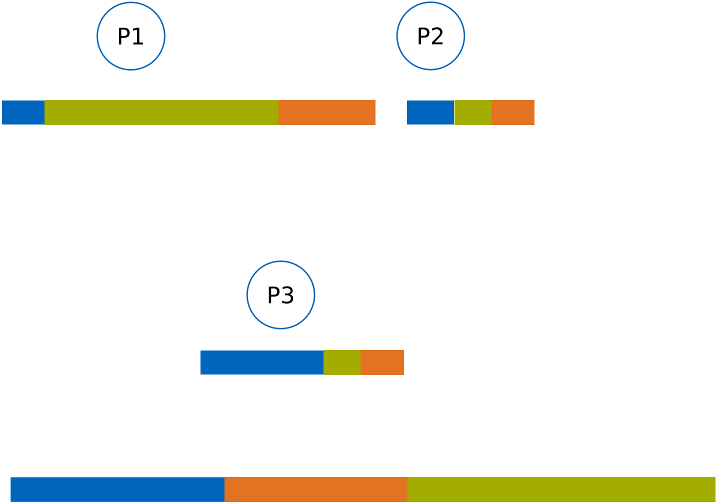

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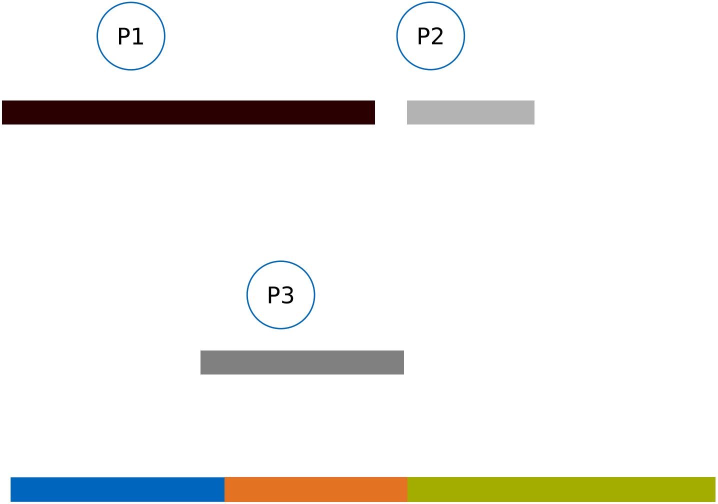

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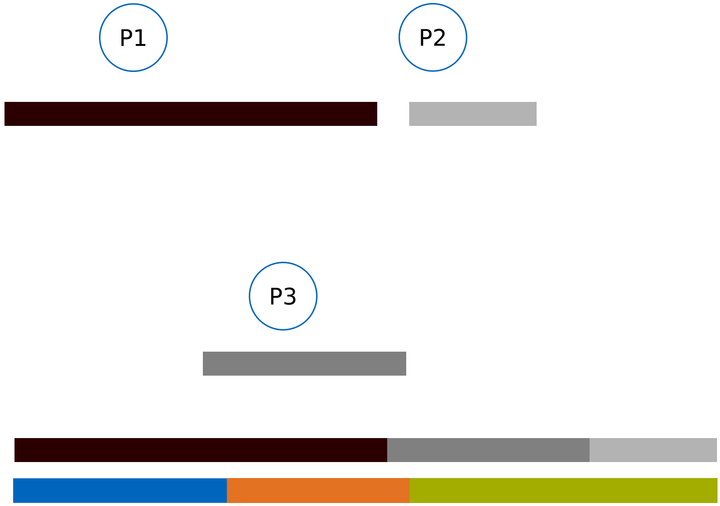
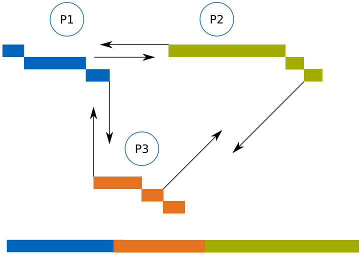
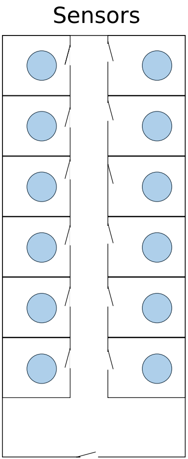


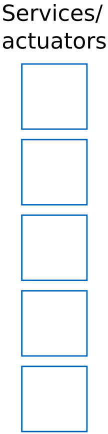
Secure Multiparty Computation: Previous Applications

- (Double) auctions [2]
- EU emission trading scheme (CO_2 trading) [9]
- KPI ranking among companies [1]
- Network anomaly and outage detection [4, 7]
- Federated learning (distributed machine learning) [3]



Leveraging SMC in the IoT: Design





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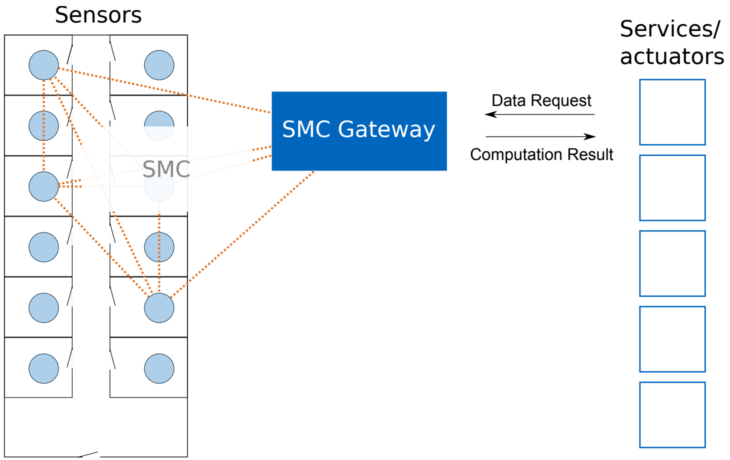

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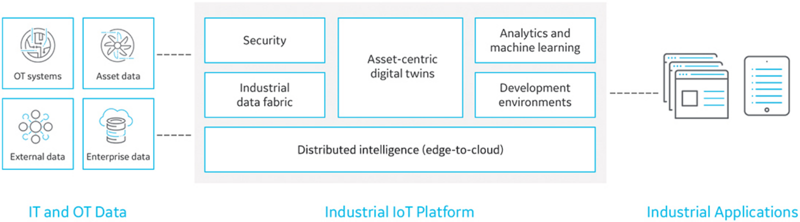

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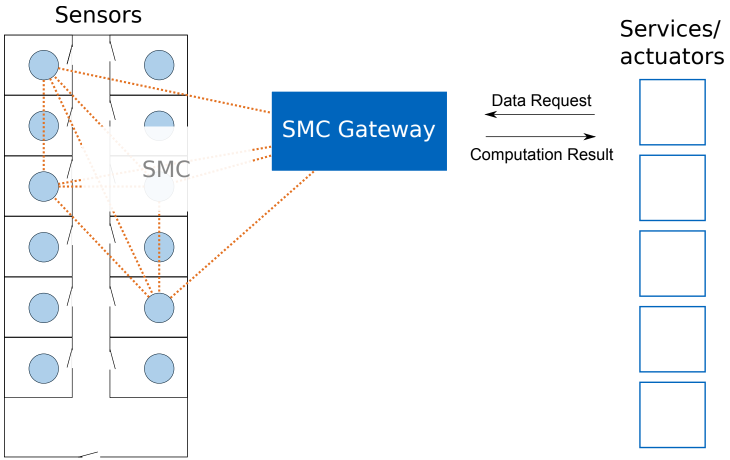


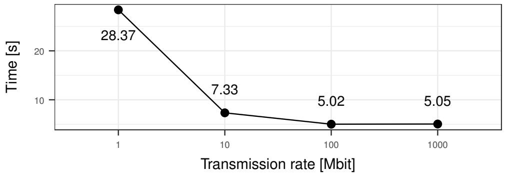
Leveraging SMC in the IoT: Addressed Challenges

A Performance and Resource Consumption Assessment of Secure Multiparty Computation.

M. von Maltitz and G. Carle. (2018, submitted)

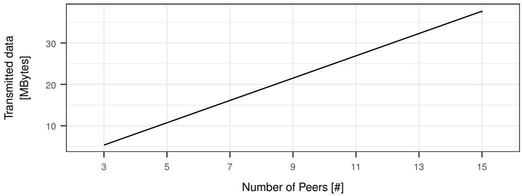
Parameters

- #Nodes
- CPU #cores and frequency
- network latency
- transmission rate
- packet loss
- parallelization



Variables

- Execution time
- CPU consumption
- Memory allocation (stack, heap)
- Bandwidth usage



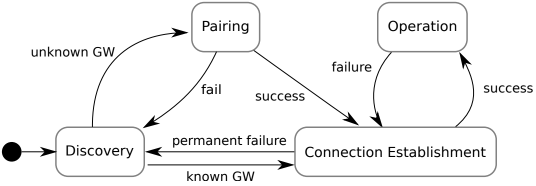
Leveraging SMC in the IoT: Addressed Challenges

A Management Framework for Secure Multiparty Computation in Dynamic Environments.

M. von Maltitz, S. Smarzly, H. Kinkelin, and G. Carle (NOMS 2018, DOMINOS Workshop)

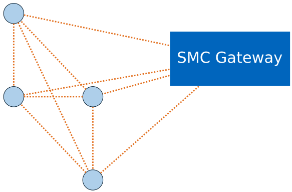
Peer Orchestration

- Discovery
- Pairing
- Recovery



Session Management

- Session Creation
- Peer allocation
- Monitoring
- Recovery



Leveraging SMC in the IoT: Addressed Challenges

Access control and Accountability for Secure Multiparty Computation.

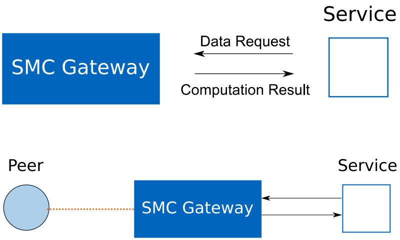
M. von Maltitz, D. Bitzer, and G. Carle. (2018, submitted)

Client Interaction

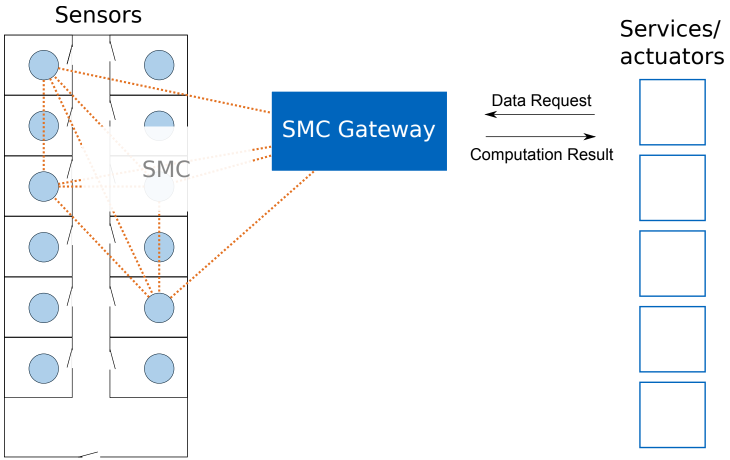
- Request and query formats
- Request generation
- Access control and authorization
- Request $\rightarrow$ session translation
- Result validation

Peer-side privacy protection

- Transparency of requests
- Intervenability upon computation
- Accountability of performed requests/ computations



Leveraging SMC in the IoT: Addressed Challenges



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