



FAKULTÄT
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Architecturing Elastic Edge Storage Services for Data-Driven Decision Making

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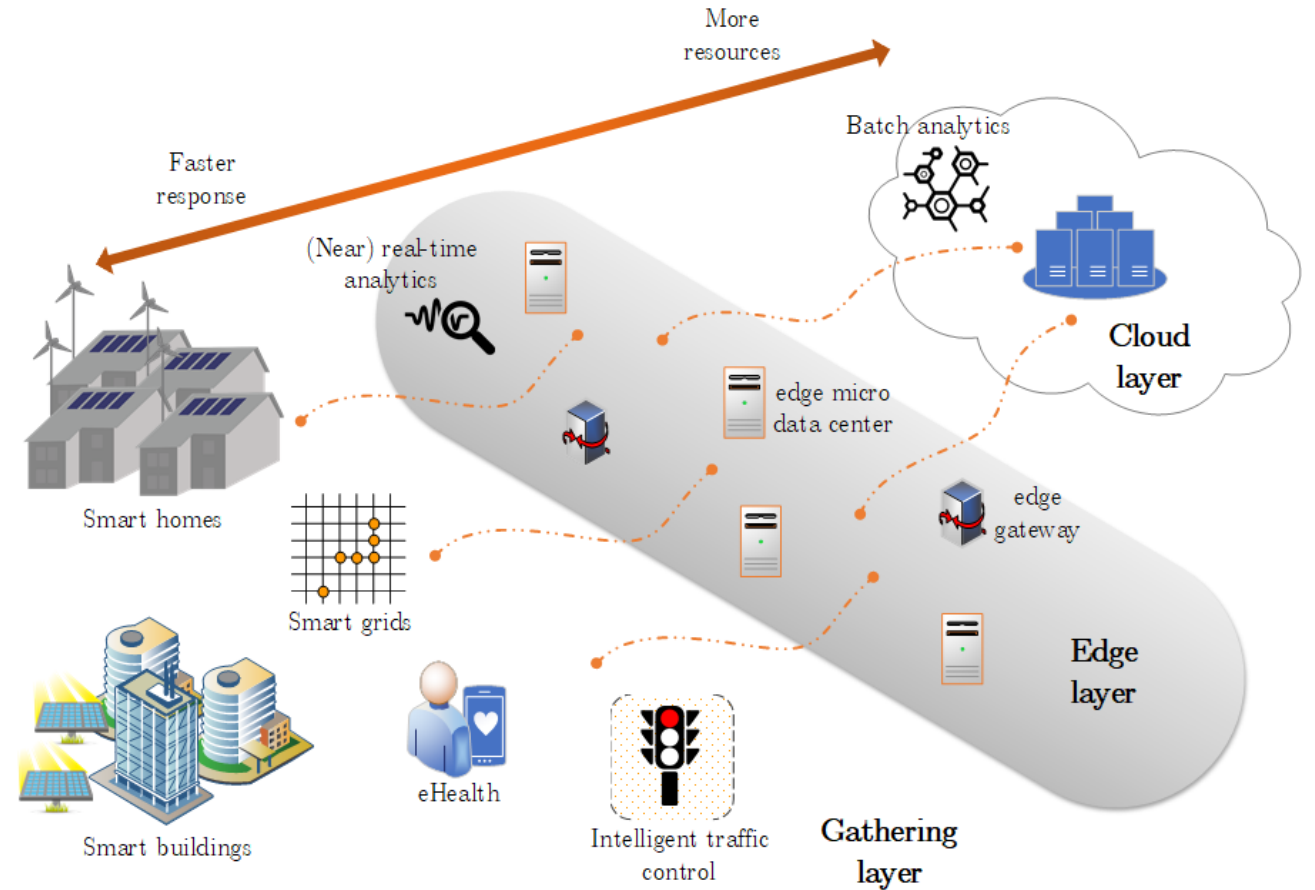
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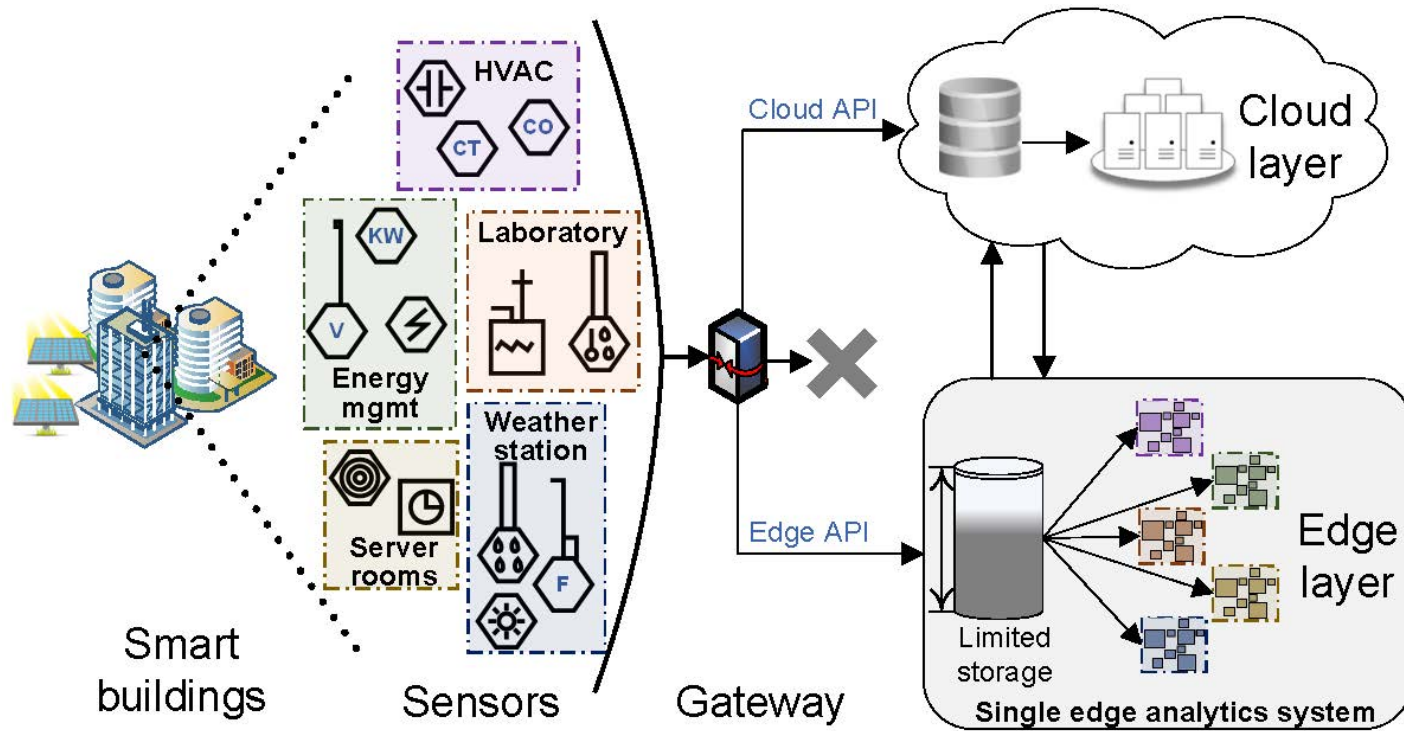
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- Traditional cloud vs. edge storage
- Explosive growth of IoT data and strict application requirements



Decision-making challenges

1. Storing only the most relevant data
2. Data-related issues (different data model types and importance levels; various errors; different data generation speed)



- Limited edge storage capacities
- Multi-model data
- Different significance levels
- Various data errors
- Data generation speed
- ...

How to incorporate such issues into the **design** of (future) **edge data services**?

What are the **architectural requirements** for **elastic edge storage services**?

1. Edge data/system characterization
2. Application context and requirements
3. Edging system operations

P1 Define and Provide Needed Metrics

P2 Support Application-Specific Requirements

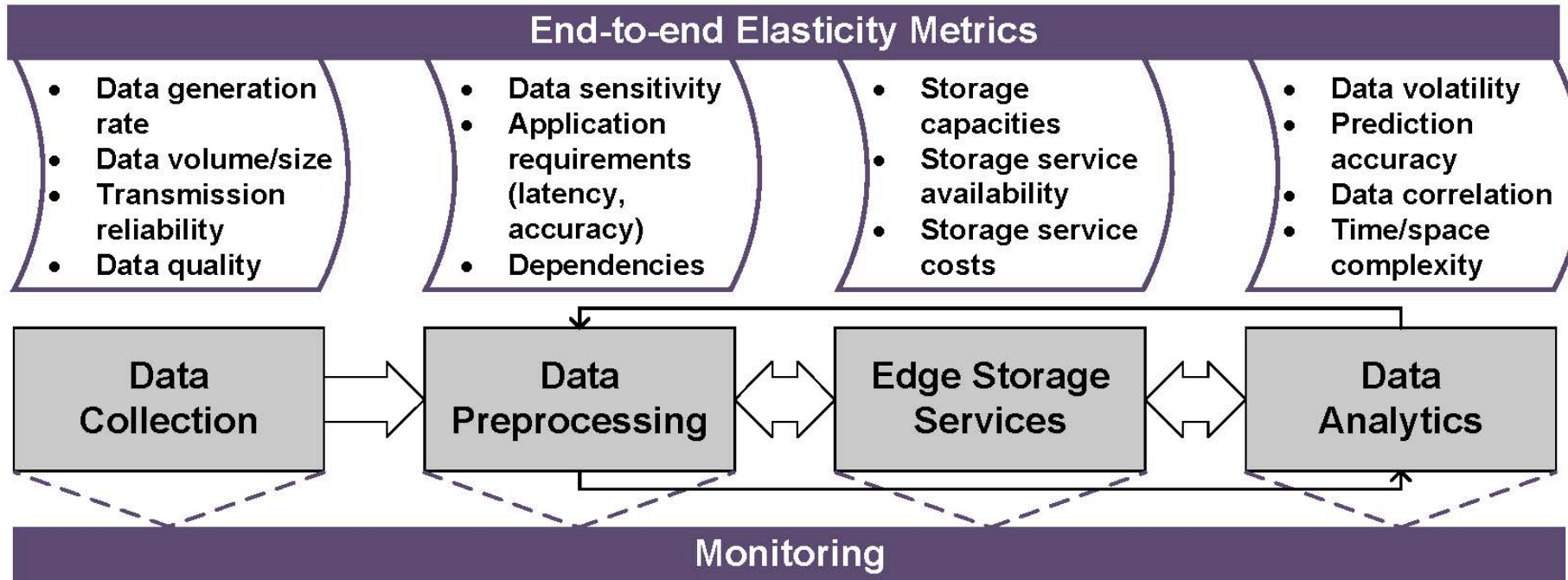
P3 Enable Adaptive Data Handling

P4 Highly Customized System Bundling

P5 Runtime Software-Defined Customization

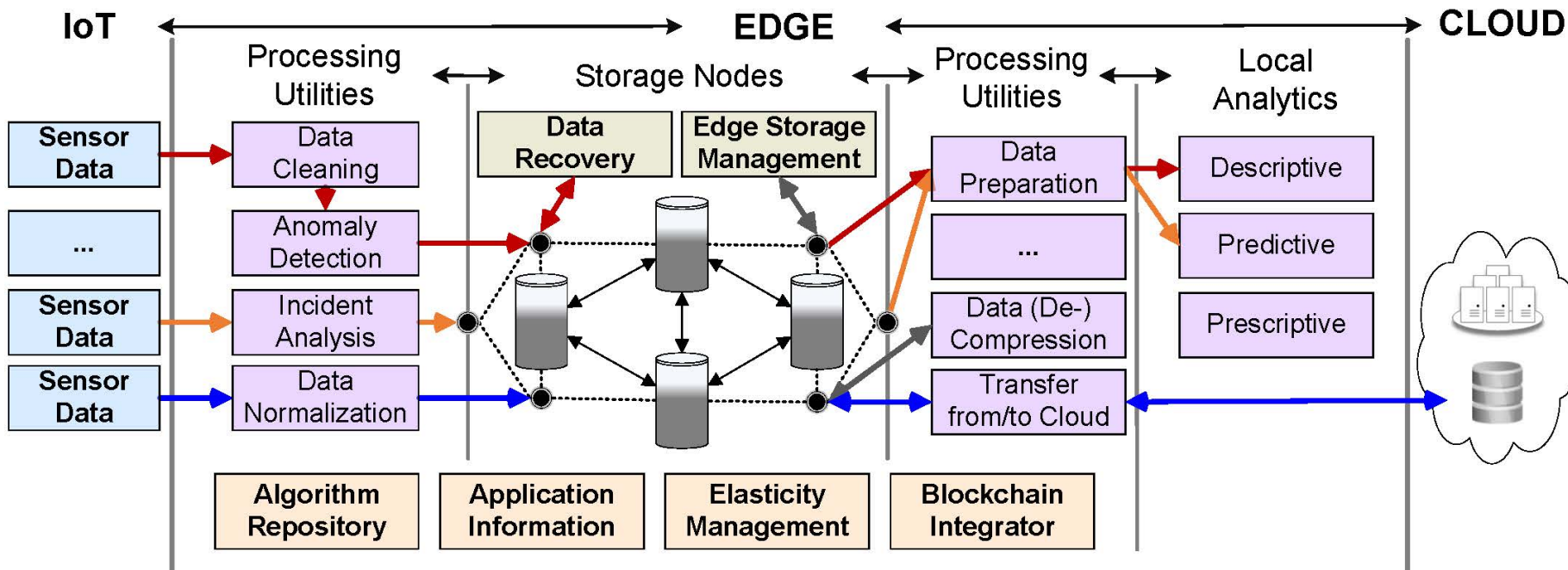
P6 Support IoT-Edge Continuum

P7 Support Edge-Cloud Continuum



- Clear definition
- Flexible monitoring
- New metrics at runtime

- Need for tools adapted for dynamic edge environments



- Allowed customization
- Emphasis on data relevance
- Dynamic data flow

- Adaptive edge storage management mechanism
- Need for pluggable microservices and application-aware storage

- Heterogeneous data workloads
- Data integrity issues

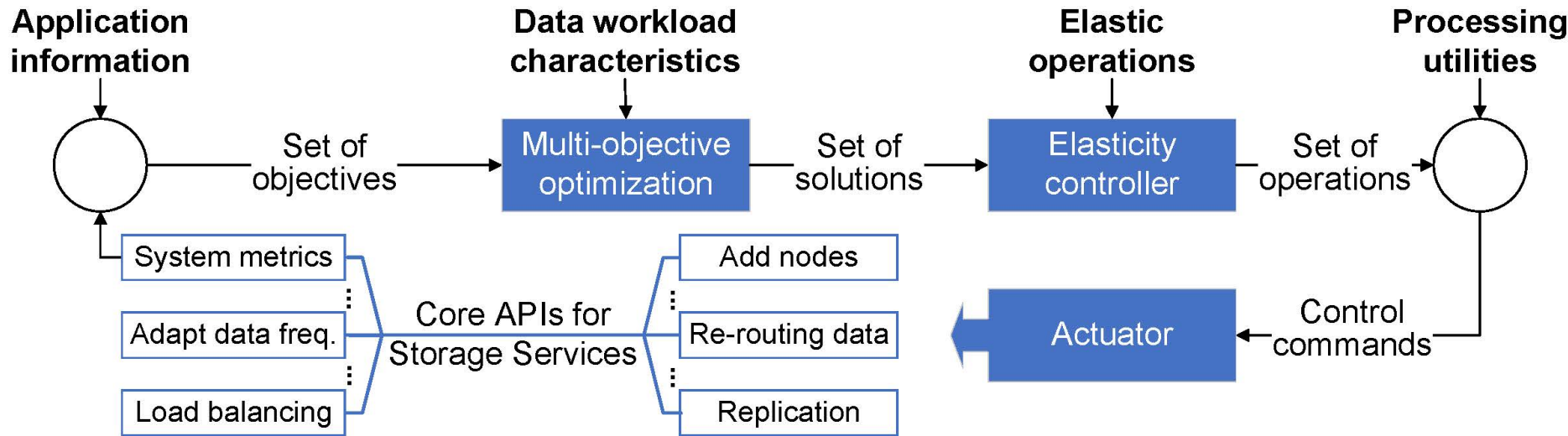
- How:
 - Software technology supporting communications, data handling features and on-demand data transfers
 - Auto-switch data handling algorithms (data reduction)

- Tooling:
 - Edgex (decentralized data handling, data integration)
 - Fogger (dynamic allocation location awareness of storage resources)
 - ...

- Edge storage – customized regarding data/system characterization
- Flexible storage configurations need to meet deployment situations

- How:
 - Bundle only components to match constraints (e.g., capacities) with application req.
 - Develop an optimizer for bundling different software modules

- Tooling:
 - Ansible, Docker Compose – bundle and deploy stack of services (without optimization for edge nodes)
 - Selecting application-specific and customized services



- Runtime customization
- Elasticity management
- Optimization strategy

- Need for dynamic configuration, runtime adaptation mechanism and service mesh
- Kinetic Edge SDN – connecting edge storage locations
- ...

- Constant data flows
- Need for triggered actions for changing data volumes generated on-demand

- How:
 - Developing an edge-IoT connector to control data flows
 - Dynamic sampling, discarding incoming data, filtering operations, ...

- Tooling:
 - Novel mechanism allowing IoT sensors to perform actuation requests
 - Approach for IoT device programmability support (building actuation APIs)

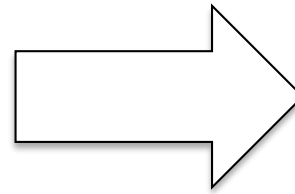
- Inter-operation and data transmission
- Efficient and secure data transfer

- How:
 - Operation viewpoint: data approximation, (de)compression, encryption/decryption
 - Network viewpoint: mechanism to avoid excessive data traffic
 - Analytics viewpoint: coordination mechanism for consistent ML models

- Tooling:
 - Mechanisms for push/pull data on-demands
 - Impact of other data representations on data transfer
 - The OceanStore for peer-to-peer, secure and persistent storage utility
 - ...

- Data-driven decision-making challenges for edge storage services
 - Maintain only the most relevant data
 - Data-related issues (various errors, data generation, etc.)

- Analyzing three important aspects
 - Edge data/system characterization
 - Application context and requirements
 - Edging system operations



Seven principles for engineering elastic edge storage services

- Open challenges
 - Enable highly customized optimization strategy
 - Evaluation of engineering principles

Thank you for your attention!

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