Karlsruhe Institute of Technology

Microservice-based Architecture for the Integration of Data Backends and Dashboard Applications in the Energy and Environment Domains

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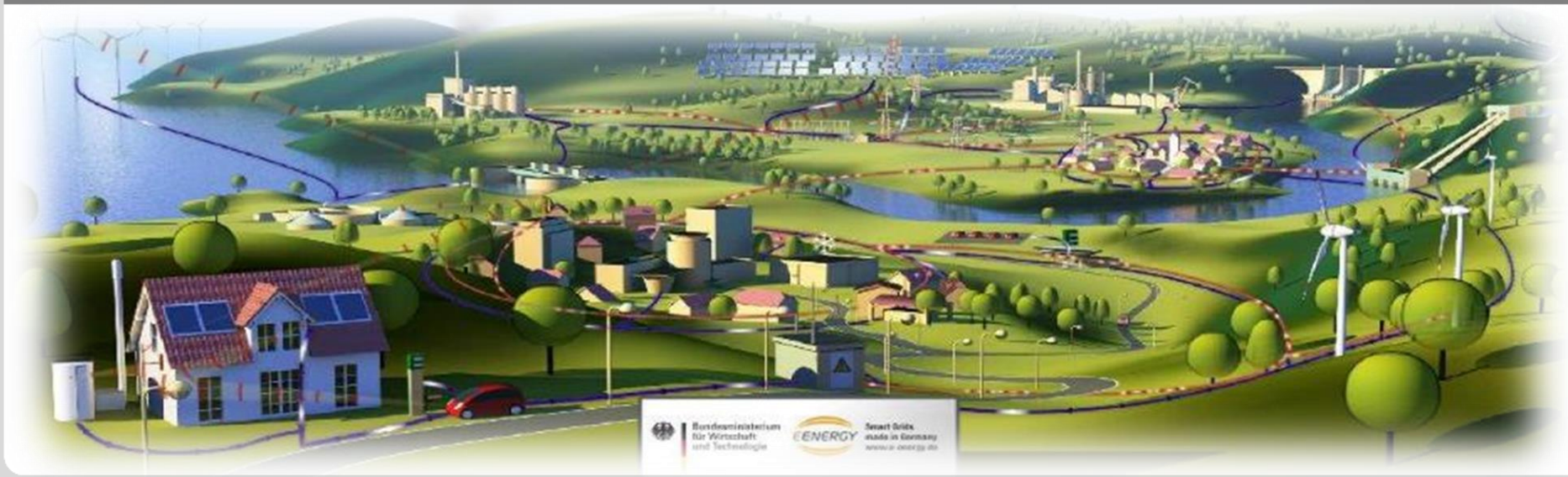
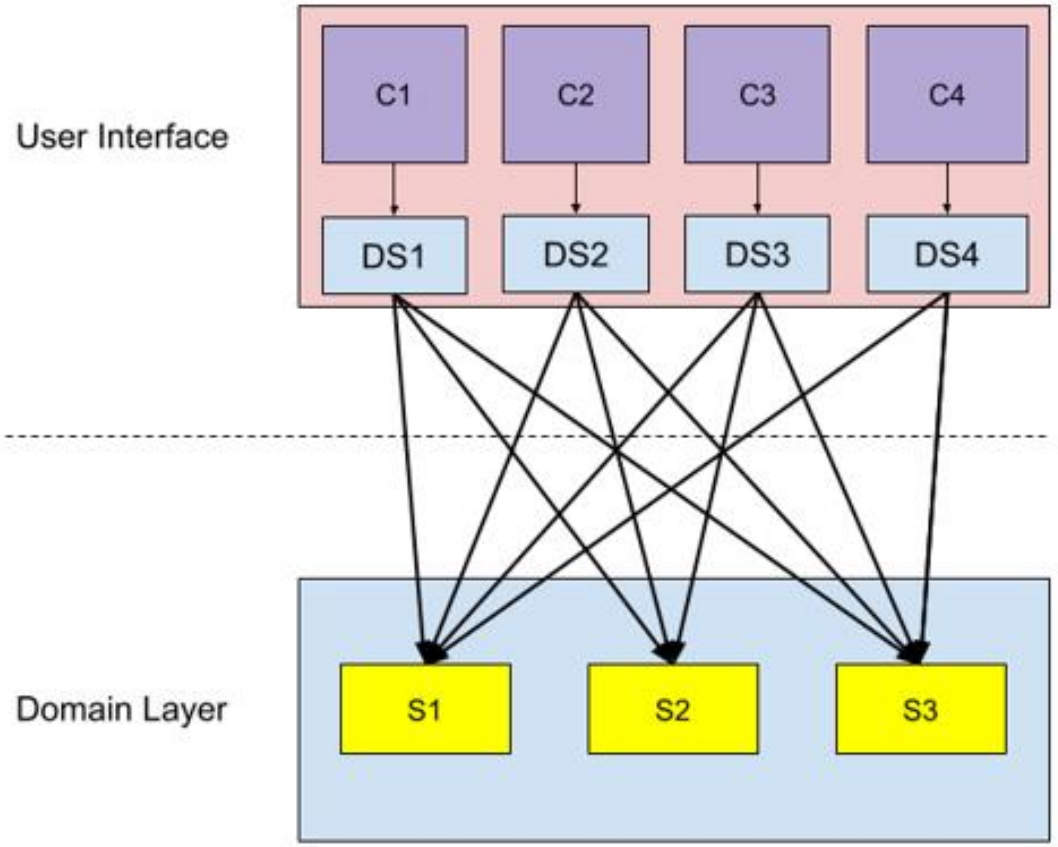


Motivation – General Aspects

- climate change
- renewable energies
- IAI – research in the energy and environment domain
  - various applications have already been created
- important components already exist
  - Generic Microservice Backend (GMB)
  - frontend framework based on reusable web components
- connecting layer still missing
  - goal: reduction of data transmission
- What is the purpose of this connecting layer?

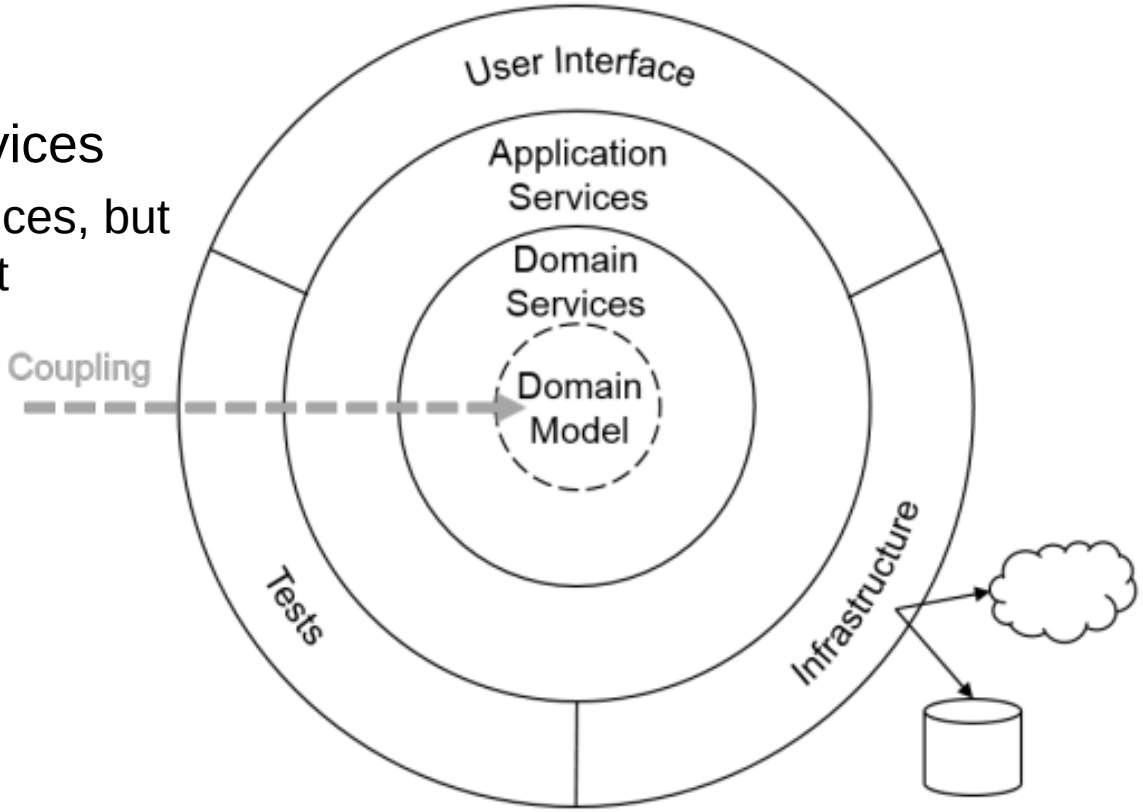
Motivation – Many Requests

- requests from frontend to backend are expensive
  - high physical distance
  - transmission of data
  - often high amount of requests necessary



Foundations – Onion Architecture

- idea derived from onion architecture
- separation of domain and application logic
- usage of application services
  - based on domain services, but principally independent

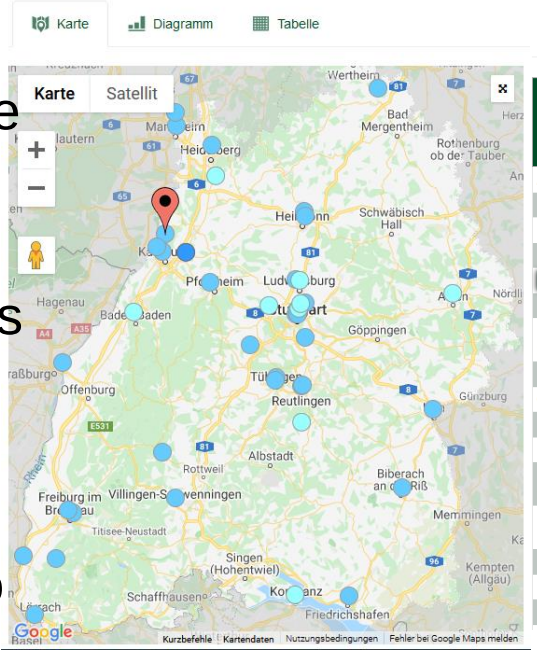


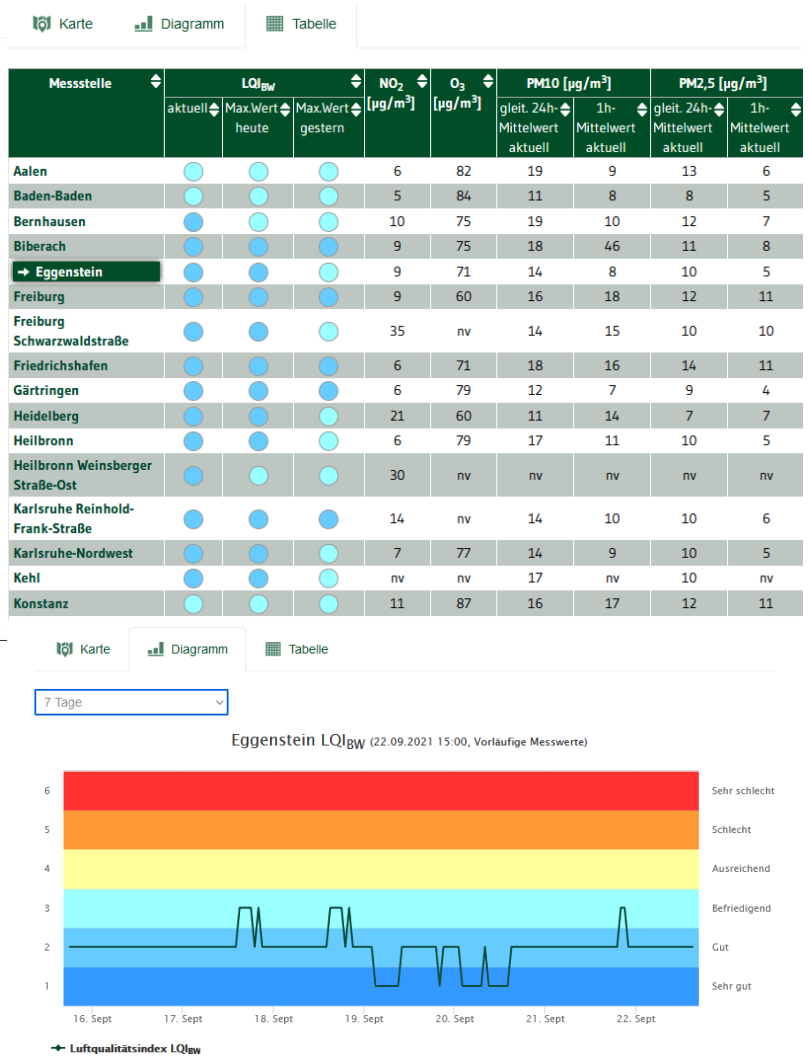
Foundations - Microservices

- encapsulate defined pieces of functionality
- commonly used in today's software design
  - good maintainability
  - good performance
  - well suited for modern server infrastructures
    - therefore efficient usage of servers
- usable in combination with the onion architecture

Air measurement

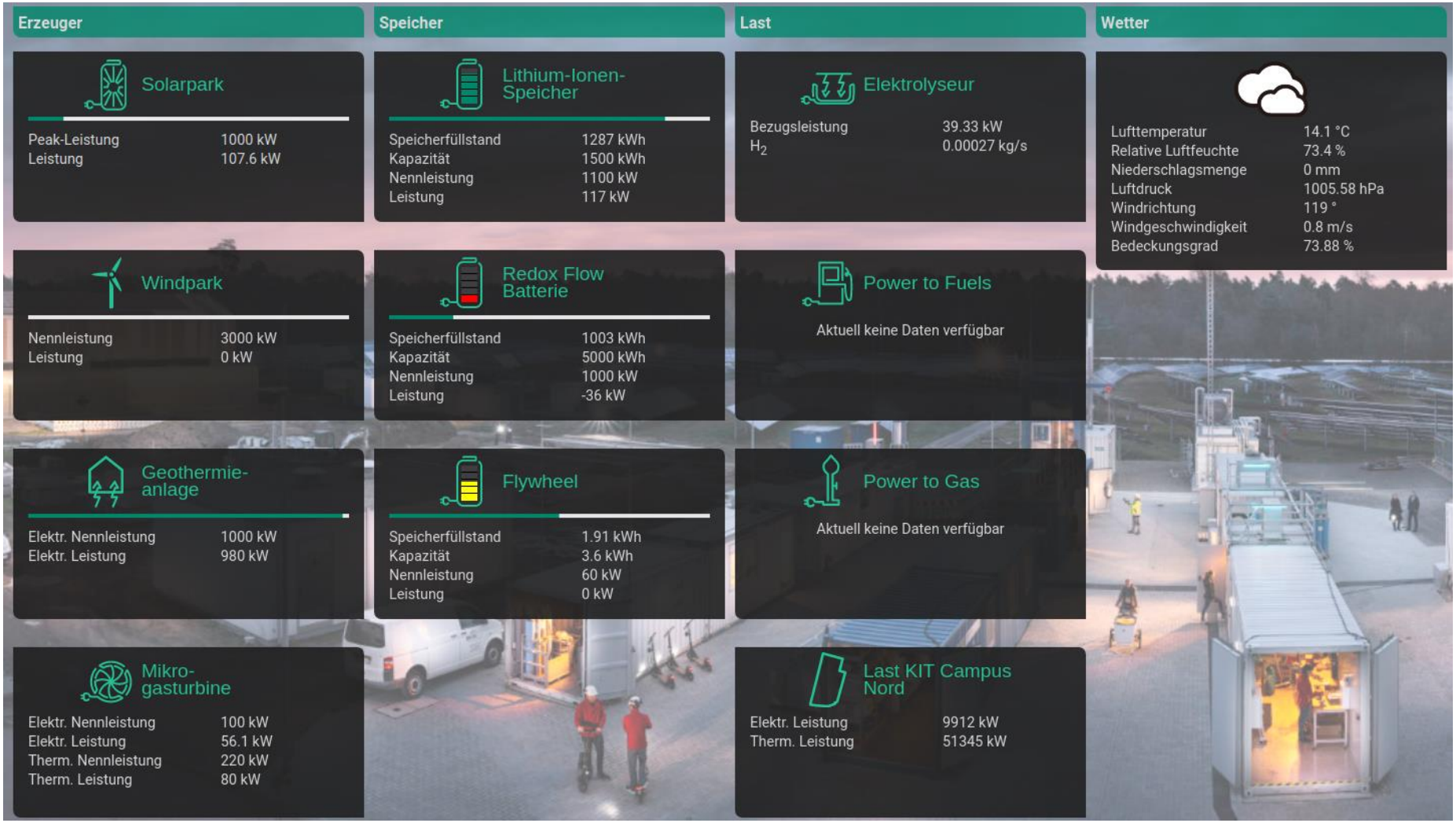
- domain services provide/aggregate measurement data
- frontend accesses domain services
- frontend processes requested data to generate format for UI components
- → user's hardware/network has to do the job!





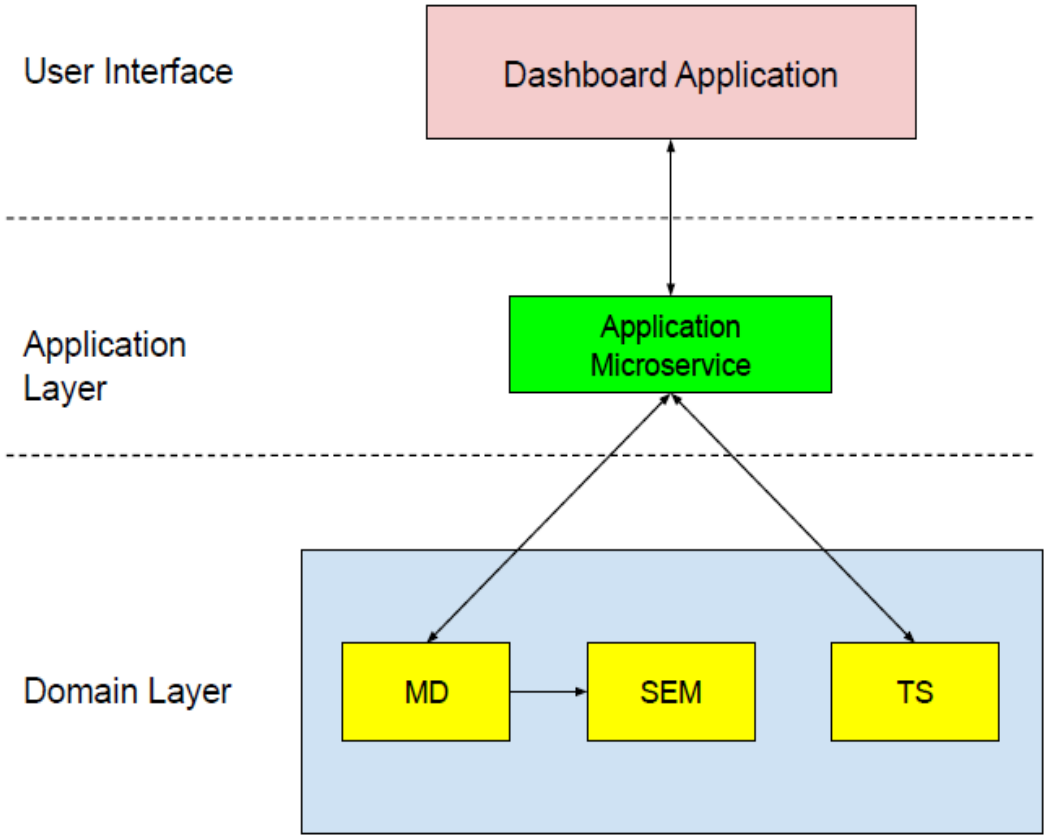
Messstelle	LQI$_{BW}$ aktuell	LQI$_{BW}$ Max.Wert heute	LQI$_{BW}$ Max.Wert gestern	NO_2 [µg/m³]	O_3 [µg/m³]	PM10 [µg/m³] gleit. 24h-Mittelwert aktuell	PM10 [µg/m³] 1h-Mittelwert aktuell	PM2,5 [µg/m³] gleit. 24h-Mittelwert aktuell	PM2,5 [µg/m³] 1h-Mittelwert aktuell
Aalen				6	82	19	9	13	6
Baden-Baden				5	84	11	8	8	5
Bernhausen				10	75	19	10	12	7
Biberach				9	75	18	46	11	8
→ Eggenstein				9	71	14	8	10	5
Freiburg				9	60	16	18	12	11
Freiburg Schwarzwaldstraße				35	nv	14	15	10	10
Friedrichshafen				6	71	18	16	14	11
Gärtringen				6	79	12	7	9	4
Heidelberg				21	60	11	14	7	7
Heilbronn				6	79	17	11	10	5
Heilbronn Weinsberger Straße-Ost				30	nv	nv	nv	nv	nv
Karlsruhe Reinhold-Frank-Straße				14	nv	14	10	10	6
Karlsruhe-Nordwest				7	77	14	9	10	5
Kehl				nv	nv	17	nv	10	nv
Konstanz				11	87	16	17	12	11

Energy Measurement



Software Architecture (1)

- domain layer consists of three microservices
- dashboard sends request to AppMS
- AppMS requests corresponding data from backend
- AppMS and domain microservices are hosted on the same server infrastructure

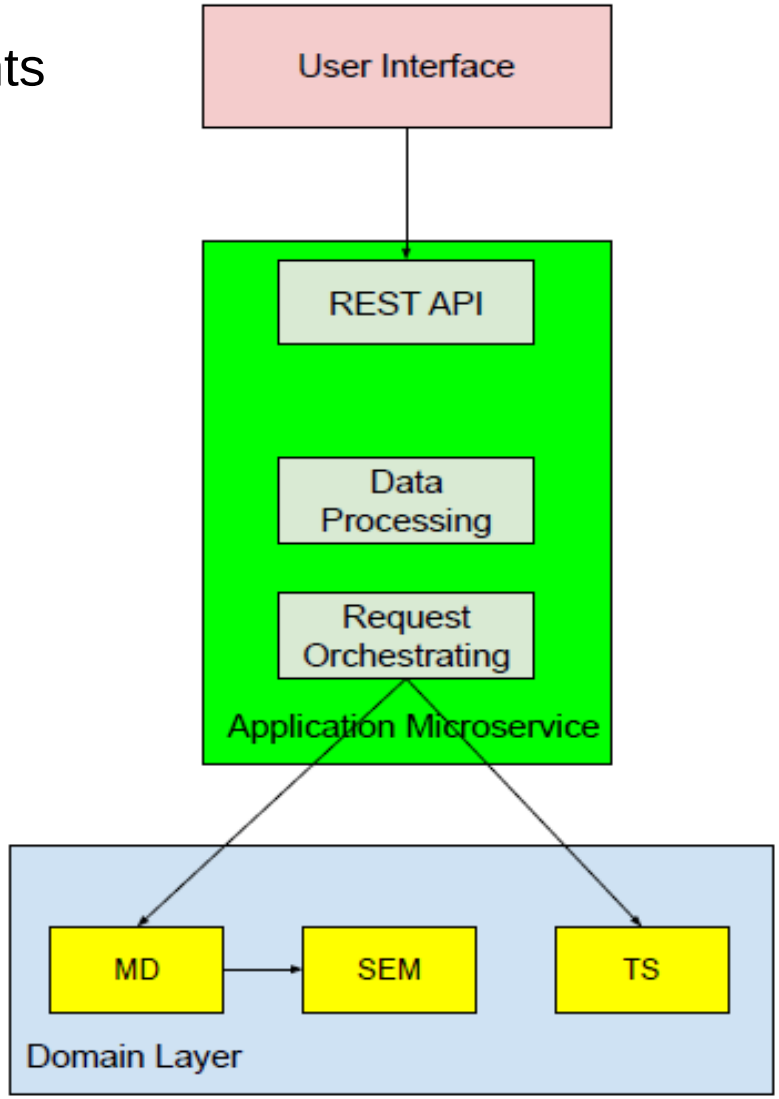


Software Architecture (2)

- domain layer consists of three microservices
  - Masterdata Service (MD)
    - provides master data of different objects in the context, e.g. measurement stations
  - Semantic Service (SEM)
    - validates master data objects
    - provides structural and semantic information for masterdata
  - Timeseries Service (TS)
    - manages time series data
    - aggregation, filtering, …

Software Architecture (3)

- AppMS has three base components
  - REST API
    - provides callable enpoints
    - called by client (User Interface)
  - Data Processing
    - generate output format
    - perform data processing steps
  - Request Orchestrating
    - make requests to the domain microservices



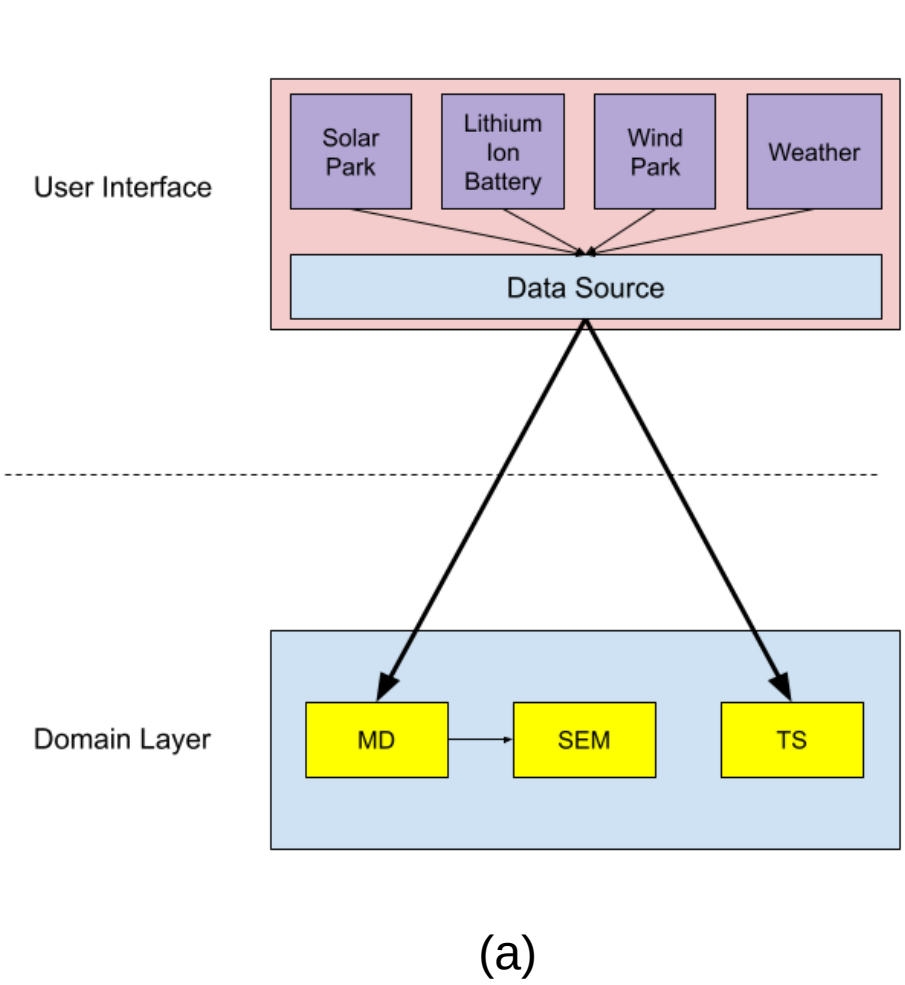
Evaluation (1)

- previously shown scenarios are used for validation
  - air measurement: no AppMS
  - energy measurement: with AppMS
- main purposes of AppMS:
  - reduction of network load
  - reduction of hardware requirements for end users
- network load aspect is examined in detail
- hardware requirements difficult to measure

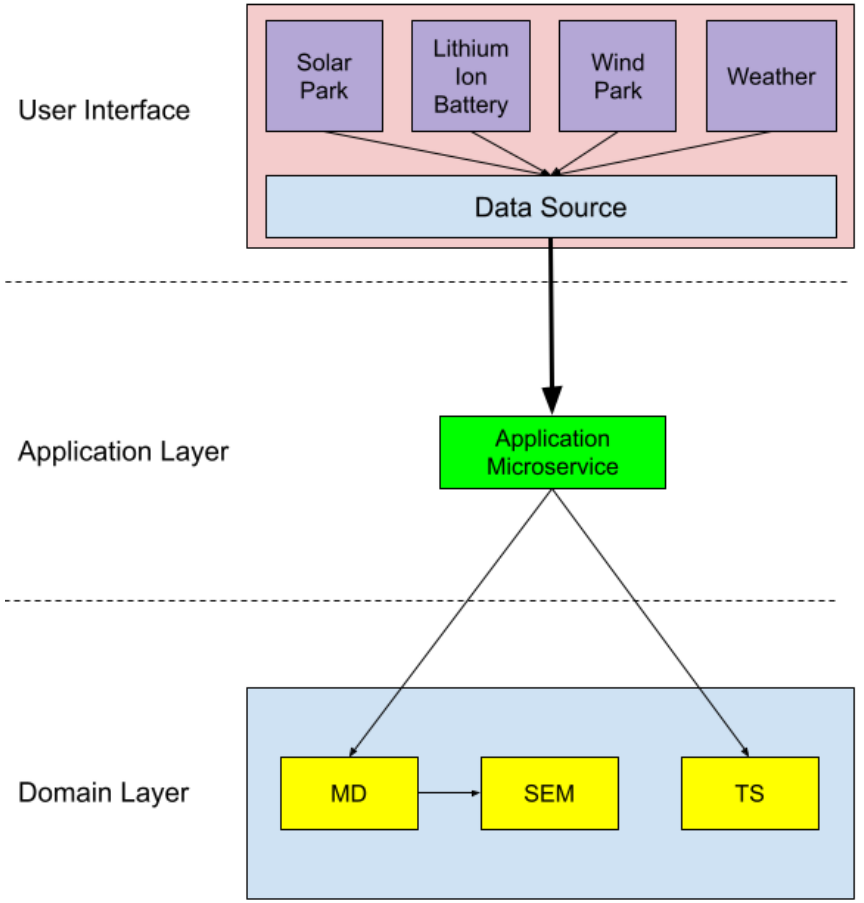
Evaluation (2)

- requests can be cheap or expensive
  - cheap request: made in same infrastructure/server environment
  - expensive request: made between two different infrastructures/server environments
- goal: reduce number of expensive requests
- two different scenarios
  - architecture uses no AppMS (a)
  - architecture uses AppMS (b)

Evaluation (3)



(a)



(b)

Evaluation (4)

Type	Number of expensive requests
no AppMS	8
with AppMS	1

- it is assumed that each component may need different resources
  - → worst case scenario (regarding required requests)
- data source can only make one request at once
  - it can call the application microservice which can make requests to all required resources

Conclusion

- extension of existing software architecture
  - usage of application service
  - more efficient sequence of requests
  - less resources for end users
- approach fits modern software architectures
- positive effect on power consumption (presumably)
- foundation for future works

Thank you…

… for your attention!

References

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