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# SmartAQNet - a measurement network for particulate matter in Augsburg

108th OGC Technical Committee  
Stuttgart, Germany

Johannes Riesterer, Till Riedel, Matthias Budde, Marcel  
Köpke, Michael Beigl

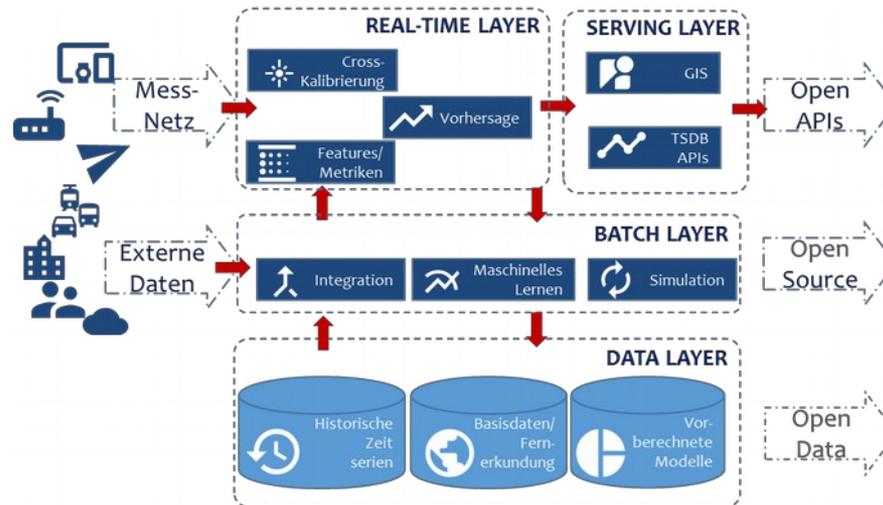
KIT/TECO

11 September 2018

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# Motivation

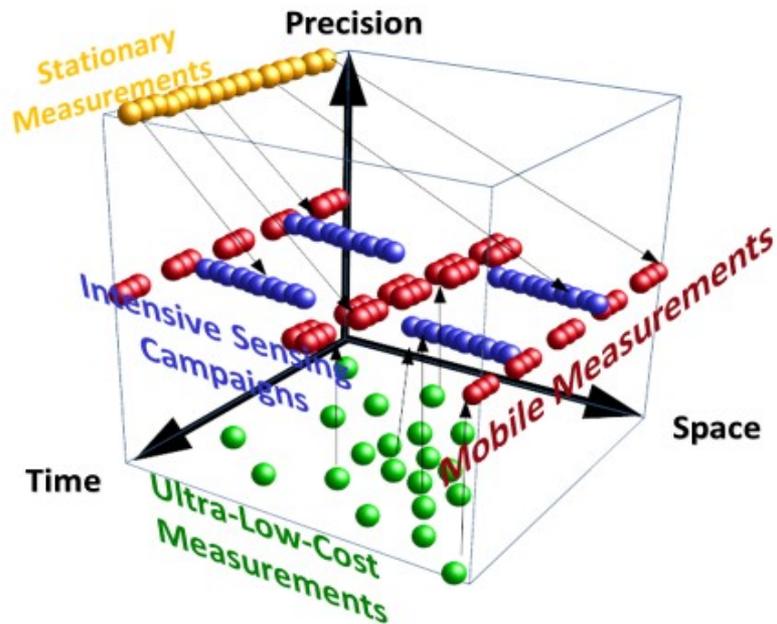
- Easy collection of raw sensor data (geotagged, timestamped)
- Easy and fast processing, preprocessing and feedback of the data
- Views on data via standardized interfaces and file formats
- OpenApi, OpenData, OpenSource e.g. Citizen Science



# Agenda



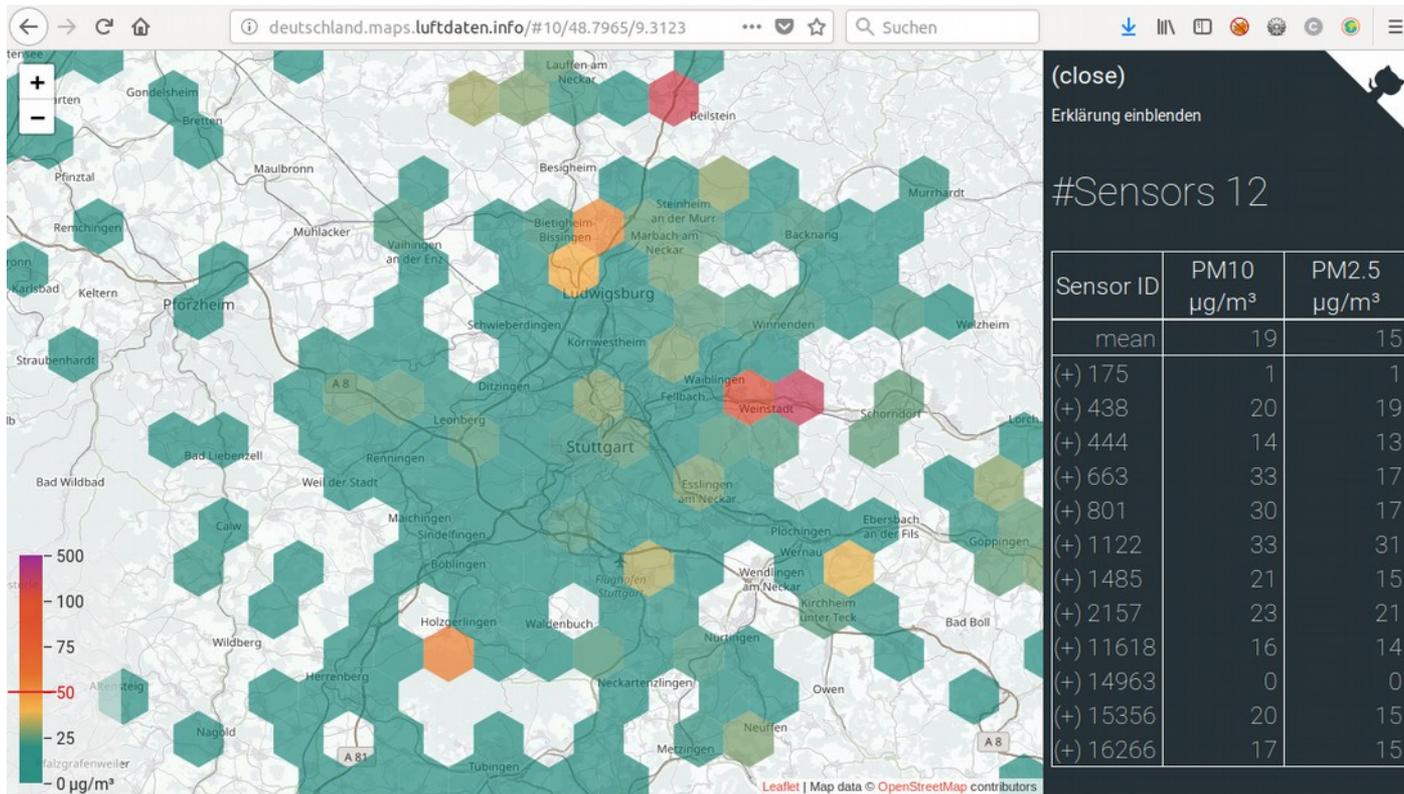
- Big Data (Volume, Velocity, Variety, Veracity)
- Standardized API's, protocols and file formats should be understandable and easy to use for non-experts



# Related Work



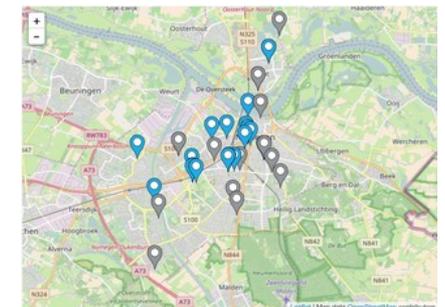
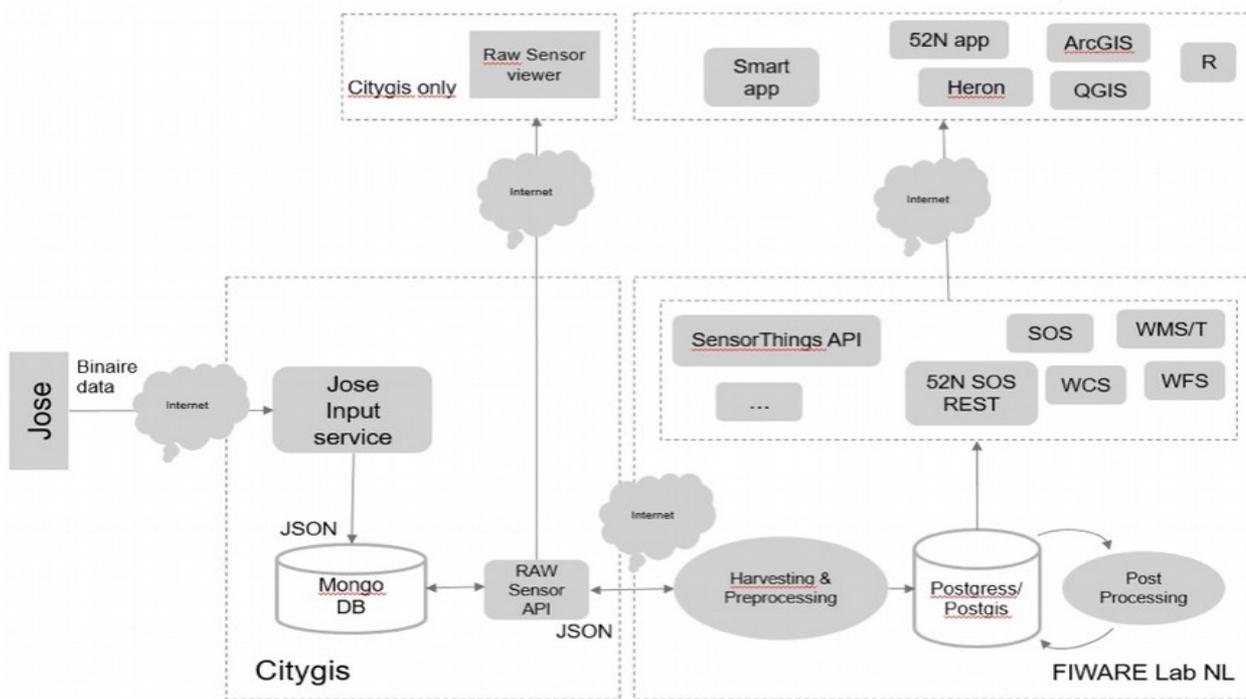
OKLAB/luftdaten.info (graphana, MQTT, Django)  
Particulate matter sensor network



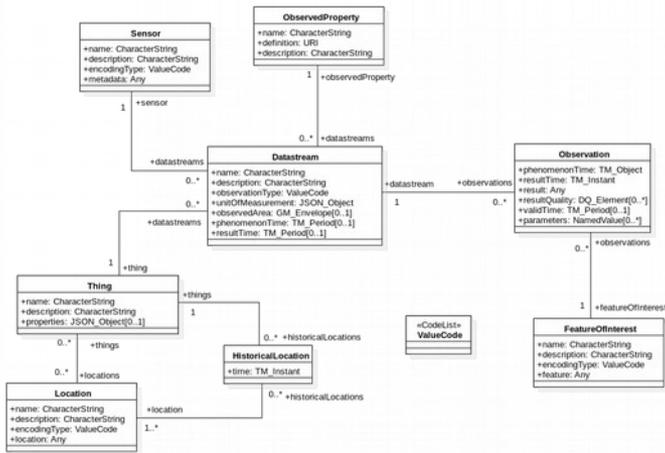
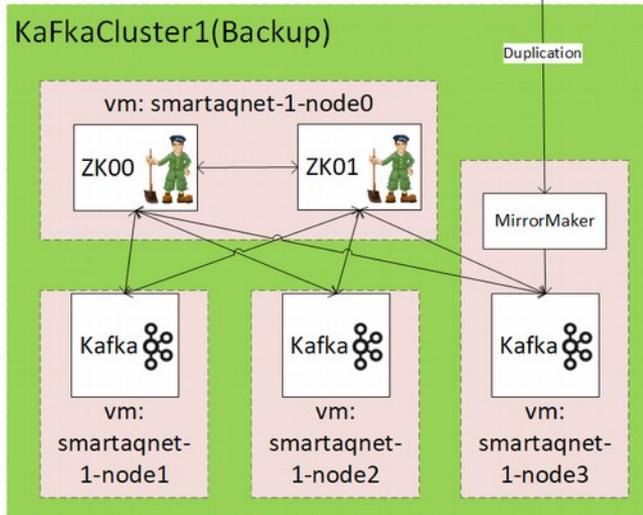
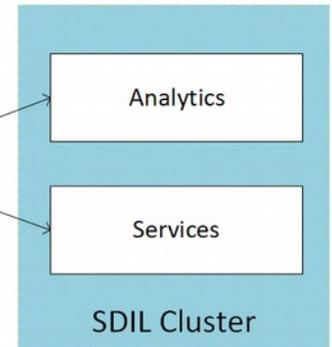
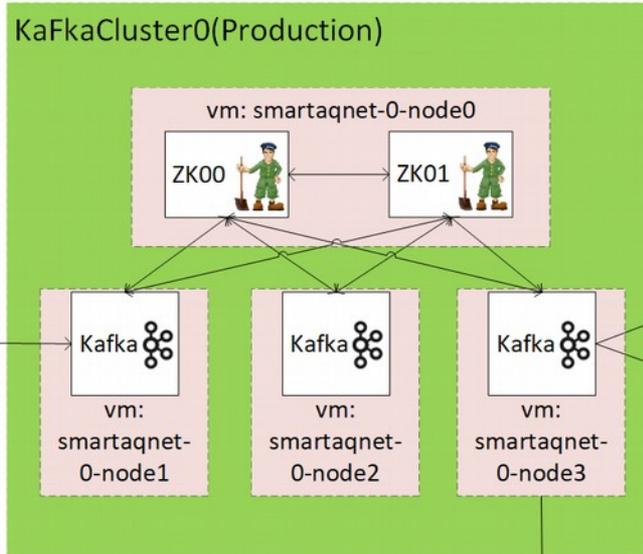
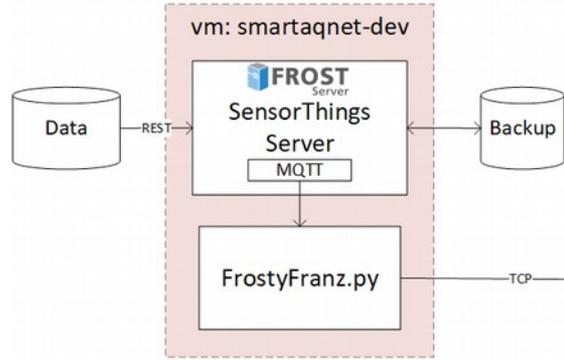
# Related Work



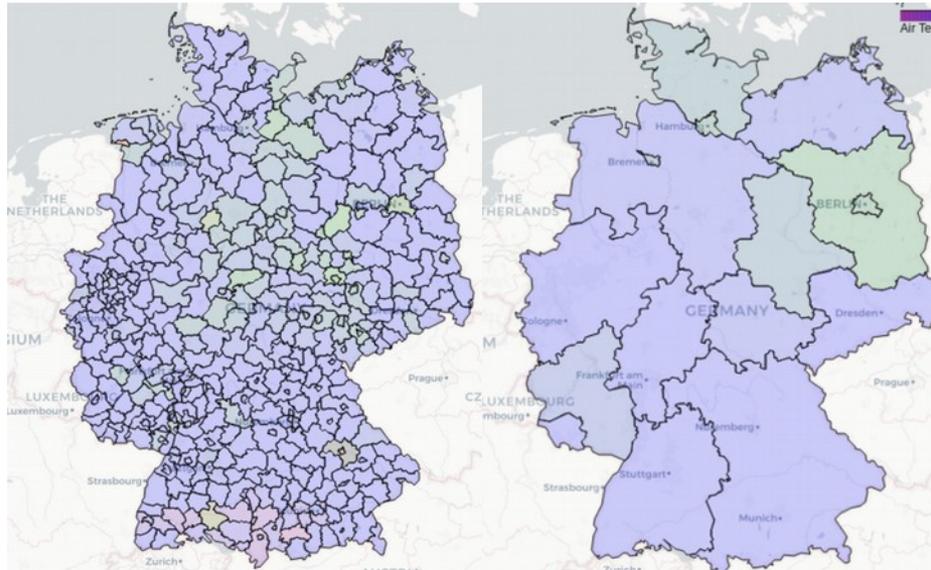
## Smart Emission in Nijmegen Gas sensor network



# TECO Kappa Architecture Setup



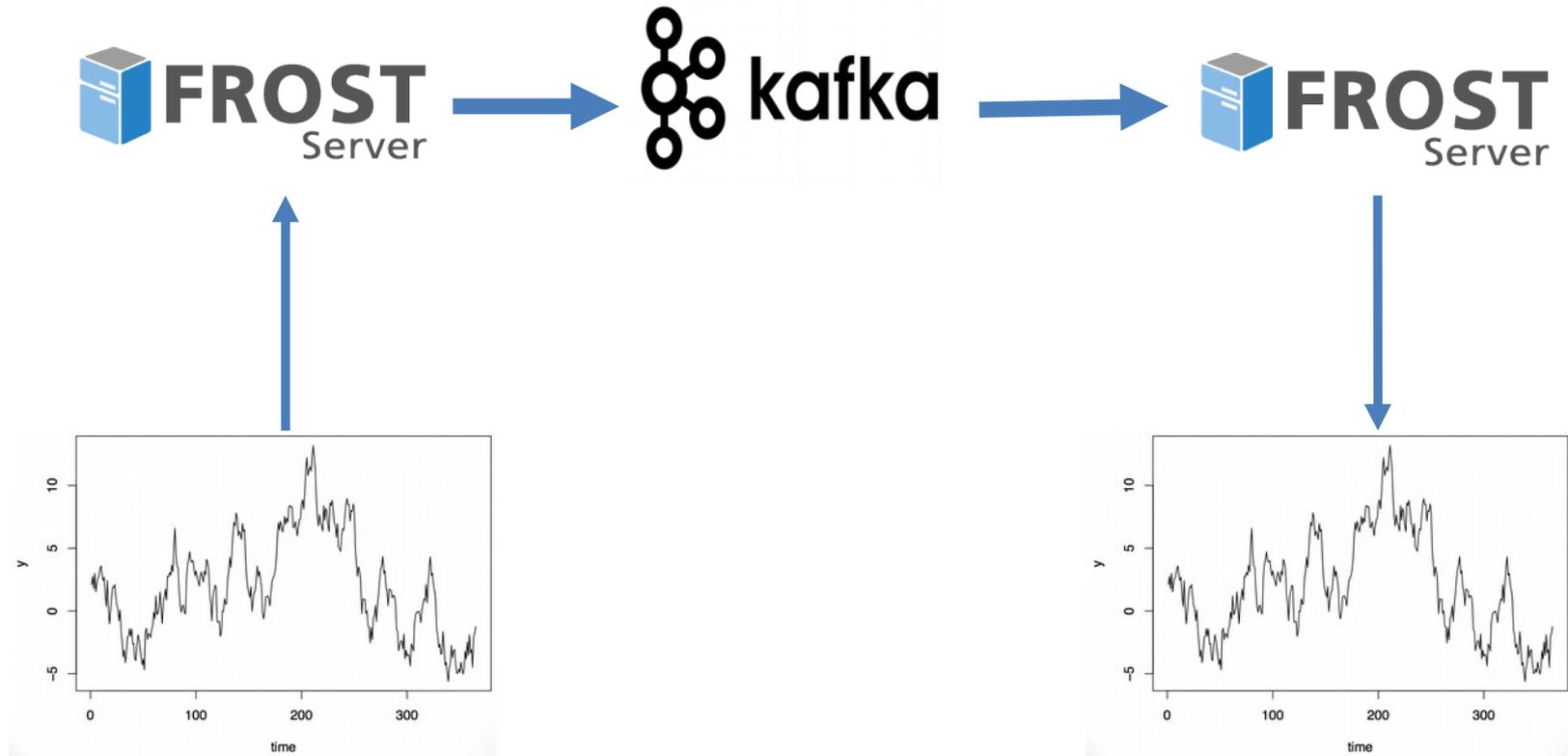
# 1st trial: >10k Sensors from wunderground



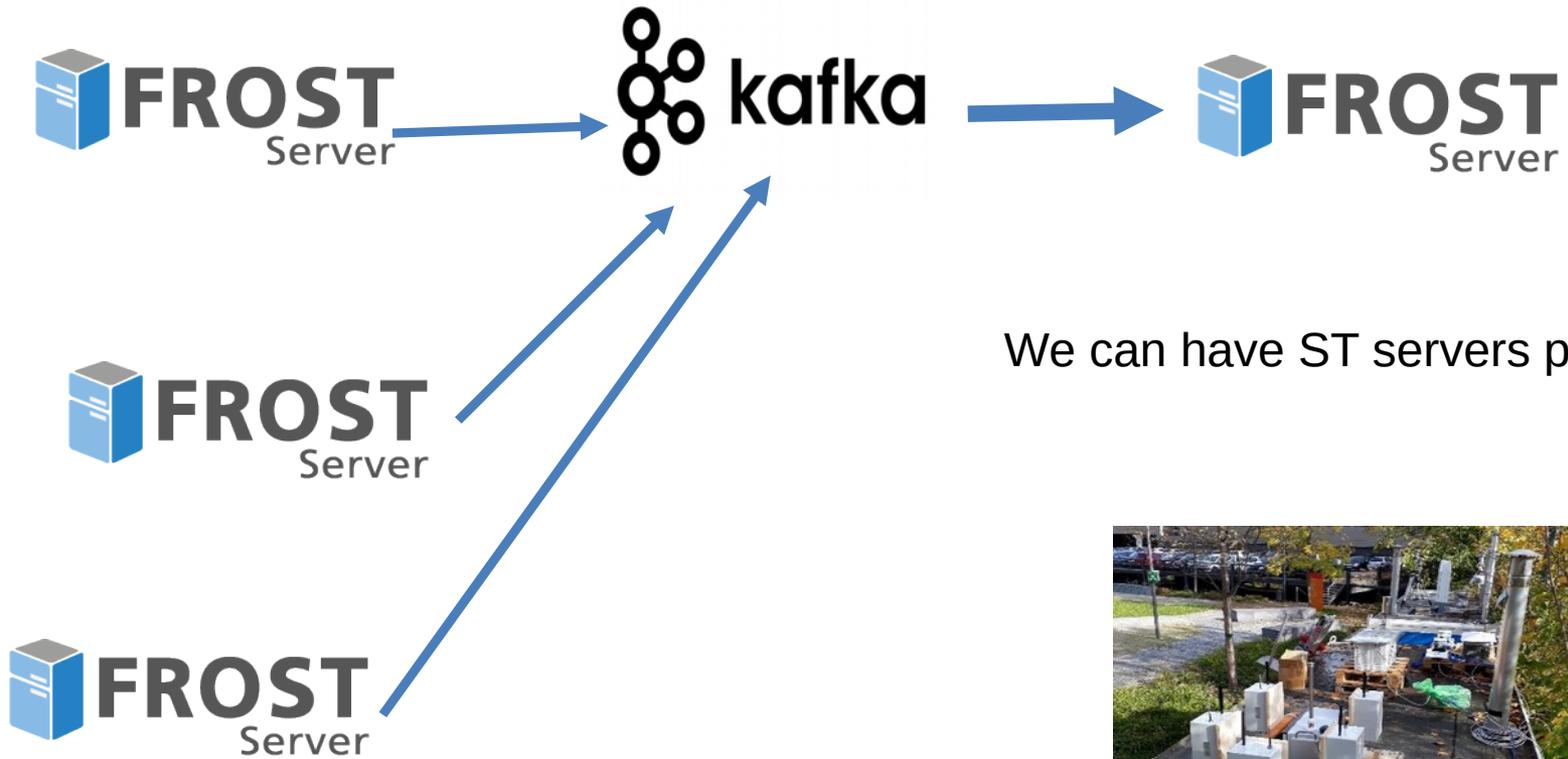
Hyperparameter optimisation on Kriging problem (interpolation with uncertainty)

Julian Bruns, Johannes Riesterer, Bowen Wang, Till Riedel, Michael Beigl (2018)  
Automated Quality Assessment of (Citizen) Weather Stations, GI\_Forum, [pdf](#),  
[doi:10.1553/giscience2018\\_01\\_s65](https://doi.org/10.1553/giscience2018_01_s65)

# ST Backup/Replay



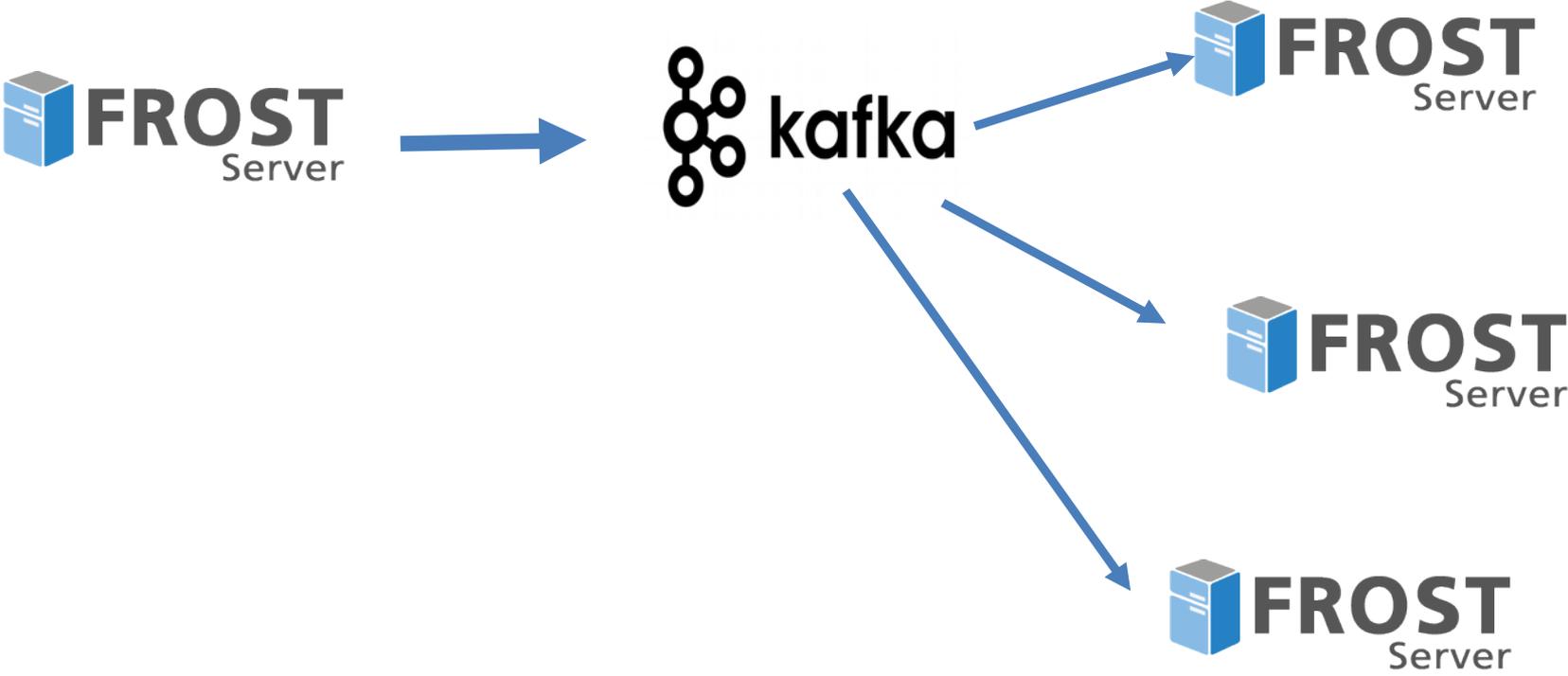
# ST Server Network



We can have ST servers per site

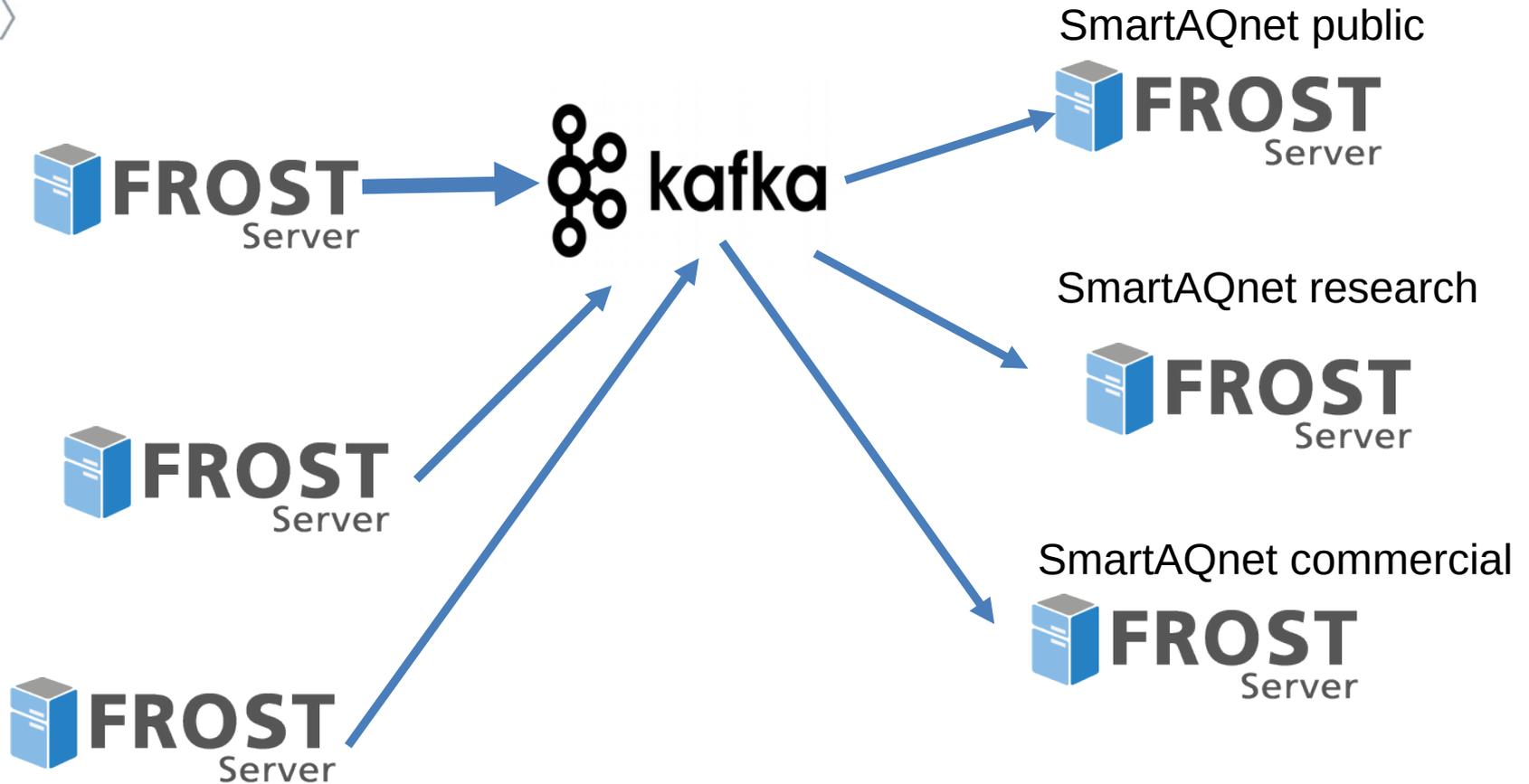


# ST Server Views



Speed up and availability!

# ST Server Replication



Different Sensor Operators

Different Customers

# Client generated @iot.ids

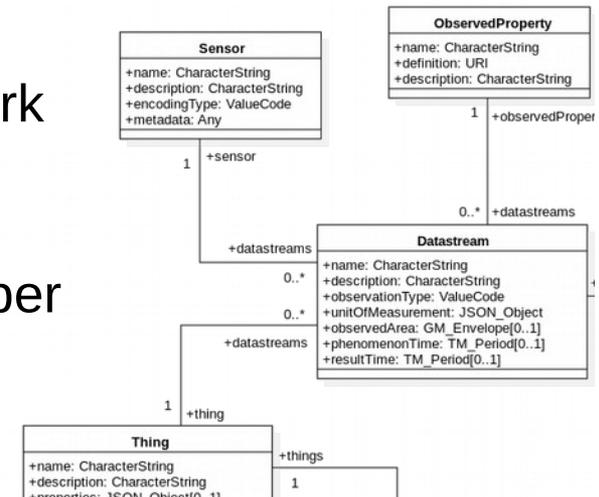


Annotation	Definition	Data type	Multiplicity and use
<b>id</b>	id is the <b>system-generated identifier</b> of an entity. id is unique among the entities of the same entity type <b>in a SensorThings service</b> .	Any	One (mandatory)

- Specification makes it close to impossible to replicate a SensorThings service
- Makes mapping of IDs difficult (e.g. for a Network Bridge)

## We need client generated ids

- Example: `teco.edu:SomeThing:SerialNumber`
- StringID Implementation in FROST works



# Autogenerated Historical Locations



## Req 8 - create-update-delete/historical-location-auto-creation

When a Thing has a new Location, a new HistoricalLocation SHALL be created and added to the Thing automatically by the service. The current Location of the Thing SHALL only be added to HistoricalLocation automatically by the service, and **SHALL not be created as HistoricalLocation directly by user.**

[http://www.opengis.net/spec/iot\\_sensing/1.0/req/create-update-delete/historical-location-auto-creation](http://www.opengis.net/spec/iot_sensing/1.0/req/create-update-delete/historical-location-auto-creation)

- Makes replication impossible again
- Network delays give wrong movement times
- No support for delay tolerance (MQTT QoS Level 2)
- Why do we need thing locations and not model them as special observations? ✉ We don't use them for mobile systems.
- New FROST implementation offers workaround we can work with

# Many questions ST standard



- Dictionaries for @iot.id of associated entities to reconstruct structure
- How to model simultaneous observations: The equals operator on ISO Time (or any float) is not well defined!
- Multidatastream should consist out of N Datastreams
- Properties for all entities, not just Thing to model metadata as implemented in FROST
- How to model rasterdata/rasterimages
- How to model simulations and interpolations.

# Many questions ST standard

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- Every entity should have a history
- Limited benefit from odata standard: problems with id escaping; Query interface is difficult to implement without relational spatial database. Is JSON-LD and/or GraphQL standard still a realizable future path (extendible, id = navlink, URI=URL) ?

# Ecosystem should be priority #1

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- We have many problems to combine tools, for example Graphana ST plugin. Nextlinks missing. String id's not supported
- Microsoft WCF tools expect \$metadata to work with odata
- API's for Arcgis, qgis, geopandas,...
- More example implementations (not only more servers). Best practices for modeling devices and observations. Location/HistoricalLocation/FeatureOfInterest/Time