BRIDGING GEOMQTT & REST

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Outline

1 Motivation

GeoMQTT:

- Linking different producers and consumers of real-time geo events in a push-based manner
- Closing the interoperability gap between geo sensor networks and Sensor Web Enablement (SWE) services (SOS,…)

→ Concept of **Sensor Bus**

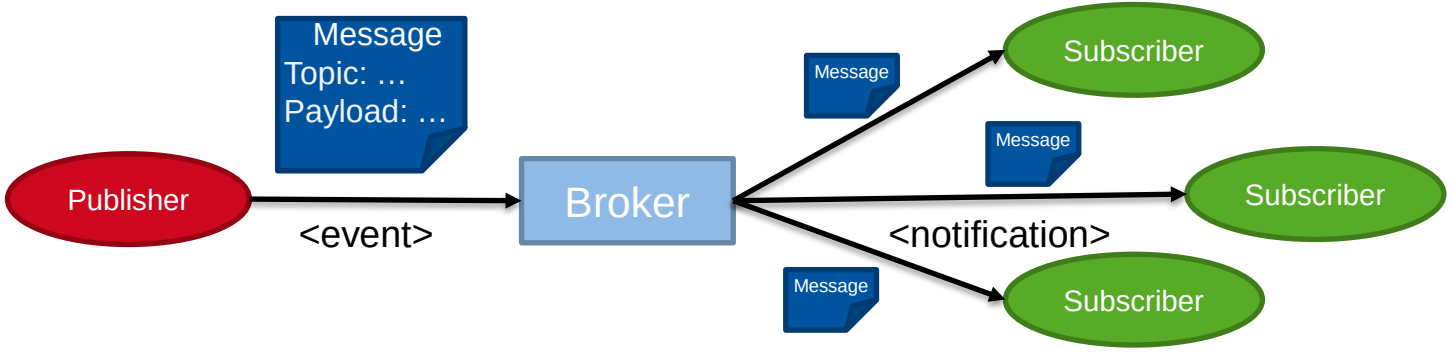
REST Bridge:

- Retrieve and send GeoMQTT messages by HTTP methods but without a GeoMQTT client
- Easy access for debugging of geo events

2 MQ Telemetry Transport (MQTT)

- Topic-based publish/subscribe model, message transmission in near real-time
- Open standard by OASIS 2013
- Low Overhead (2 bytes header) → lightweight messaging
- Standard gives guidance for security implementation
- Quality of Service (QoS) & Last Will and Testament (LWT) feature provides reliability
- Scalable with TCP load balancers
- MQTT for Sensor Networks (MQTT-SN) for constrained devices and connectionless environments

2 How does MQTT works?

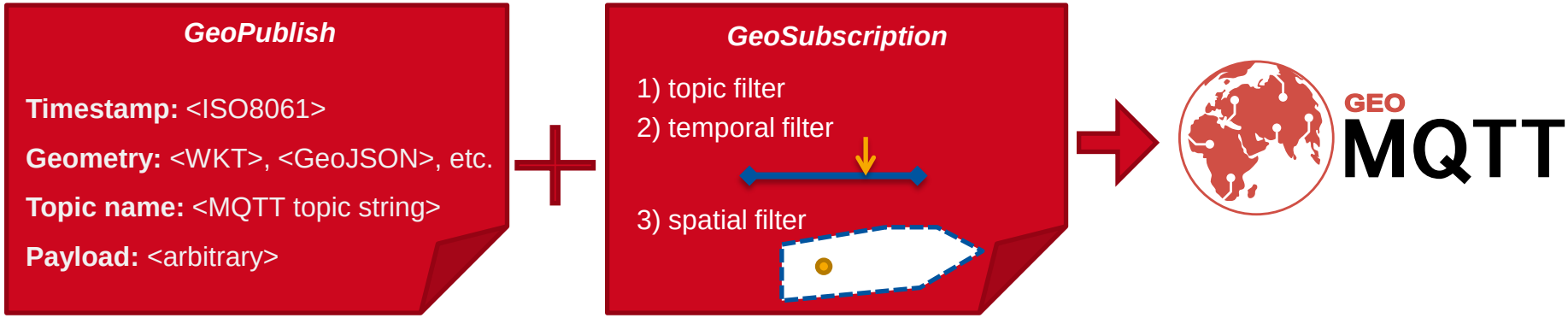


- Addressing via **topics**
- Publish event with a topic name: room/237/temperature
- Subscribe to topic filters
  - Entire topic name → room/237/temperature
  - „+“: single level wildcard → room/+/temperature
  - „#“: multi level wildcard → room/237/#

3 GeoMQTT Extension

- GeoEvent message: **(<timestamp>, <geometry>, <eventname>, <payload>)**
- Geo data stream: infinite stream of tuples

(2015-09-22T11:10:21+*00:00; POINT(*6.06799 50.77906); temperature; 20.752)
(2015-09-22T11:10:22+*00:00; POINT(*6.06799 50.77906); temperature; 20.760)
(2015-09-22T11:10:23+*00:00; POINT(*6.06799 50.77906); temperature; 20.769)
(2015-09-22T11:10:24+*00:00; POINT(*6.06799 50.77906); temperature; 20.759)
...
(2015-09-22T11:10:52+*00:00; POINT(*6.06799 50.77906); temperature; 20.750)



3 GeoMQTT: Temporal Filter

- Based on ISO8601 standard for (repeating) time intervals:

<start>/<end>
<start>/<duration>
<unixtime>/<duration>
<unixtime>/<seconds>
(<CRON>)/<duration>
(<CRON>)/<seconds>

Examples:

1) 2015-08-31T12:00:00/2015-09-15T10:00:00
2) 2015-08-31T12:00:00/PT2H
3) 1441017813/7200
4) (0 0 8 ? * SAT)/PT2H30M

with: <start>,<end> in ISO time stamps, <duration> in ISO duration, <unixtime> in Epoch time, <CRON> according to Quartz scheduler

→ Evaluate if time stamp of GeoPublish message is within interval of GeoSubscription

3 GeoMQTT: Spatial Filter

- Filters geo event by location
- Spatial filter is specified with a geometry in Well-known Text (WKT), GeoJSON etc.
- Currently limited to World Geodetic System 84 (WGS84)

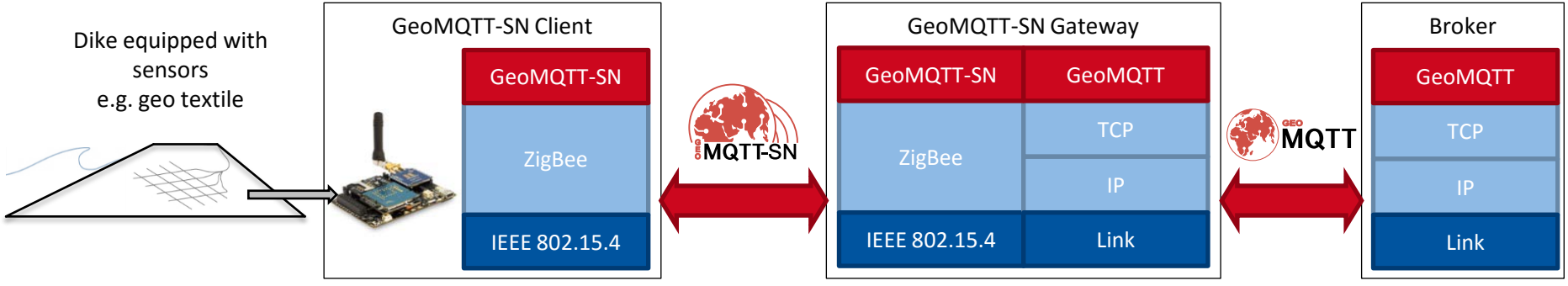
Examples:

1) POINT(6.06799 50.77906)
2) POLYGON((11.59 51.88, 11.76 51.37, 12.61 51.41, 12.16 52.35, 11.98 52.18, 11.59 51.88))
3) BUFFER(POINT(6.06799 50.77906), 1.0)
4) BBOX(9.59416 53.24793, 10.51208 53.84986)

→ Evaluate if geometry of the GeoPublish message is coveredBy the GeoSubscription geometry

3 GeoMQTT in geo sensor networks

- Extending MQTT-SN to GeoMQTT-SN:



- Added also three message type: GeoPublish, GeoSubscribe & GeoUnsubscribe
- Adjusted to constrained devices

4 GeoMQTT-REST Bridge

- Bridging publish/subscribe and request/response scheme

→ Close the gap between machines and developers in IoTS
(Collina et. al 2012: QEST Broker)

Map topic names/filters to REST resources:

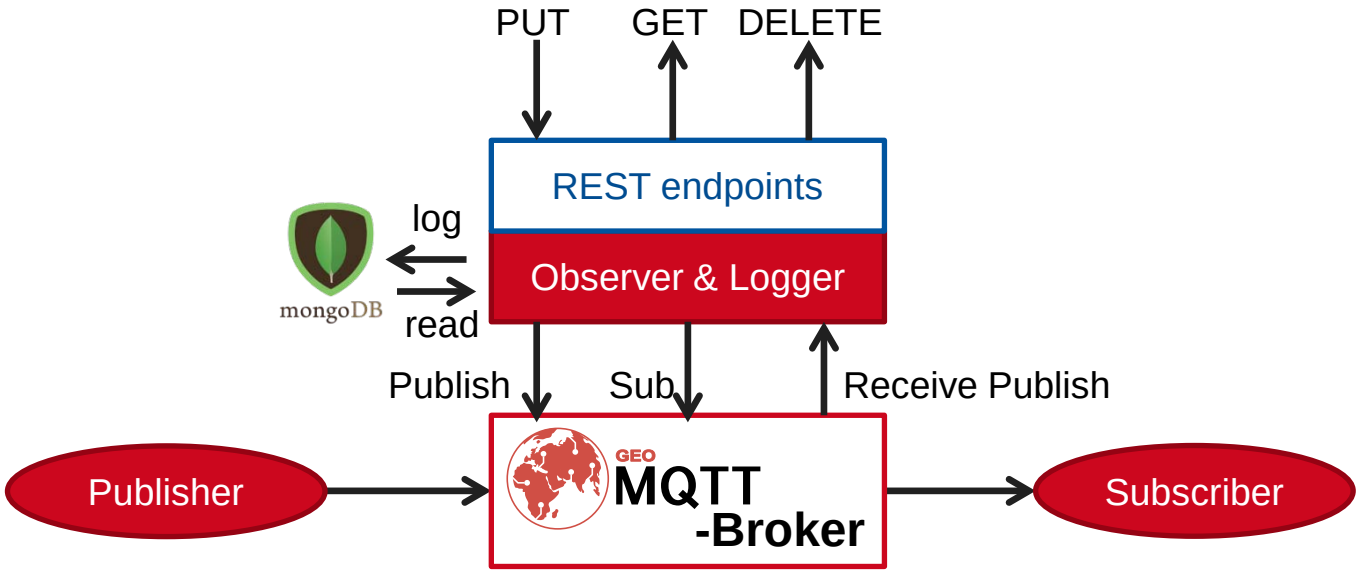
Method	Resource	Topic name / filter
HTTP GET	/topics/room/+/temperature	room/+/temperature
HTTP PUT	/topics/room/237/temperature	room/237/temperature

But missing push notification:

→ *Long-polling, WebSockets*

4 GeoMQTT-REST Bridge

- Implementation acts as a bridge and logger.
- 2 endpoints: MQTT and GeoMQTT



4 GeoMQTT-REST Bridge

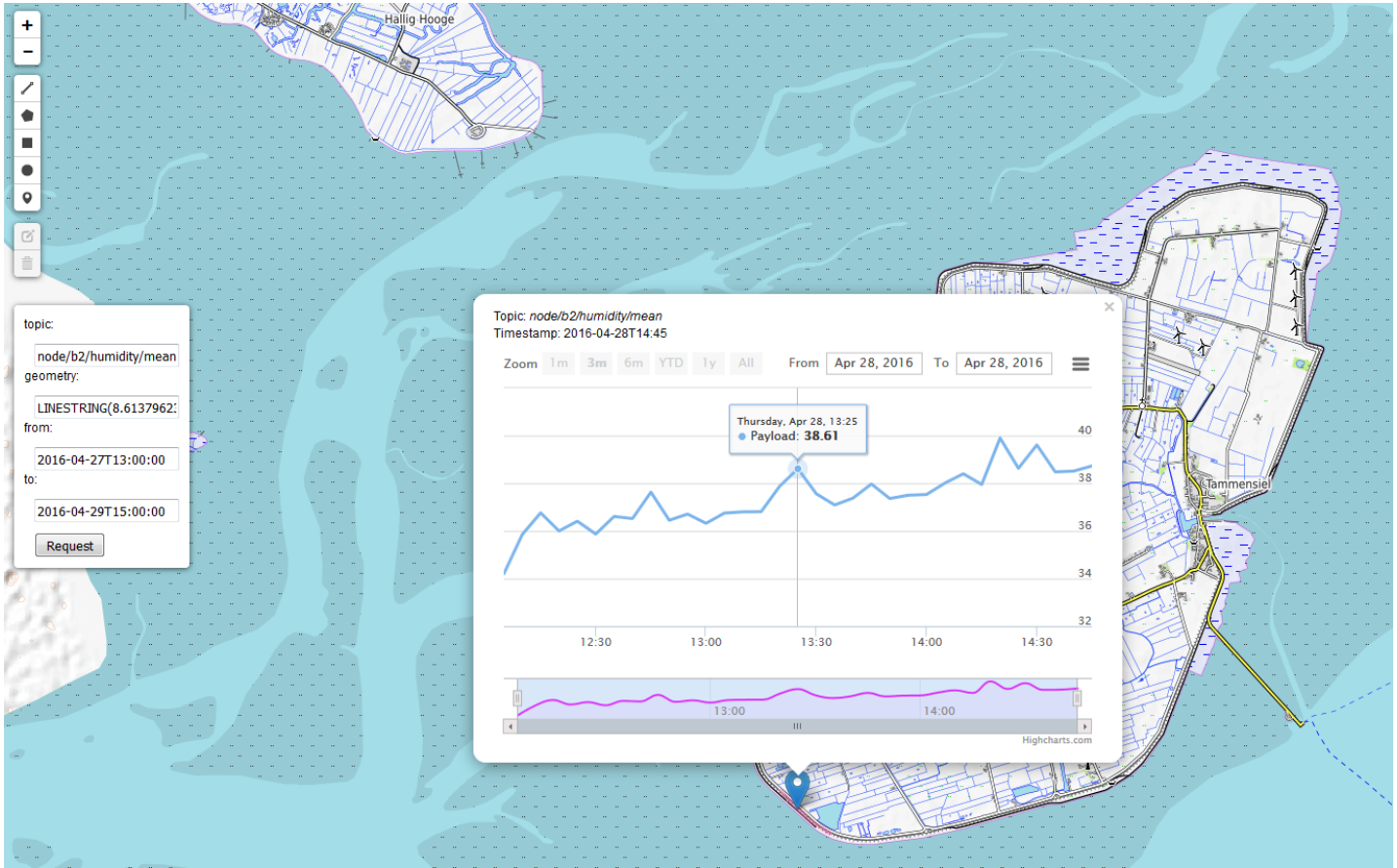
- GeoMQTT endpoint

Method	Resource ↔ topic	Parameters	Output
GET DELETE	topic filter: /geopublish/temperature ↔ temperature	from: *ISO8601* to: *ISO8601* geometry: *WKT* size: *integer* merge: *boolean*	GeoJSON FeatureCollection
PUT	topic name: /geopublish/temperature ↔ temperature	time*: *ISO8601* geometry*: *WKT*	Status

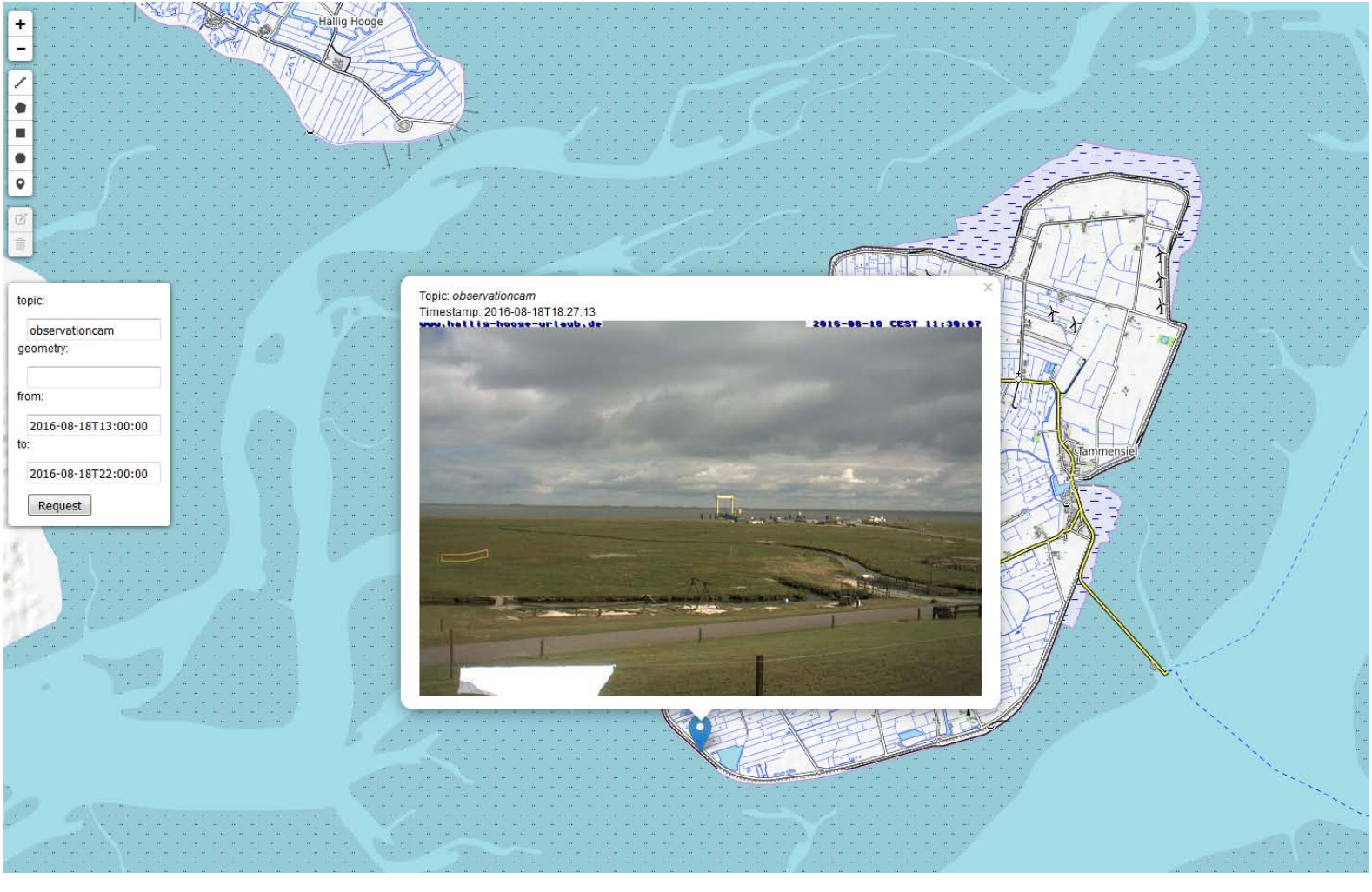
* mandatory

5 Application

http://localhost:8080/rest/geopublish/node/b2/humidity/mean?geometry=LINESTRING(…)&from=2016-04-27T13:00:00&to=2016-04-29T15:00:00&merge=true&size=40



5 Application



6 Conclusion

GeoMQTT for couple IoTS devices with GIS and geo web service

- → Close the gap to the Sensor Web → sensor bus concept
- → Enhance geo web services with real-time and asynchronous functionalities

REST bridge to close gap between machines and developers.

→ Acts as a logger for raw geo events issued by GeoMQTT clients

→ Especially useful for debugging the history of geo events

→ Future developments: implementation of Long-Polling RESTful approach