Monitoring the hidden: TimeMap

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Outline

- Why Timemap
- Current status
- Beyond observation: anomaly detection
- Further development

What are we talking about?

How is the road ahead today?

And how is it is in average?

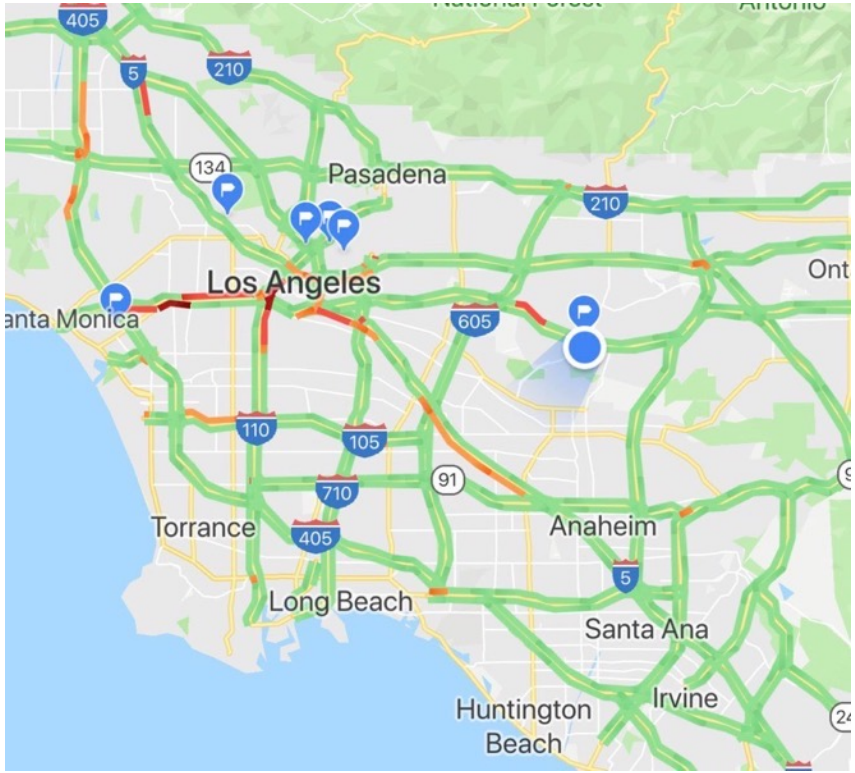
“Road report: on HWY 101 there are 364 vehicles per minute”

it may
Be nice
…

“Road report: on HWY 101 there are 364 vehicles per minute”

Or…
Lots of Stop & Go

“Road report: on HWY 101 there are queues at the red spots”



…but we also like to know transit times

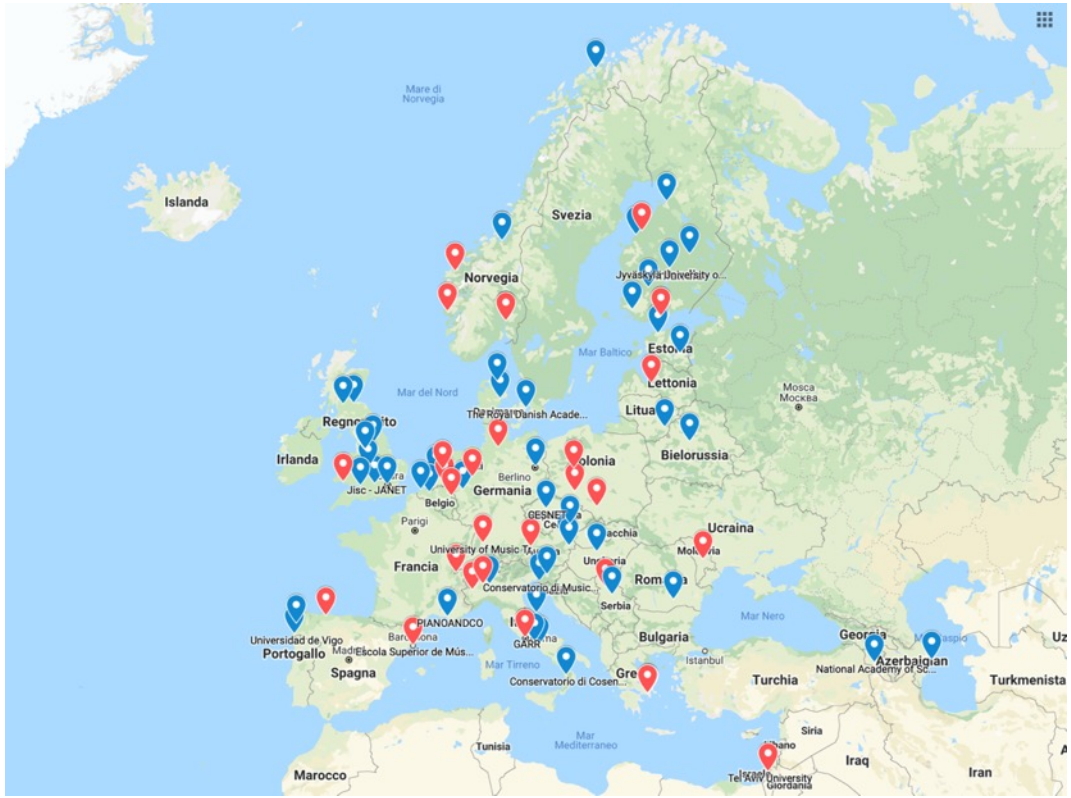
Network Traffic: what do we usually have?

But this is OK for bulk data transfers

NOT for real time applications which are sensitive to Latency & Jitter!

Can my application set the cruise control on and live happily?

Applications which need “cruise control” on are on fast rise!

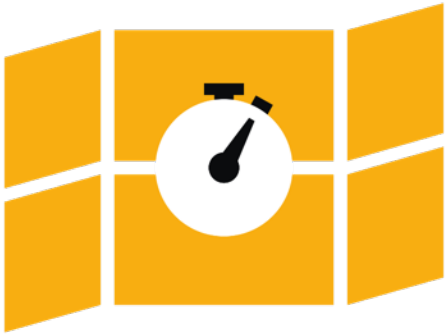


- LoLa

+ 30%

We need to monitor ”the hidden”:

- latency
- jitter



TimeMap

We need to keep track of ”the hidden”:

- historic series

We need to find anomalies in “the hidden”

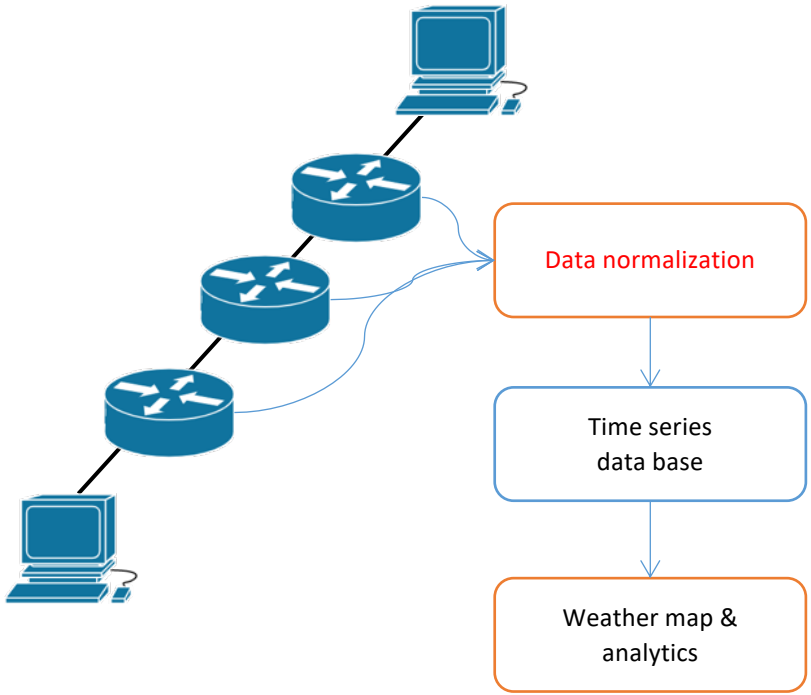
- machine learning
- alarms
- call the Police! … well, call the NOC people!

So in GN4-3, WP6 T1 we designed TimeMap!

Architecture requirements

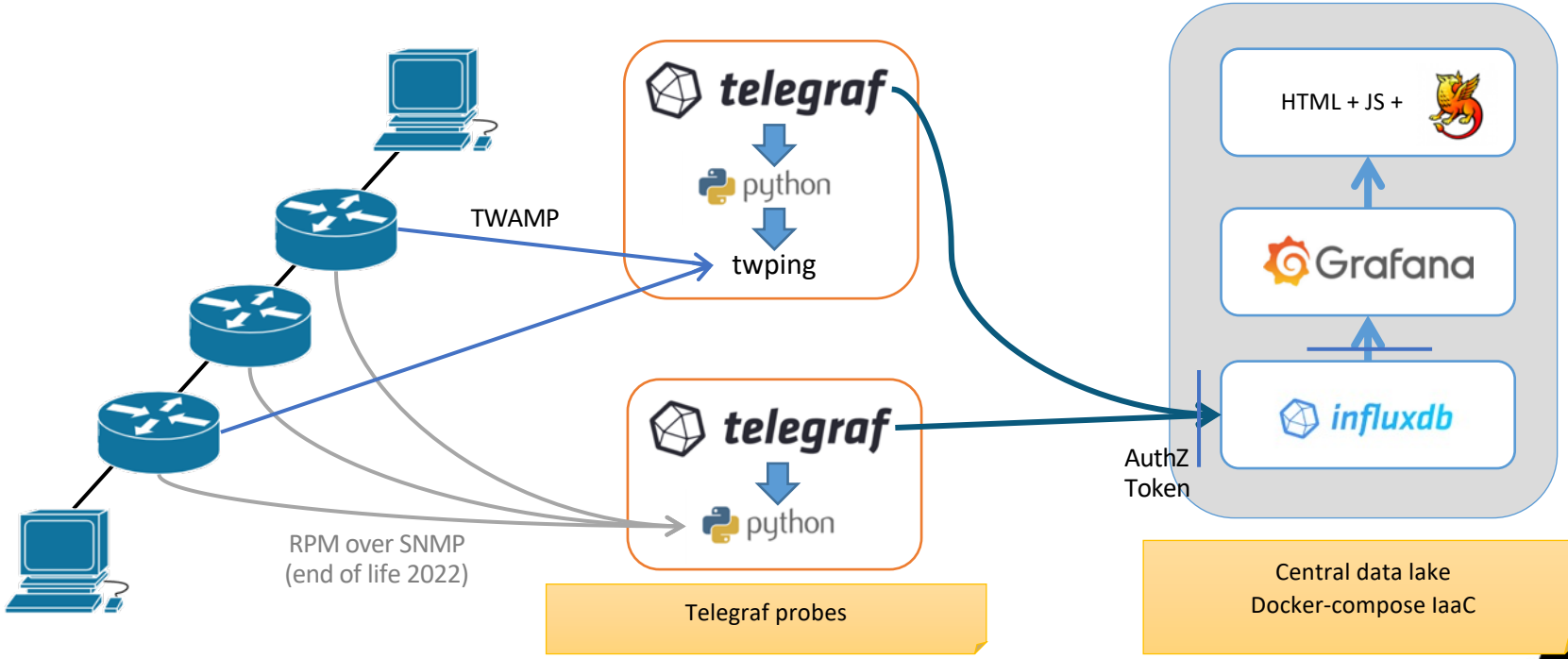
- Scalable and portable system
- Network architecture neutral
- Based on monitoring standard specifications
- Based on Open Source components
- Modular containerized system
- Easy to deploy
- With federated access control

TIMEMAP architecture and features

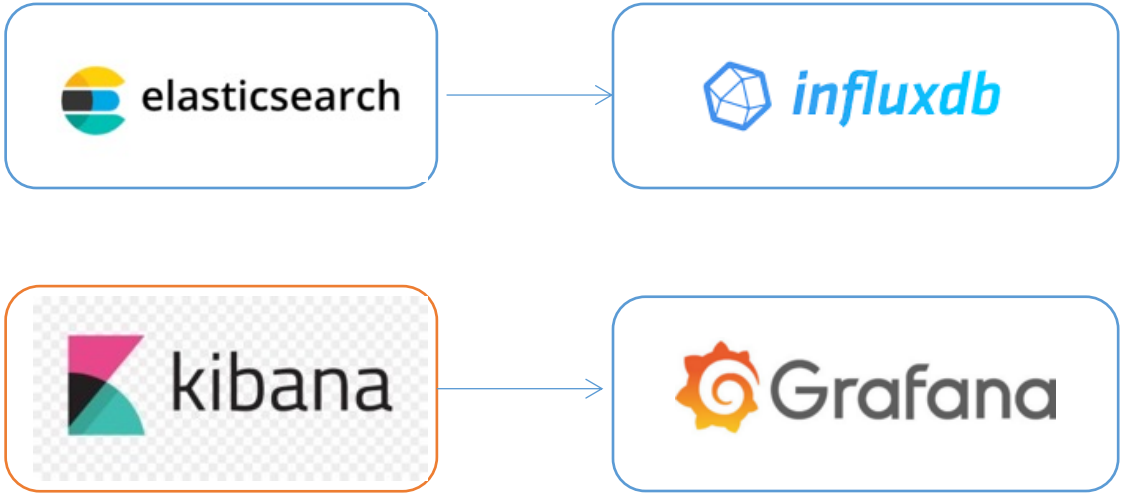


- Latency & Jitter data collection
  - TWAMP from all backbone routers
  - TWAMP from selected PerfSonar installations
  - RPM from all backbone routers (EoL 2022)
- Simplicity: almost zero footprint
  - Docker + Linux packages
  - Minimal custom code
  - Dynamic weather map GUI
- Security
  - eduGAIN authentication
  - Role Based Access Control
  - multi-tenancy

TIMEMAP v1 architecture – 1+ year of data taking

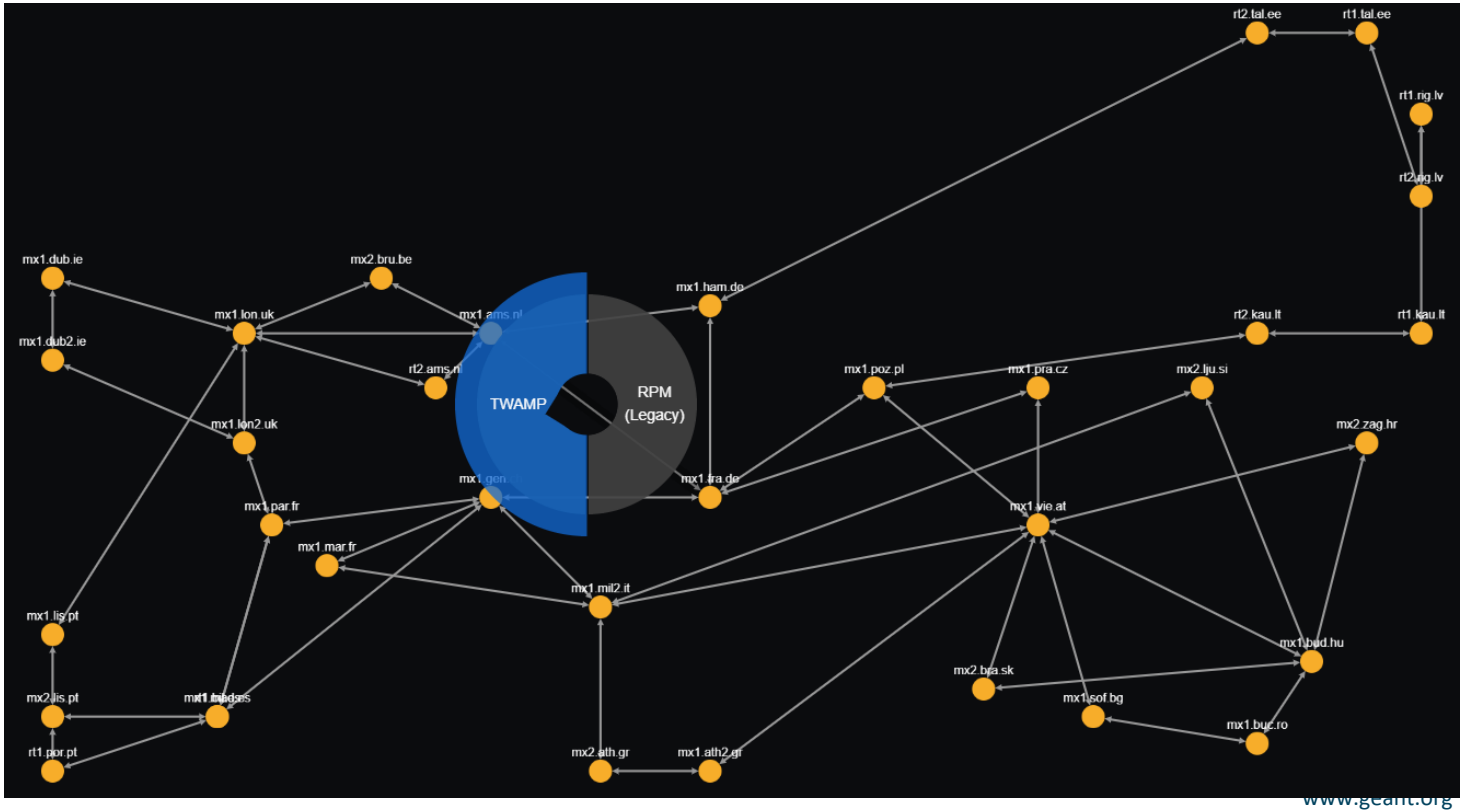


Flexibility: from prototype to production modules:

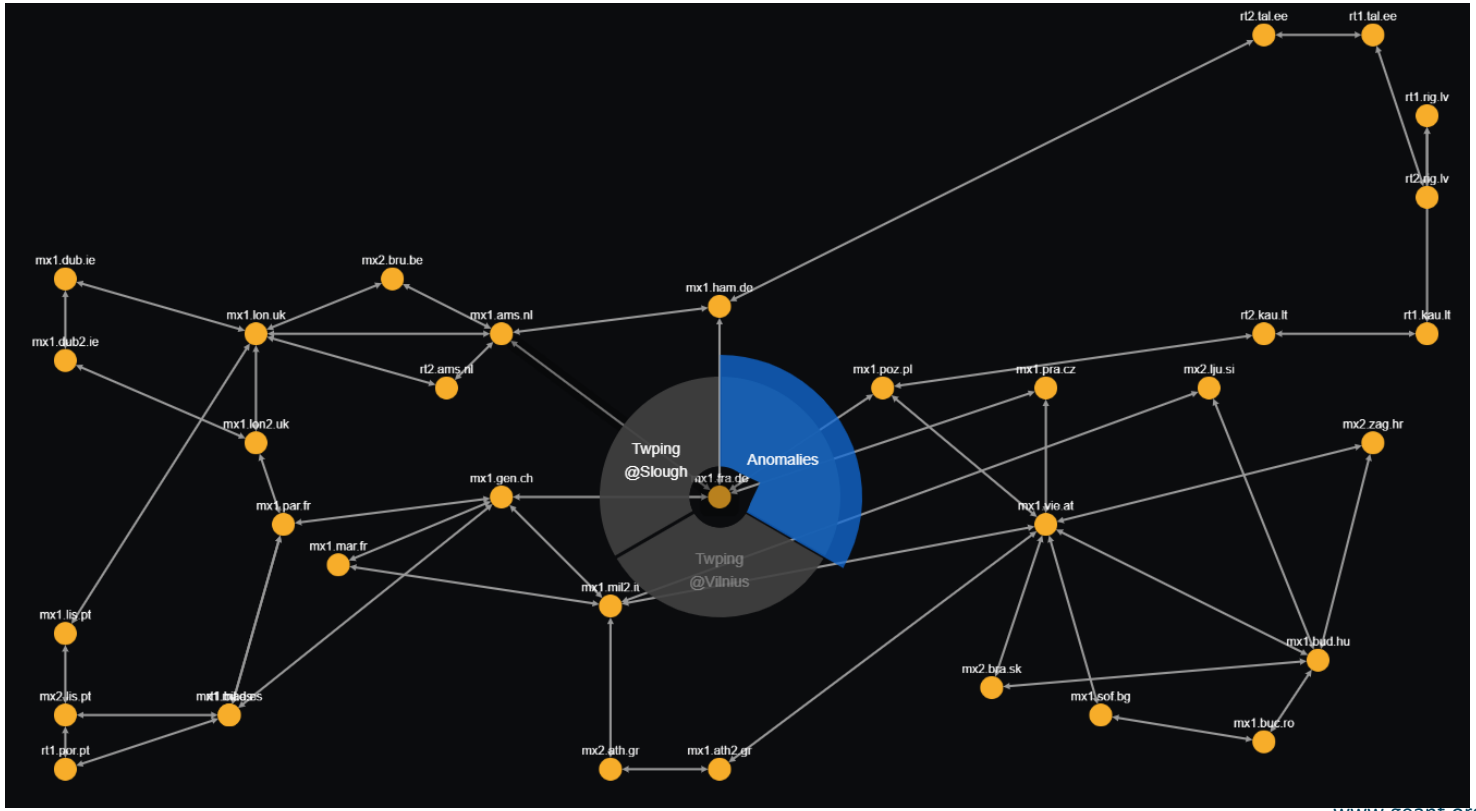


An “offline” view of the service (before we try go live!)

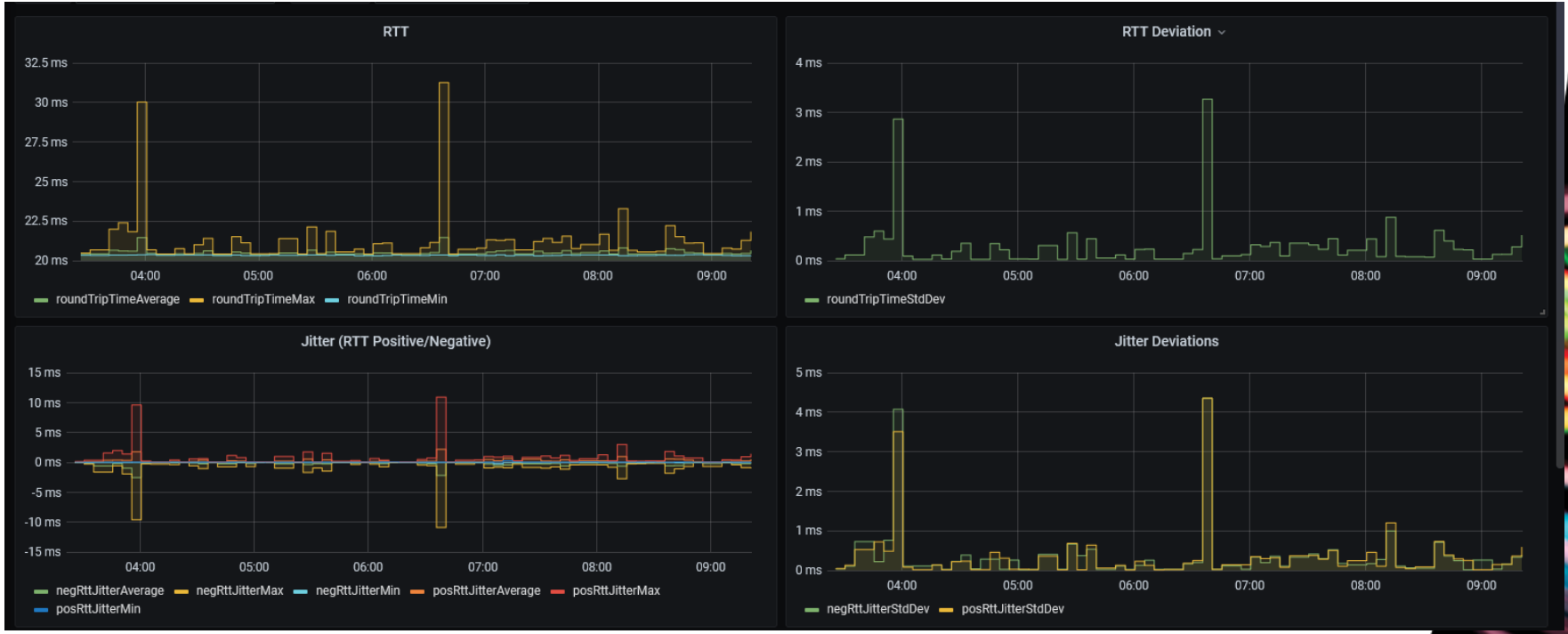
The entry map page: click on link



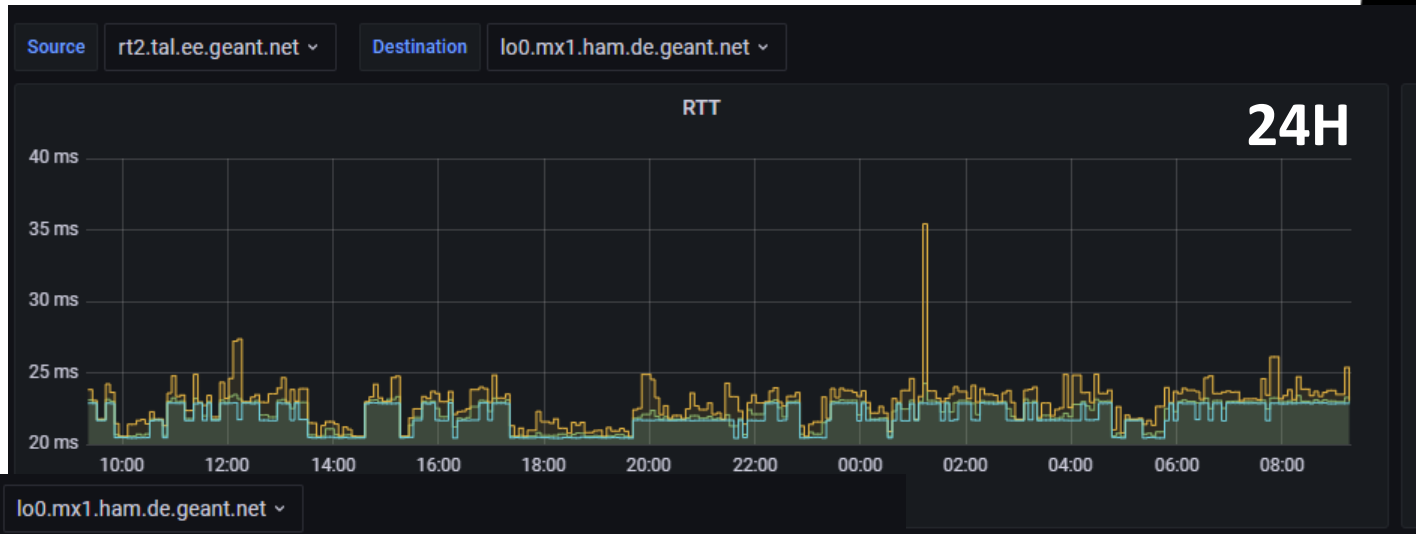
The entry map page: click on router

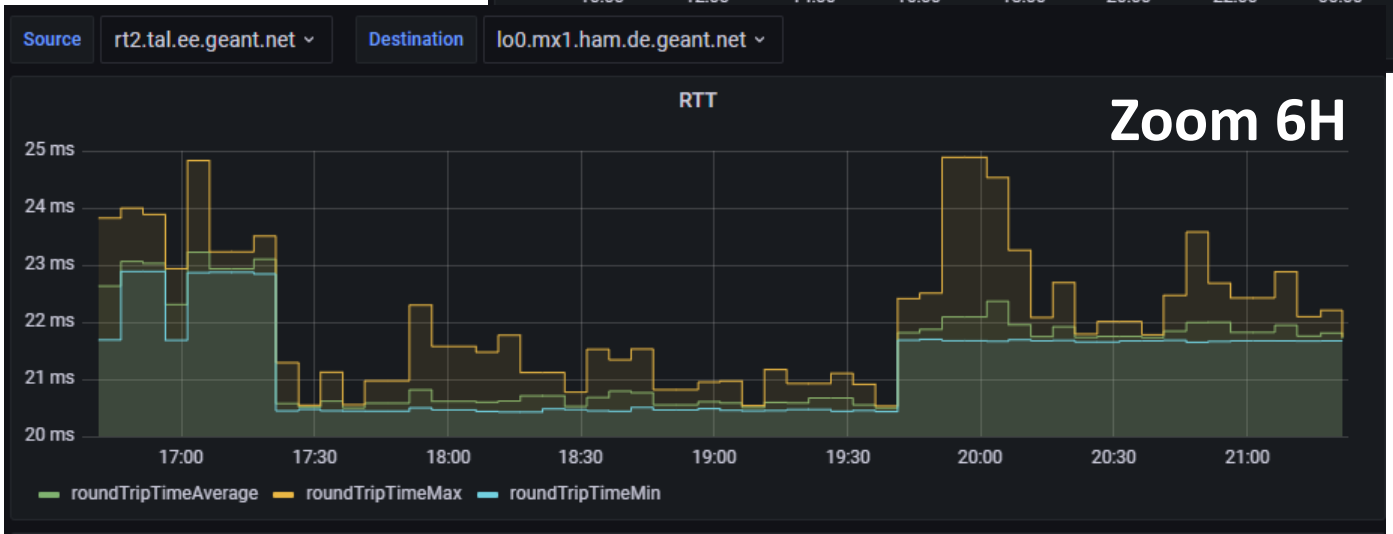


Periodic events

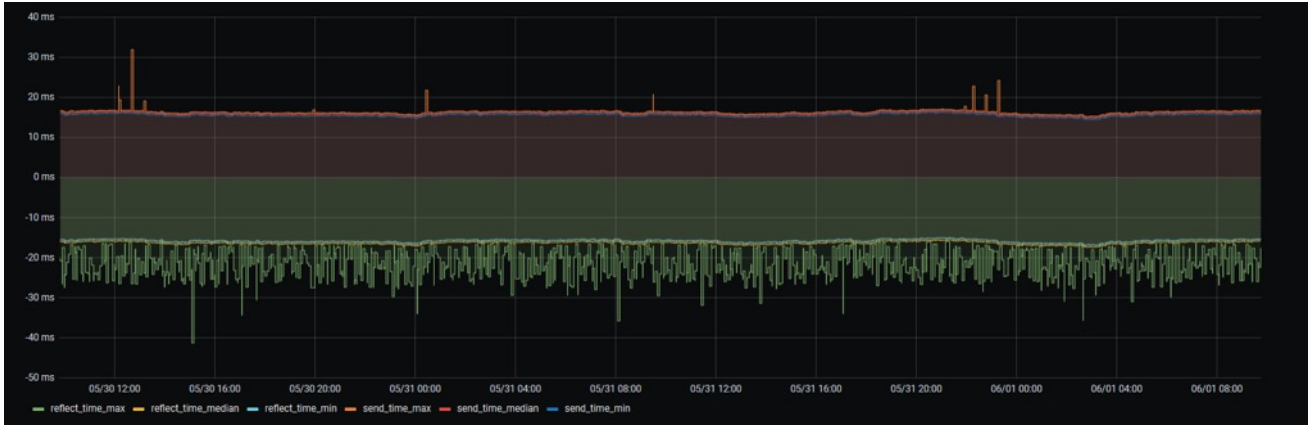


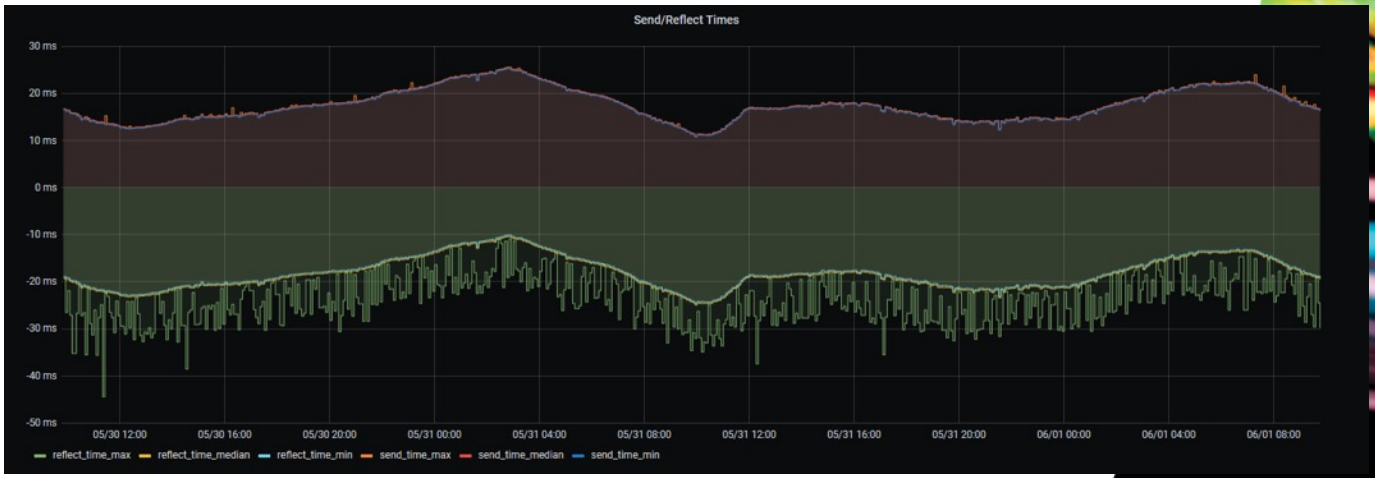
Re-routing


Source
rt2.tal.ee.geant.net
Destination
lo0.mx1.ham.de.geant.net
RTT
24H
40 ms
35 ms
30 ms
25 ms
20 ms
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00
02:00
04:00
06:00
08:00

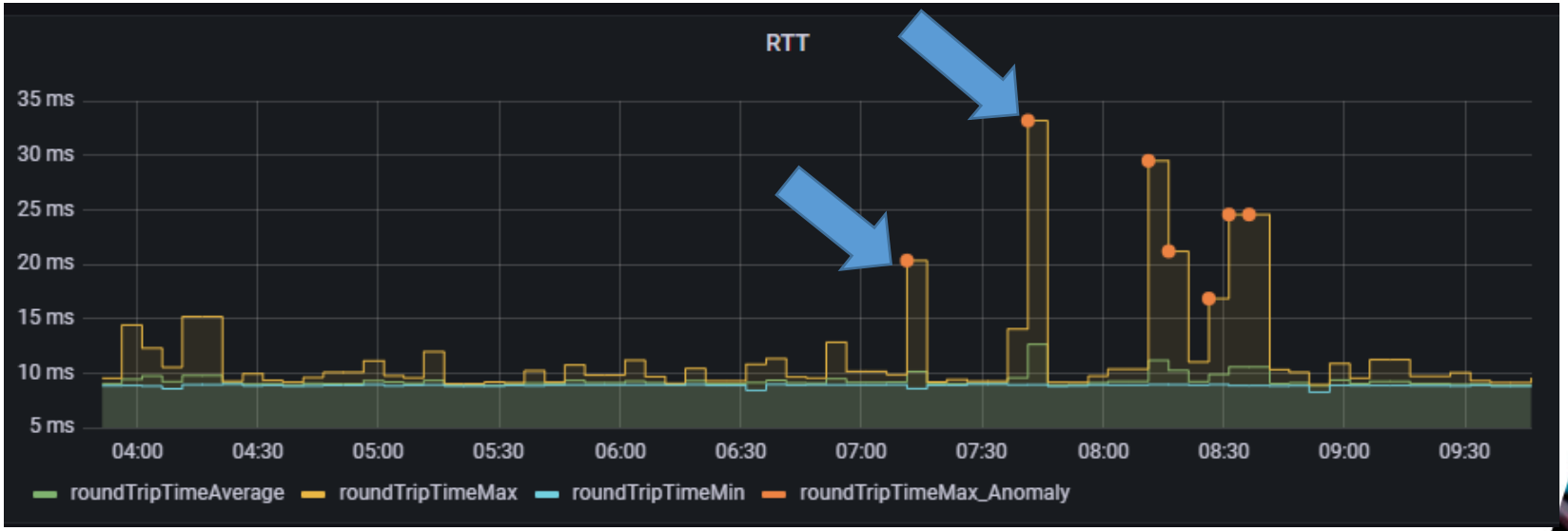

Source
rt2.tal.ee.geant.net
Destination
lo0.mx1.ham.de.geant.net
RTT
Zoom 6H
25 ms
24 ms
23 ms
22 ms
21 ms
20 ms
17:00
17:30
18:00
18:30
19:00
19:30
20:00
20:30
21:00
roundTripTimeAverage
roundTripTimeMax
roundTripTimeMin

Trends (clocks shifting?)

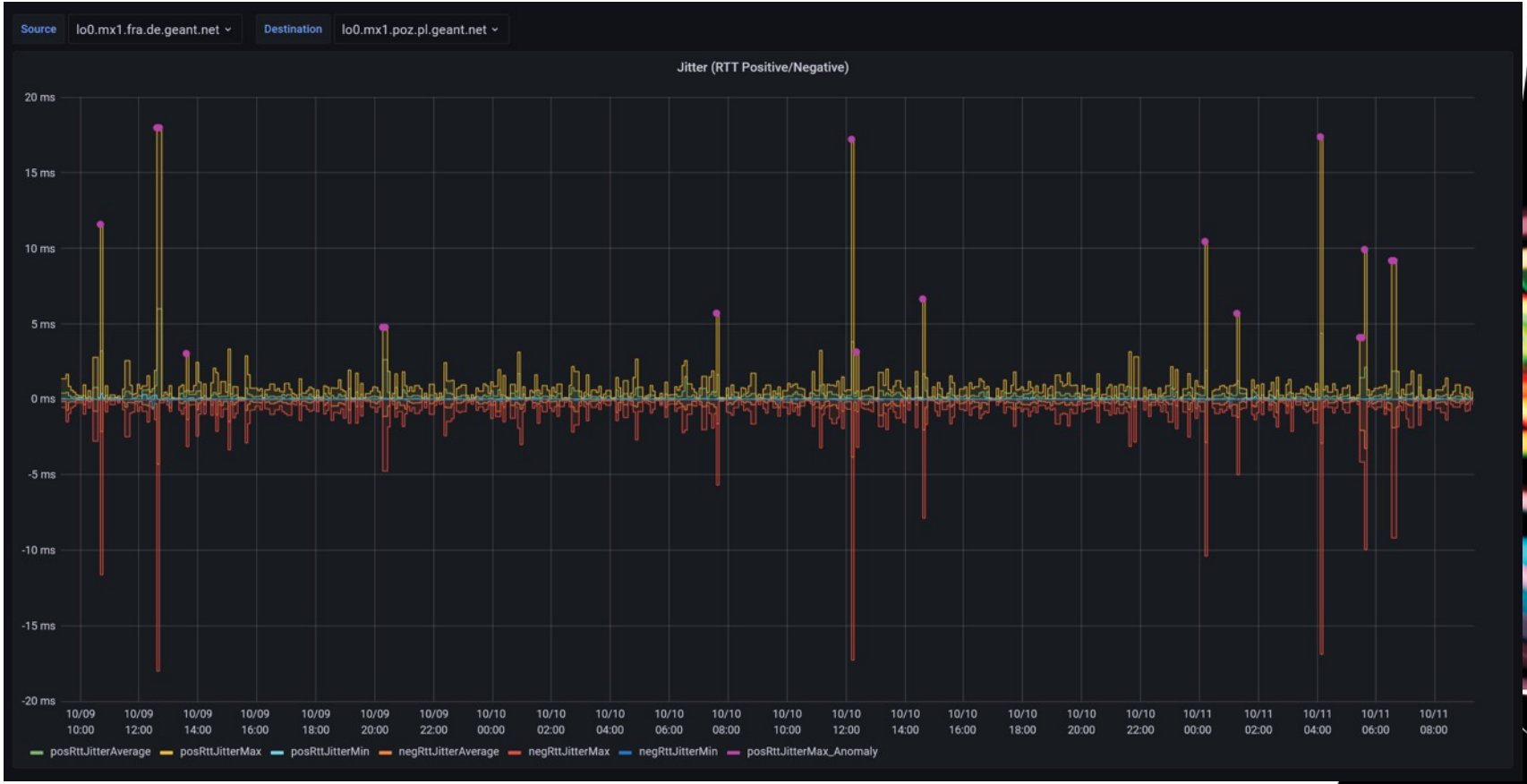




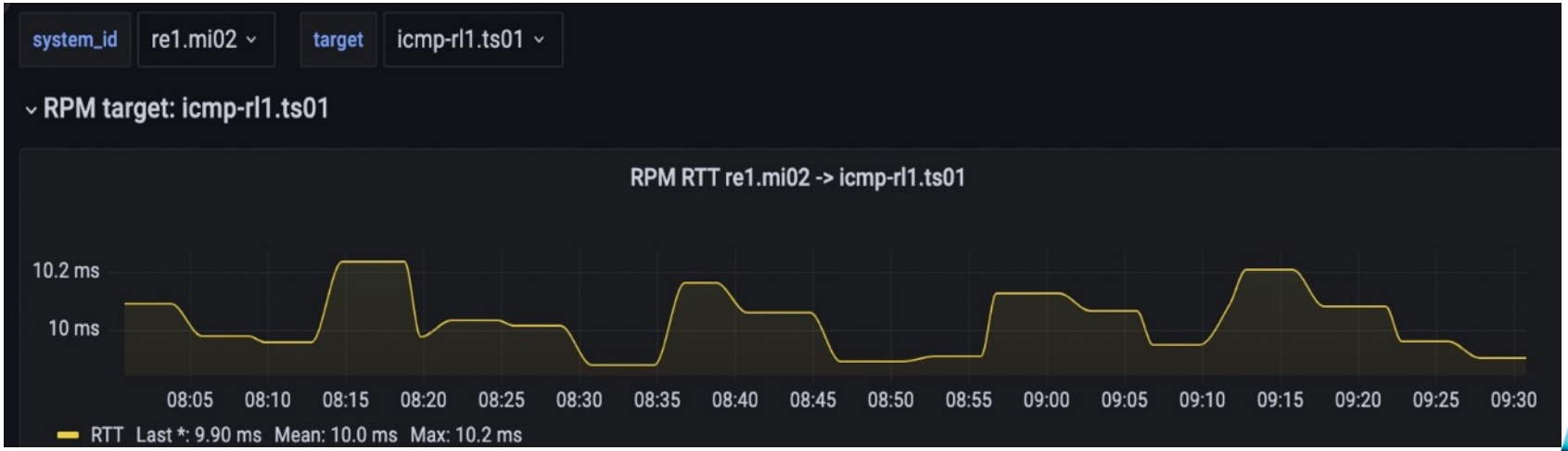
Anomaly Detection (AD) in Timemap



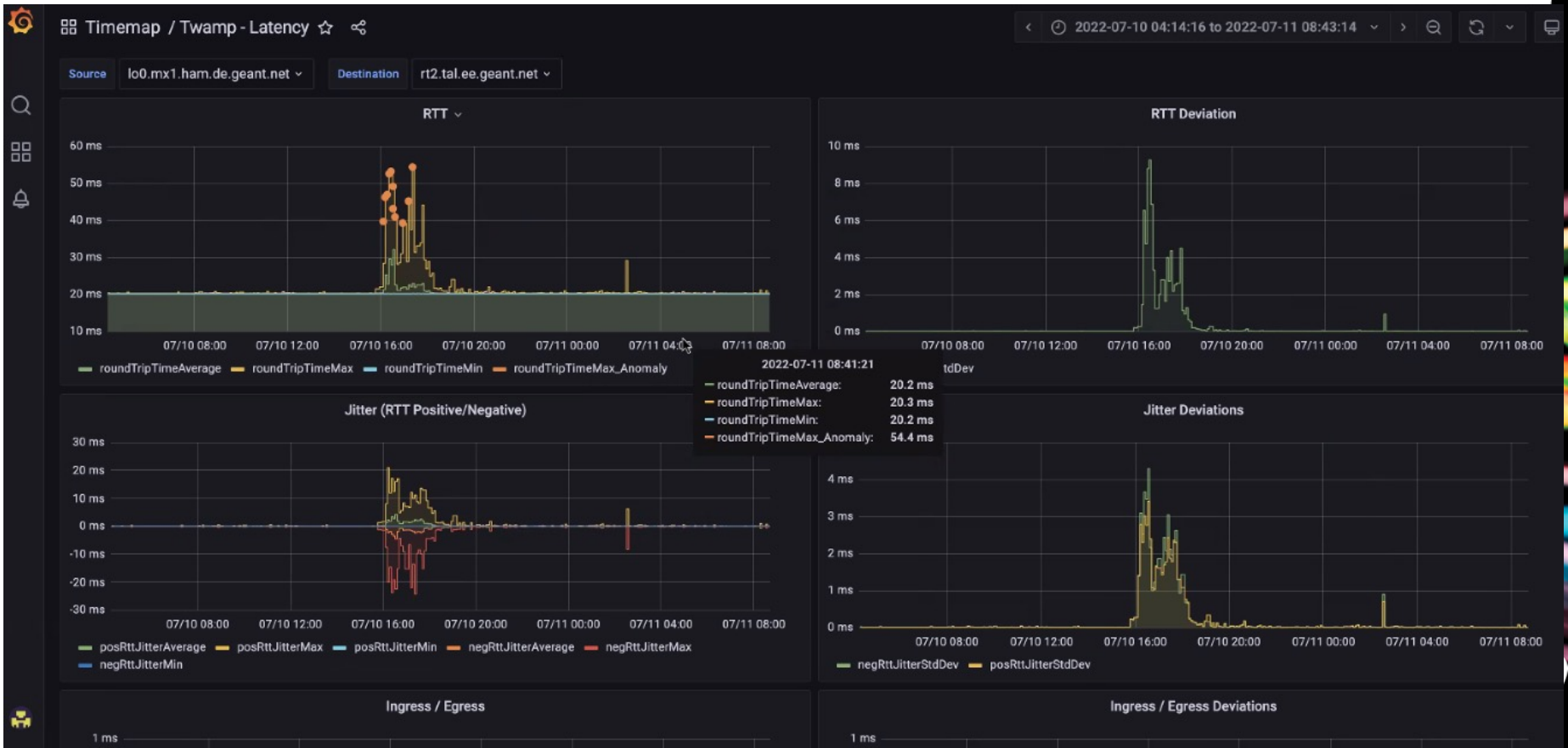
One more plot



Equal Cost Multipath Protocol (ECMP) effects

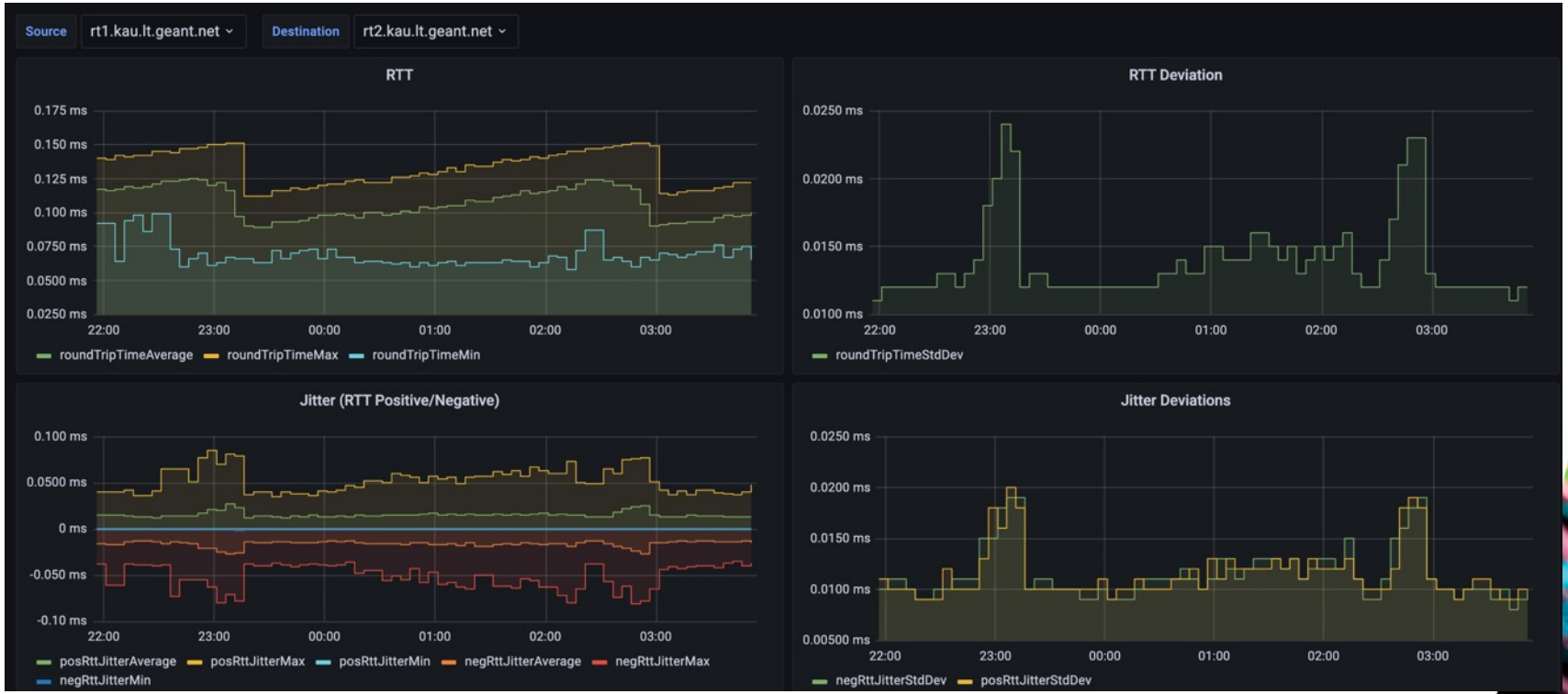


«non-identified event»



«non-identified event»

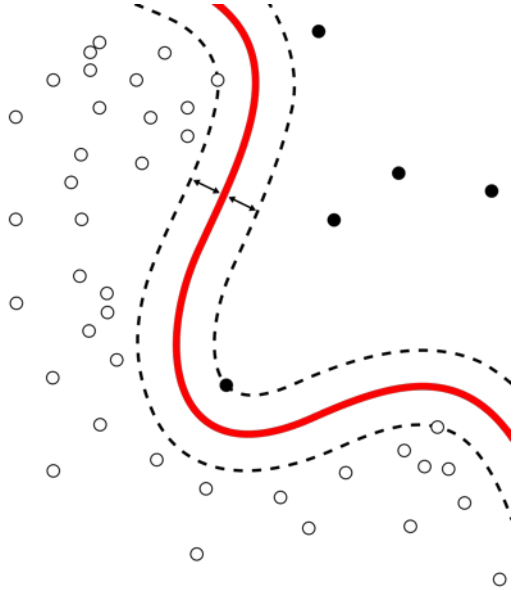
«non-identified event»



The research: Anomaly Detection (AD) in Timemap requirements

- Move beyond the simple observation
  - AD for Analytics and Alerting
  - Co-occurring events correlation

- Requirements on AD machine learning
  - Real-time or micro-batch learning/inference
  - Robust estimation
  - Light footprint

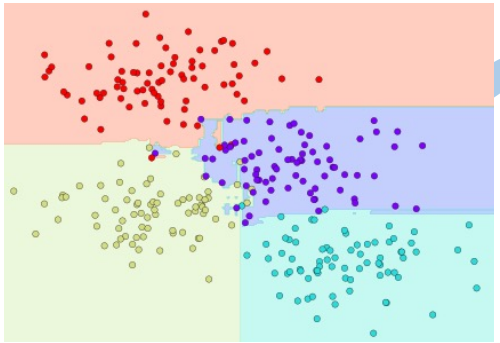


Anomaly Detection in Timemap – toolset

- Anomaly Detection, in short
  - Std.Dev classification
  - Unsupervised
  - Sensible to overfit

- Streaming ML in Python
  https://riverml.xyz

Half-space Random Trees

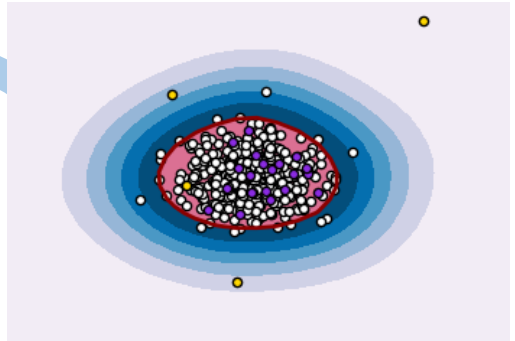


3σ

3σ

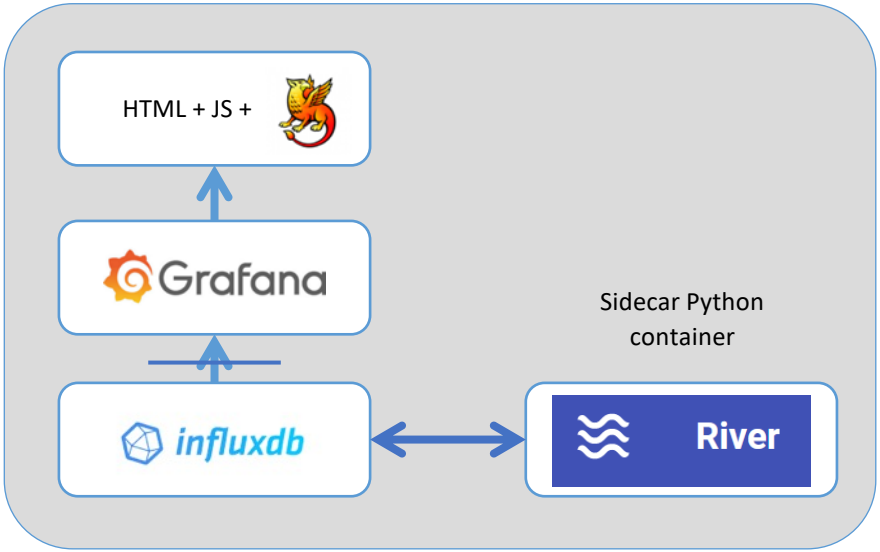
Model bagging

One-class Support Vector Machine

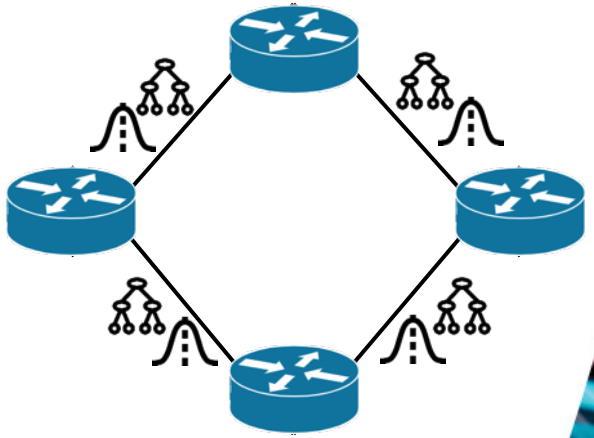


Anomaly Detection in Timemap – architecture

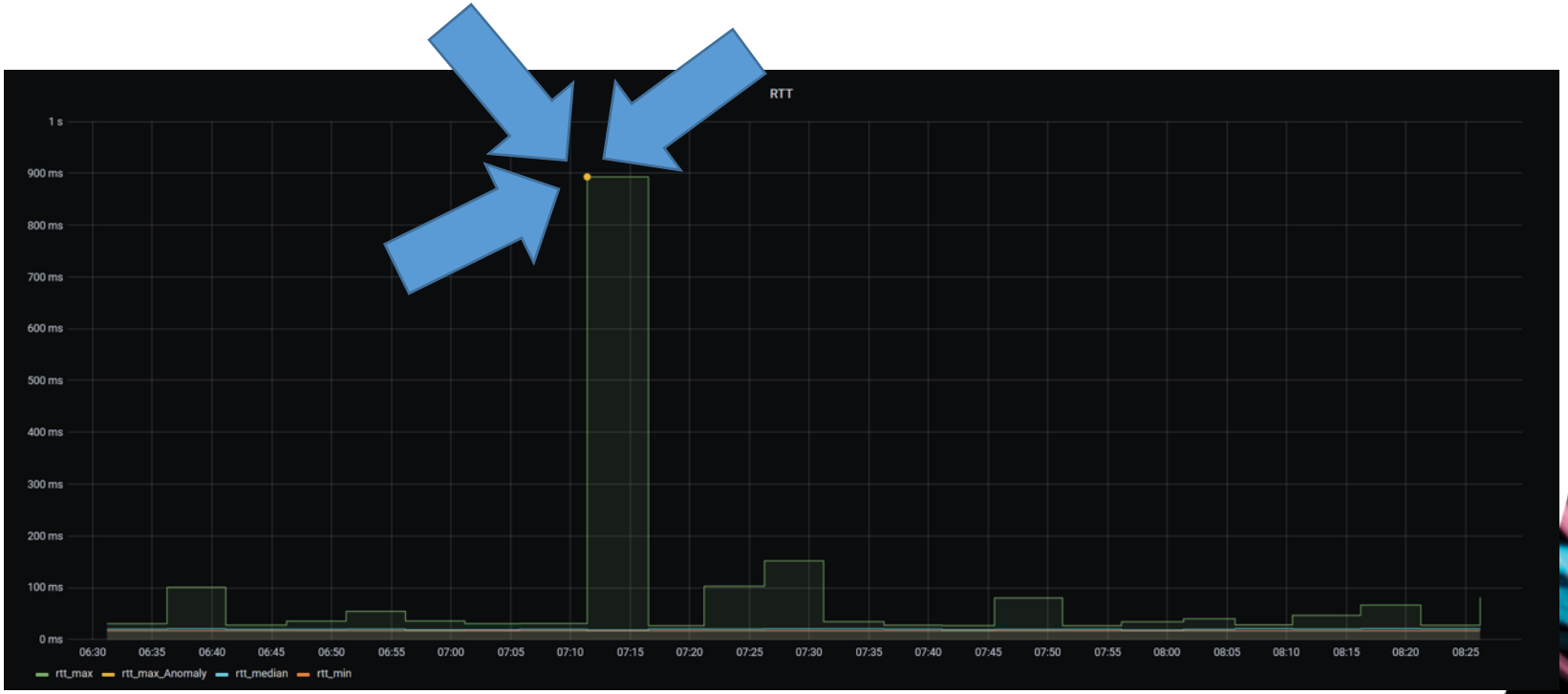
Software architecture extension



Network topology and ML models



Almost the same look and feel



More about TimeMap

- The service on GEANT backbone

https://timemap.geant.org/

- Documentation: source code, user and admin guides, customization

https://gitlab.geant.org/gn4-3-wp6-t1-lola/timemap_public

https://timemap.geant.org

Current Status

- TimeMap is a new service in production for GÉANT

- Next steps
  - More deployments @NRENs
    - Timemap @ GARR
    - DeIC is deploying TimeMap
    - Sikt is assessing TimeMap
  - Anomaly Detection
    - Up and running, Streaming ML, multi-model over network topology
    - About 200 lines of code in a Docker image
    - New feature-rich algorithms in development
  - New usage
    - Inter-Domain
    - Measure not only 1 segment (a path or a part of path)
    - Improve anomaly detection for BGP rerouting, clock drifting, …
    - Characterize the behavior model for a link thanks to AI (ambitious)

Just to repeat …

- The service on GEANT backbone

https://timemap.geant.org/

- Documentation: source code, user and admin guides, customization

https://gitlab.geant.org/gn4-3-wp6-t1-lola/timemap_public

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Thank you!

Do you have any questions?

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