

Extending TimeMap: novel visualization and better ML tools

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TimeMap

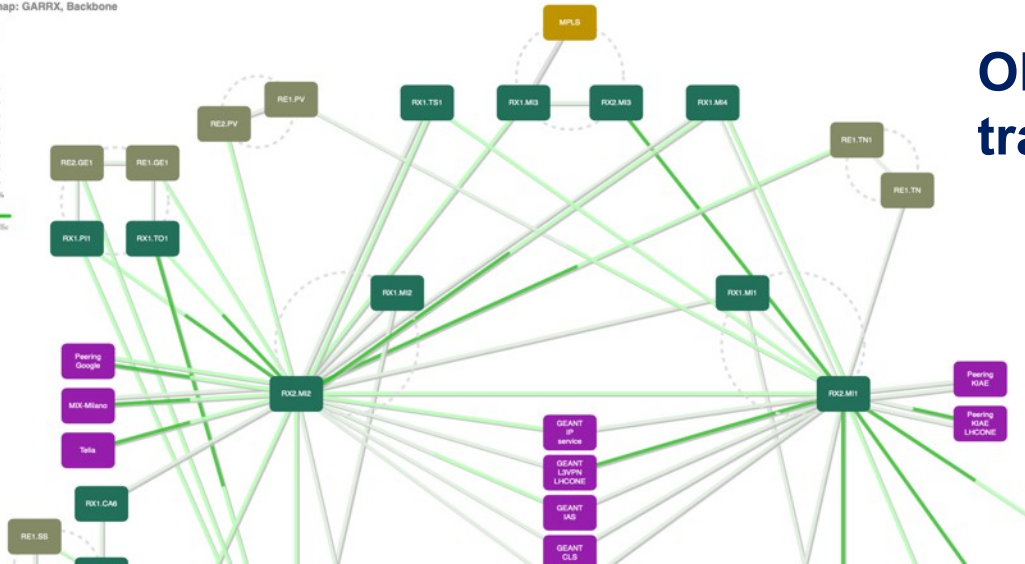
Outline

- Why TimeMap and current status
- GUI enhancement for new use-cases
- More on Anomaly Detection

Network Traffic: what do we usually monitor?

GARR Weathermap: GARRX, Backbone

Load percentage

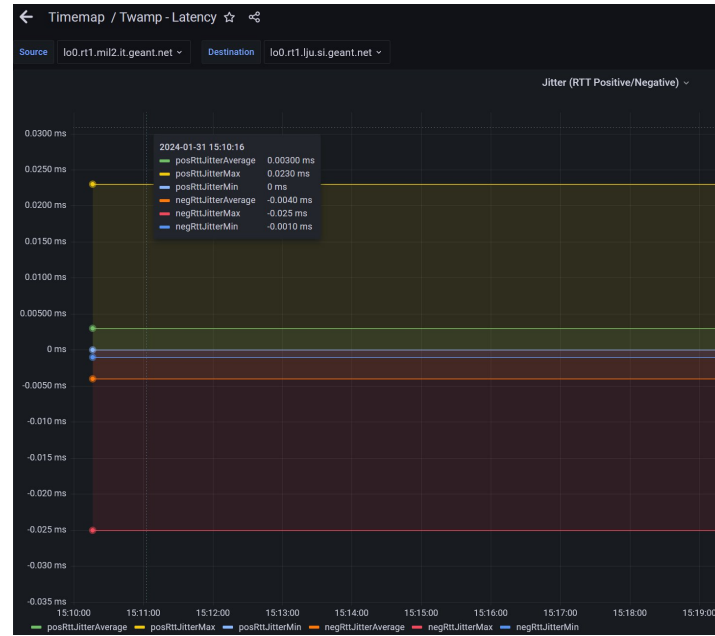
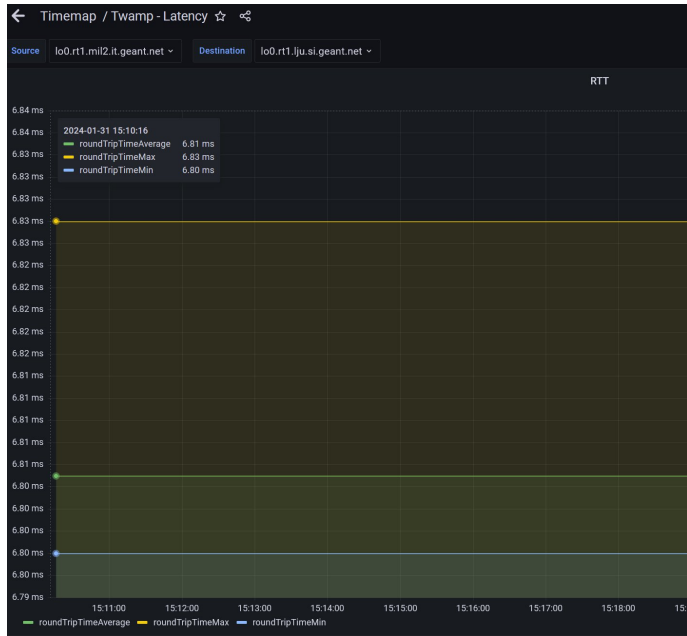


OK for bulk data transfers only

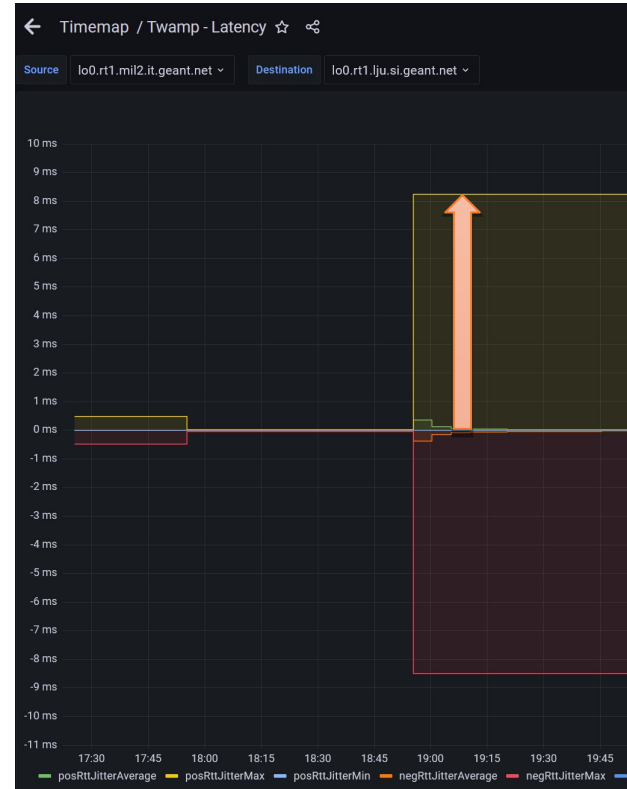
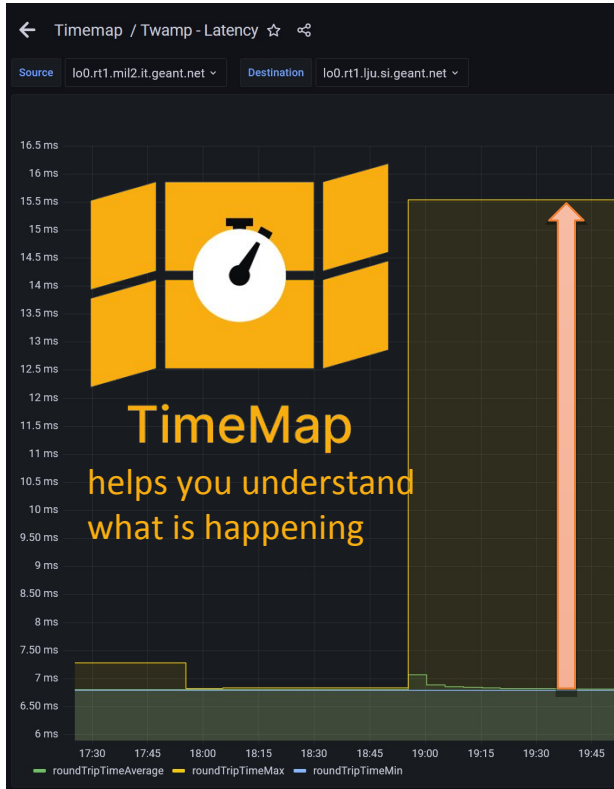
LOLA, a real-time application sensitive to Latency & Jitter



Active measurements – all network segments good 👍



During the rehearsal... 🙄



Why TimeMap

We need to monitor "the hidden"

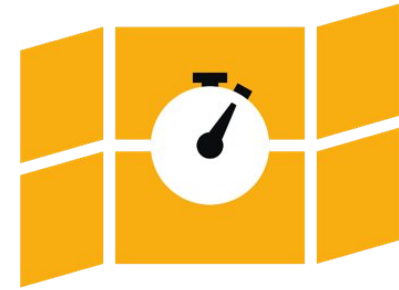
- latency
- jitter

We need to keep track of "the hidden"

- historic series

We need to find anomalies in "the hidden"

- machine learning
- alarms
- call the right NOC for the right network segment



TimeMap

TimeMap technical requirements

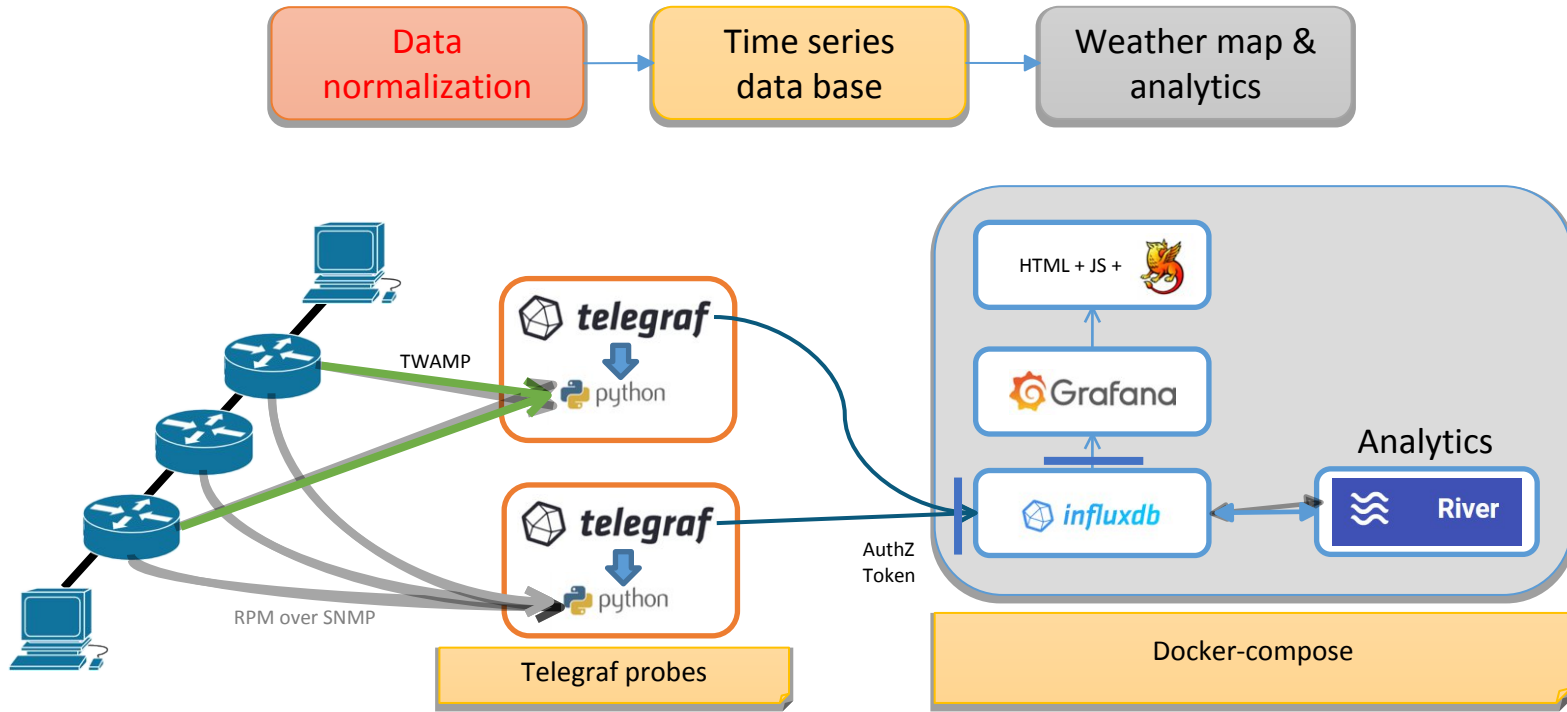
Agile design:

- Scalable micro-services, easy to deploy, **minimal custom code**
- As neutral as possible: **monitoring standards and FOSS**

- Security, with federated access control
 - **eduGAIN** authentication
 - Role Based Access Control, API tokens, multi-tenancy

- **Dynamic**: almost no changes needed when networks change

TimeMap architecture



Current Status: TimeMap instance for the GÉANT backbone

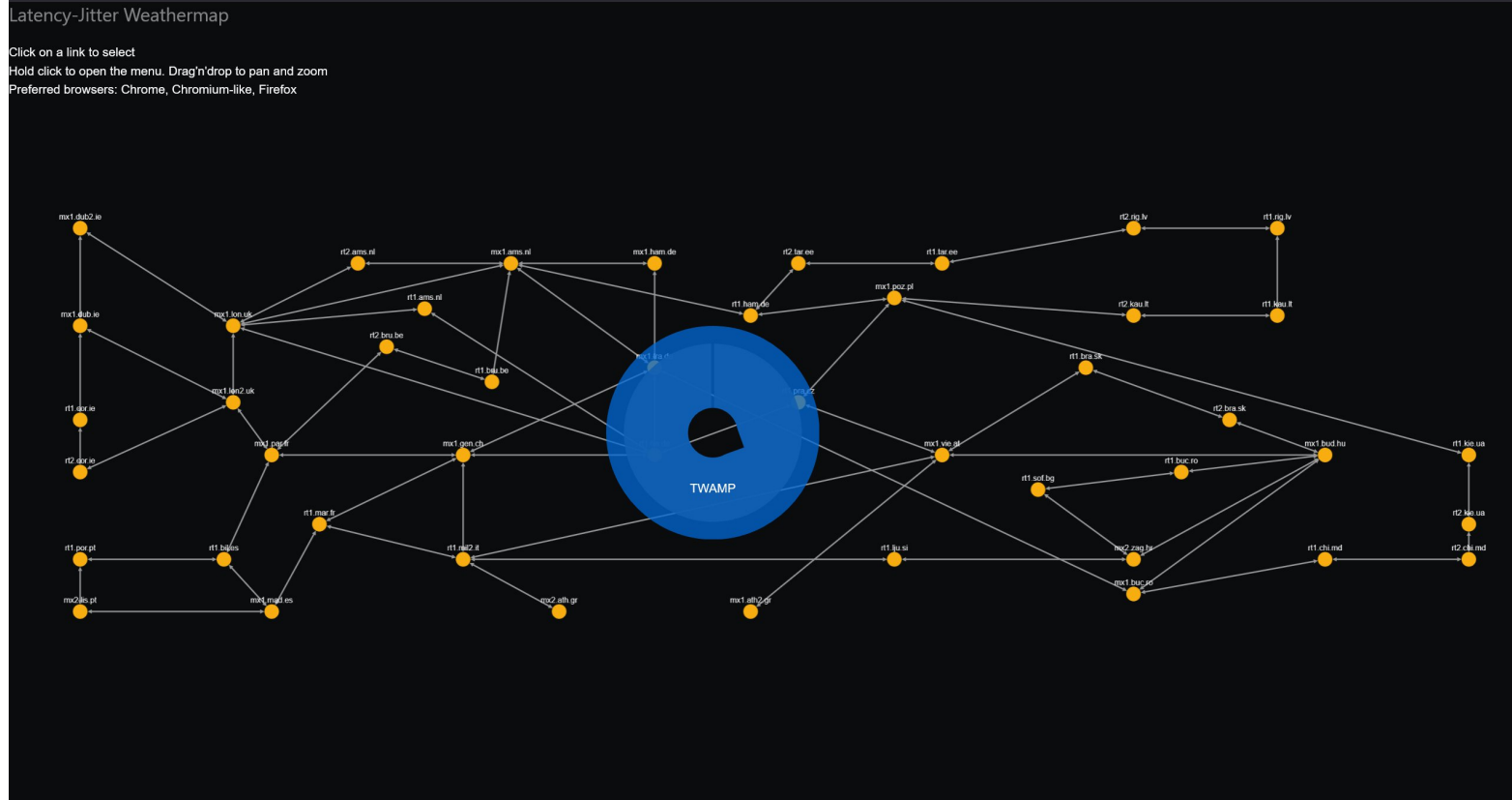
- The service on GEANT backbone

<https://timemap.geant.org/>

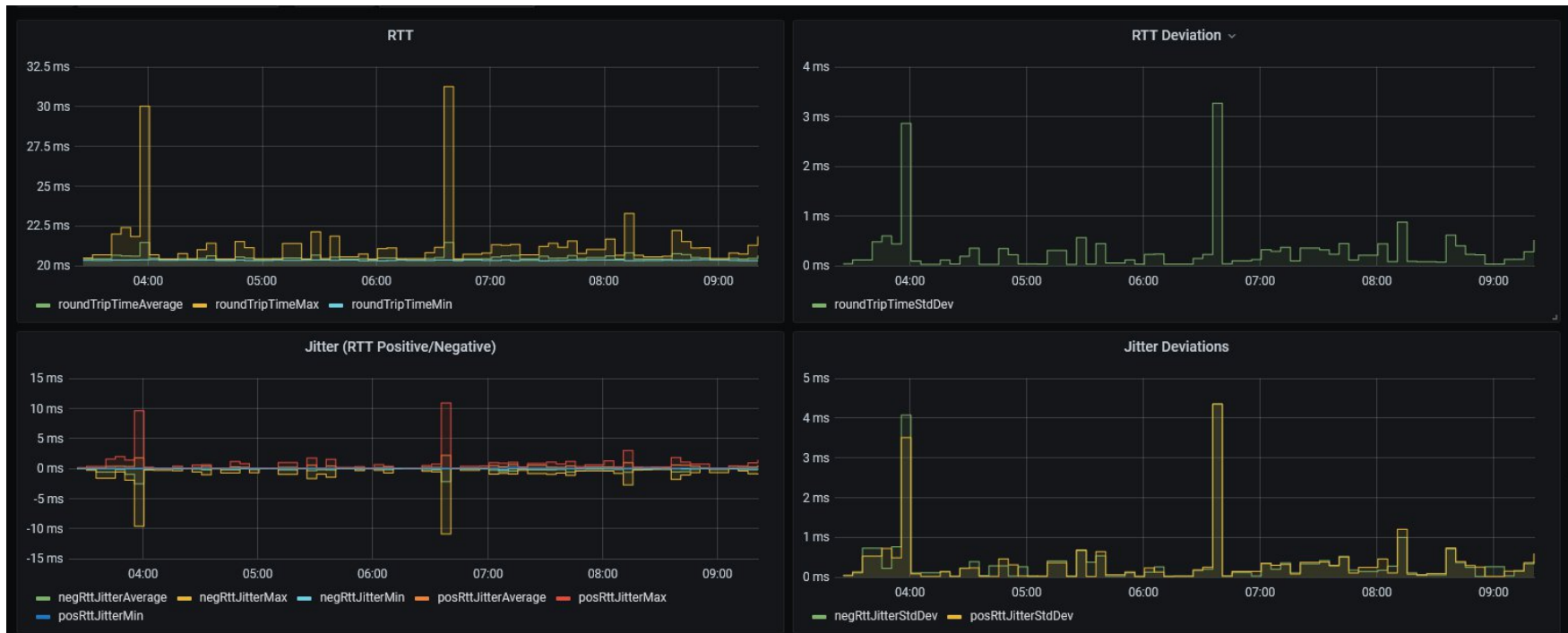
- Documentation: source code, user and admin guides, customization

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

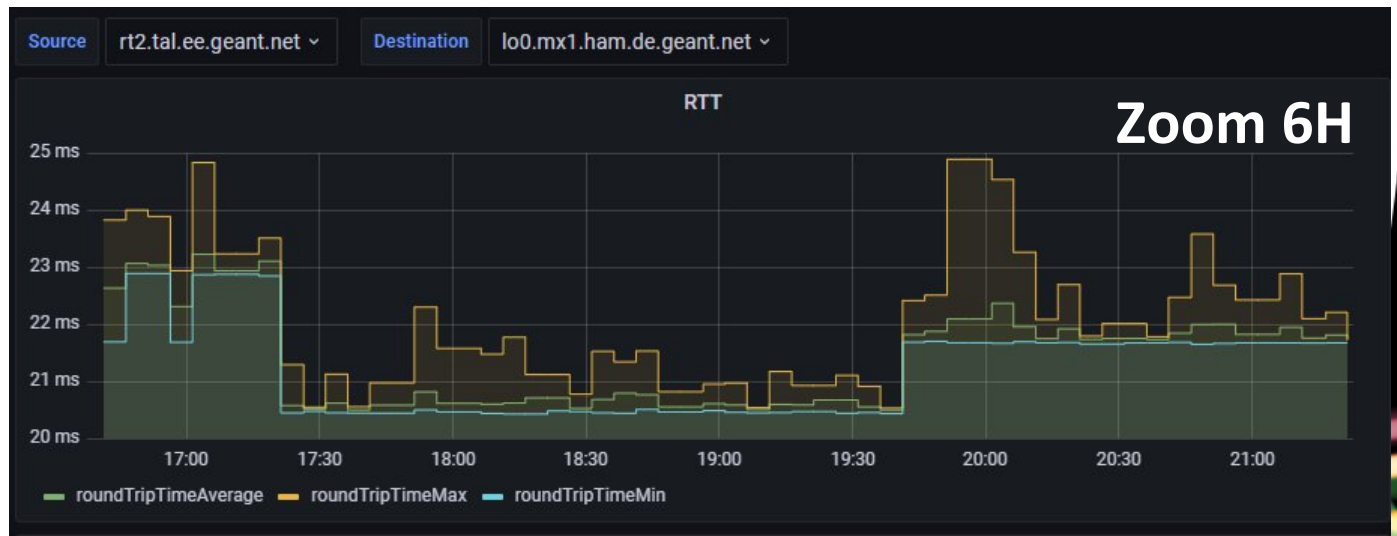
The entry map page: right-click on link



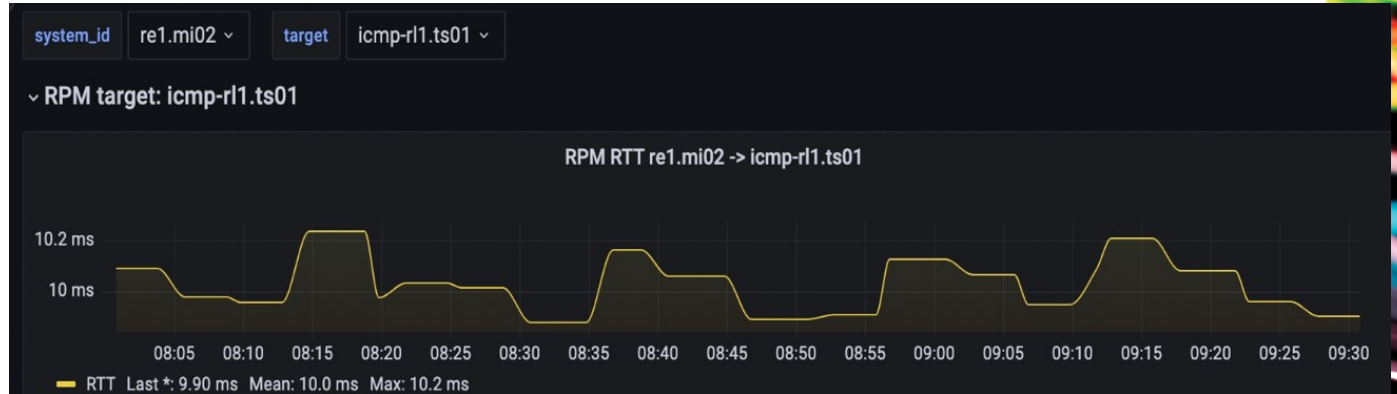
Observations



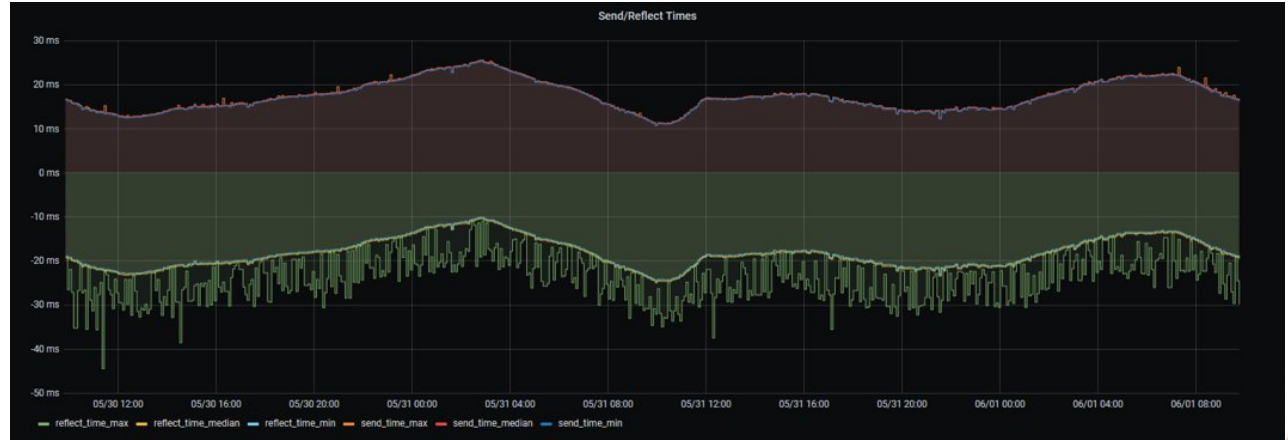
Re-routing



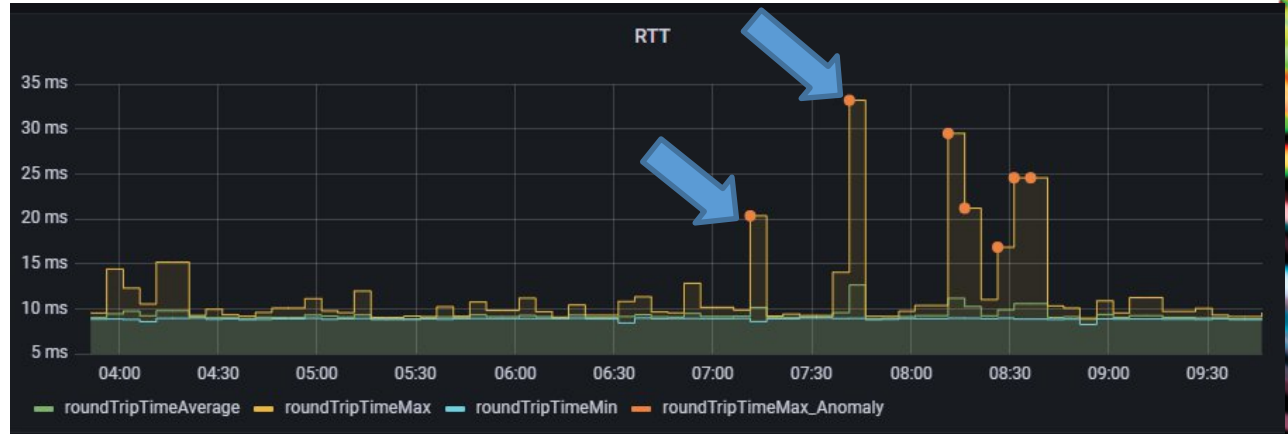
ECMP effects



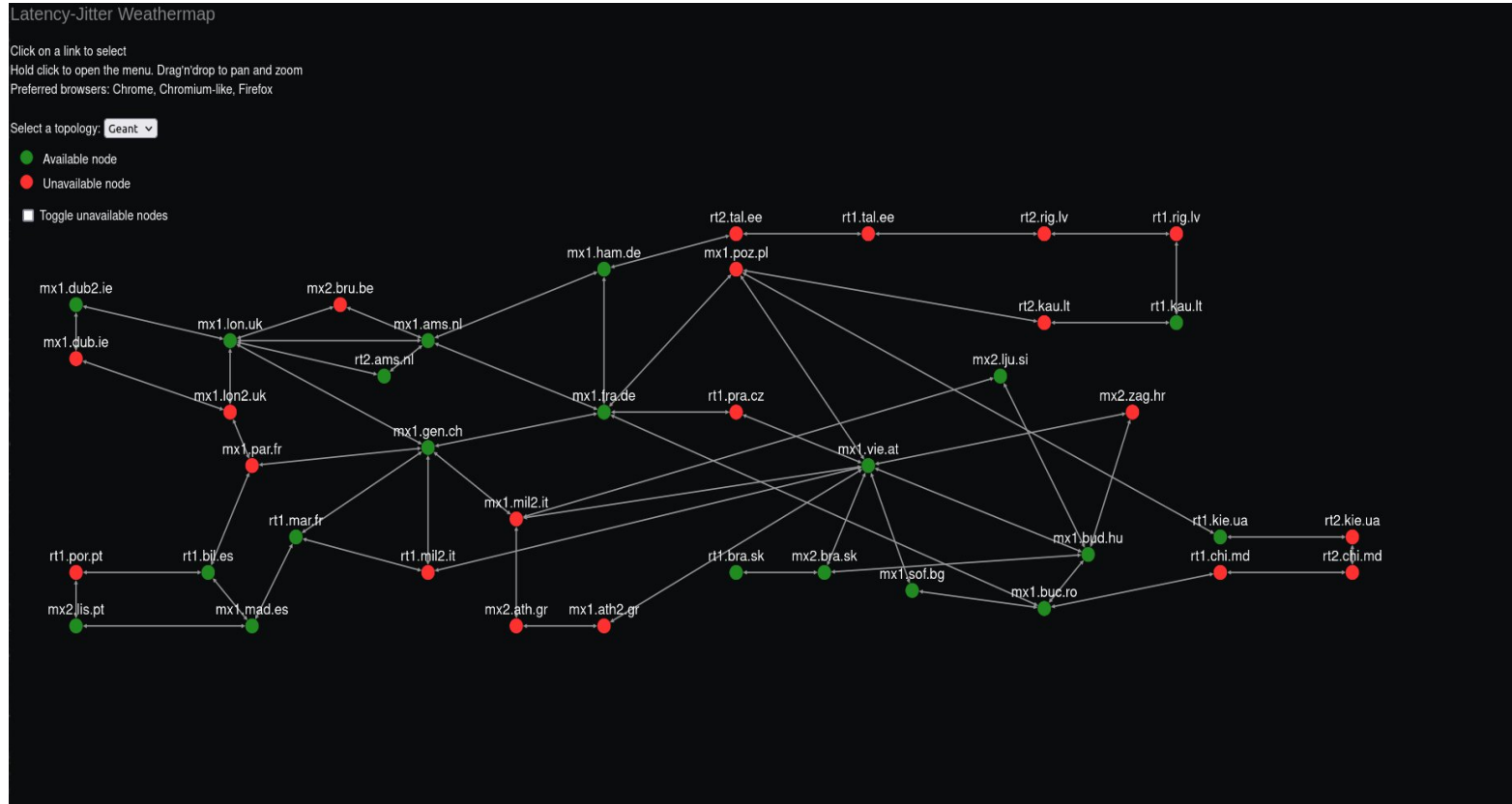
Trends (clocks shifting?)



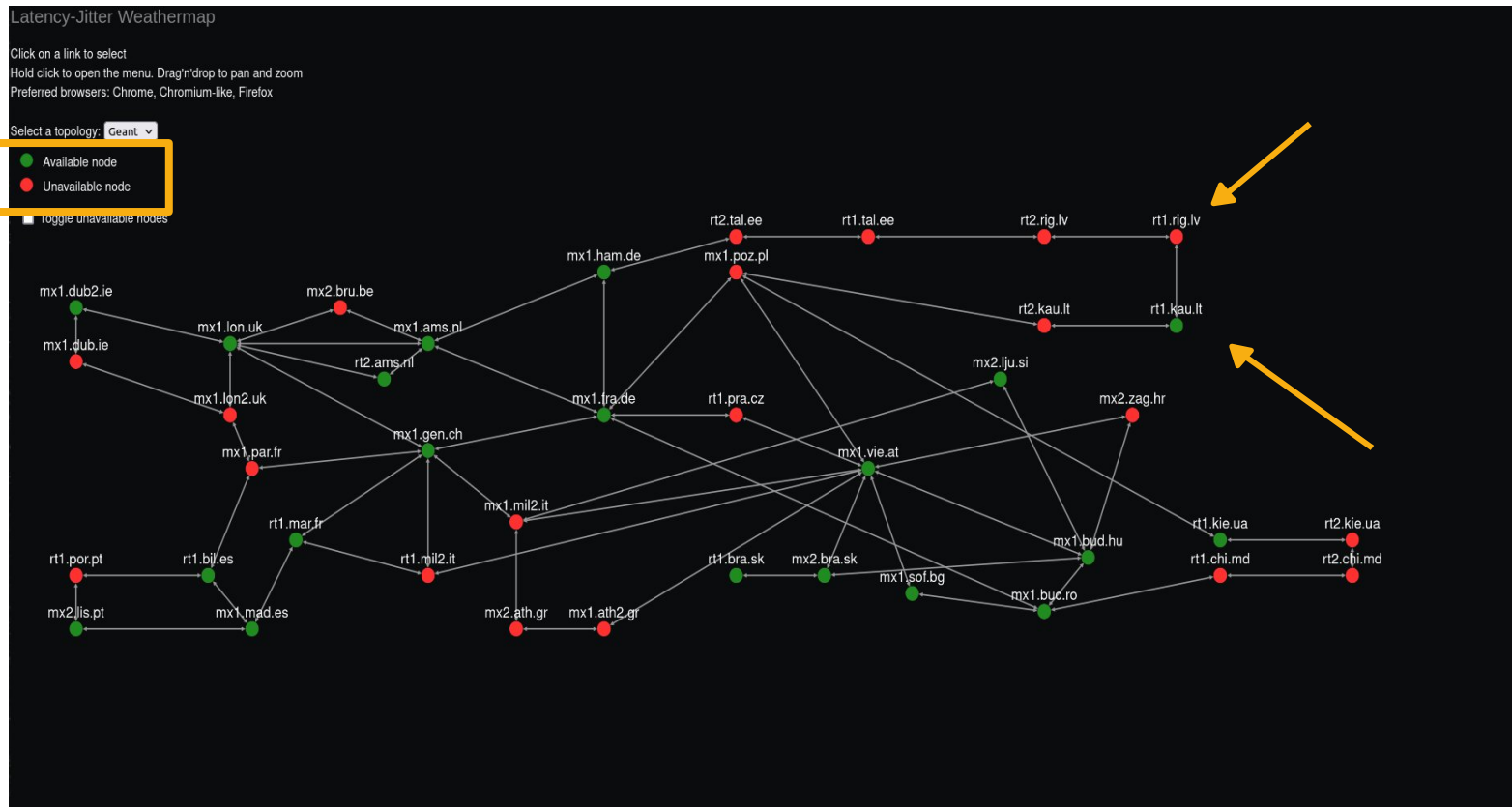
Anomaly Detection in action



GUI enhancement to support new use-cases



GUI enhancement to support new use-cases

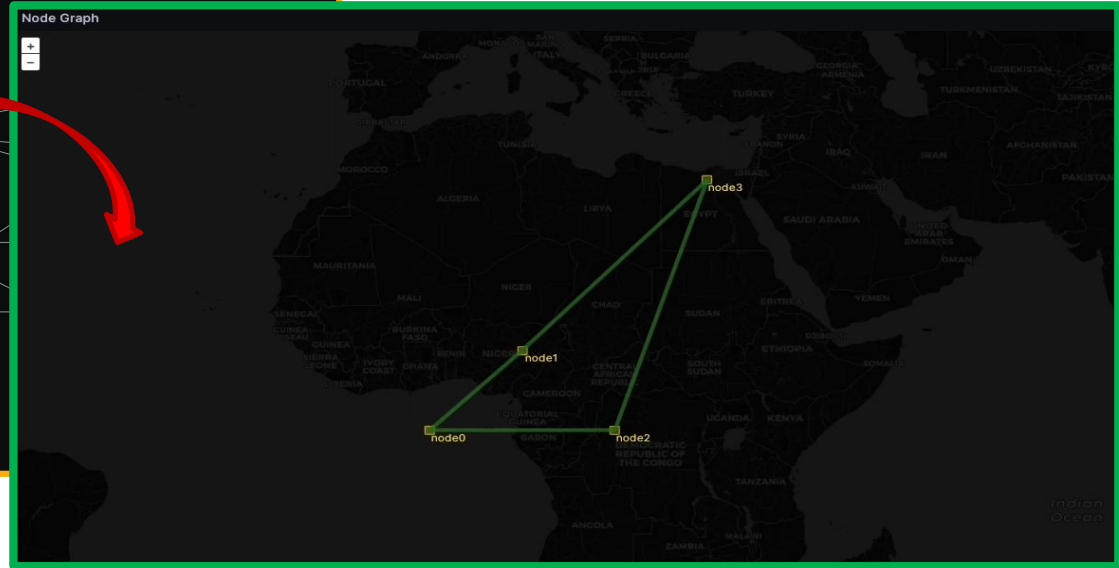
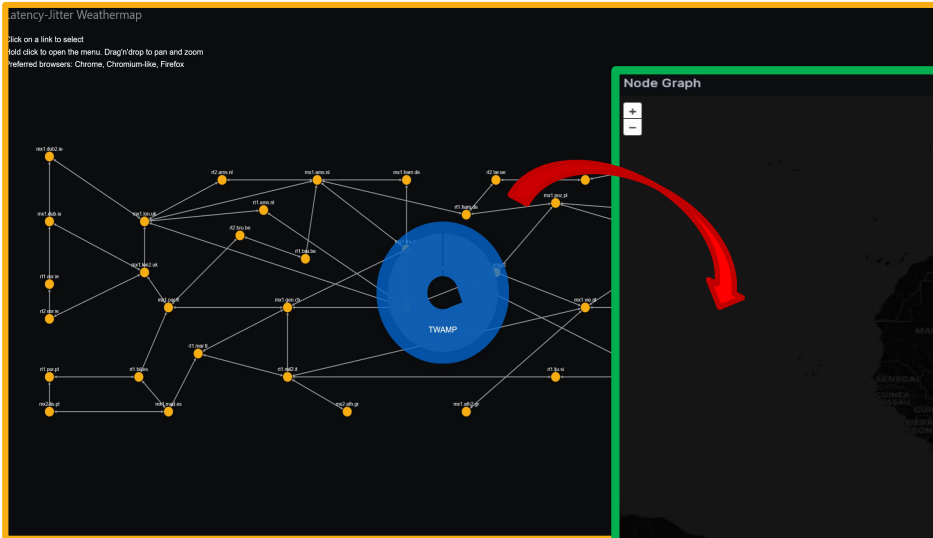


Future of the Graphic User Interface?

Keep improving our custom implementation?

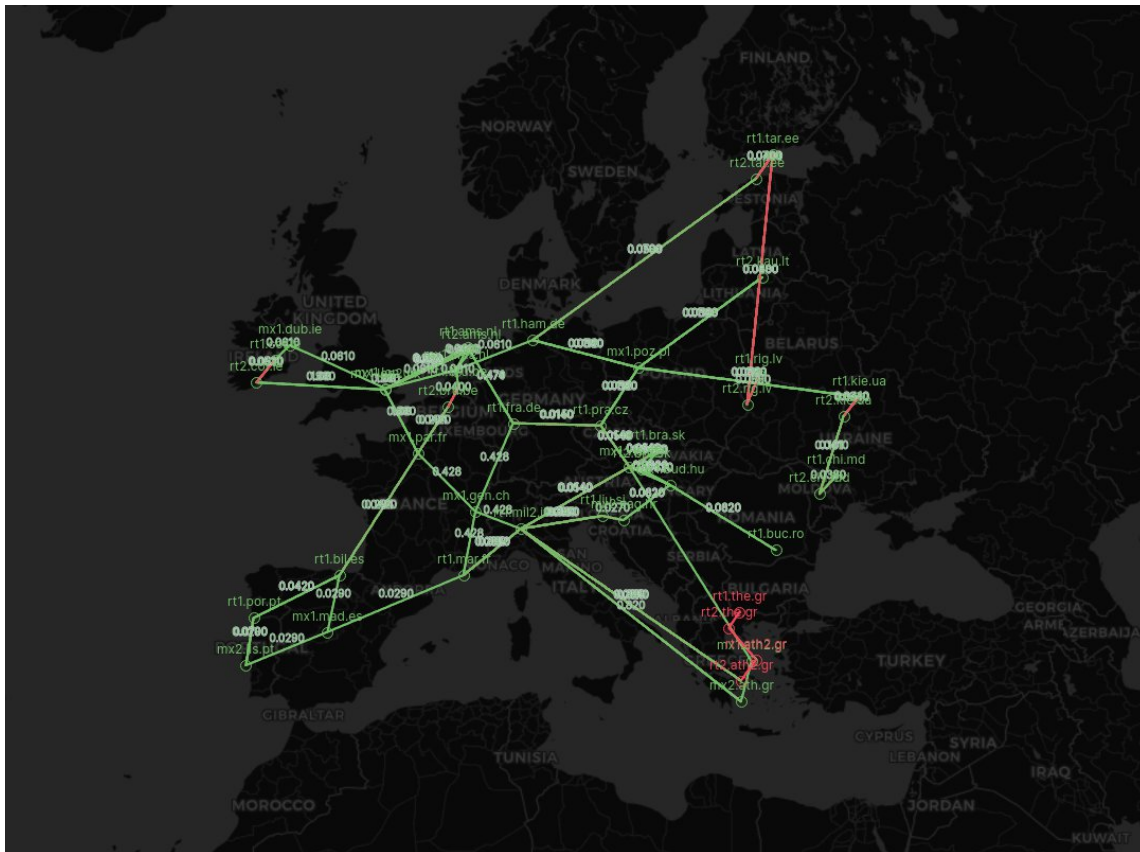
VS

Grafana Geomaps?



<https://grafana.com/docs/grafana/latest/panels-visualizations/visualizations/geomap/#network-layer-beta>

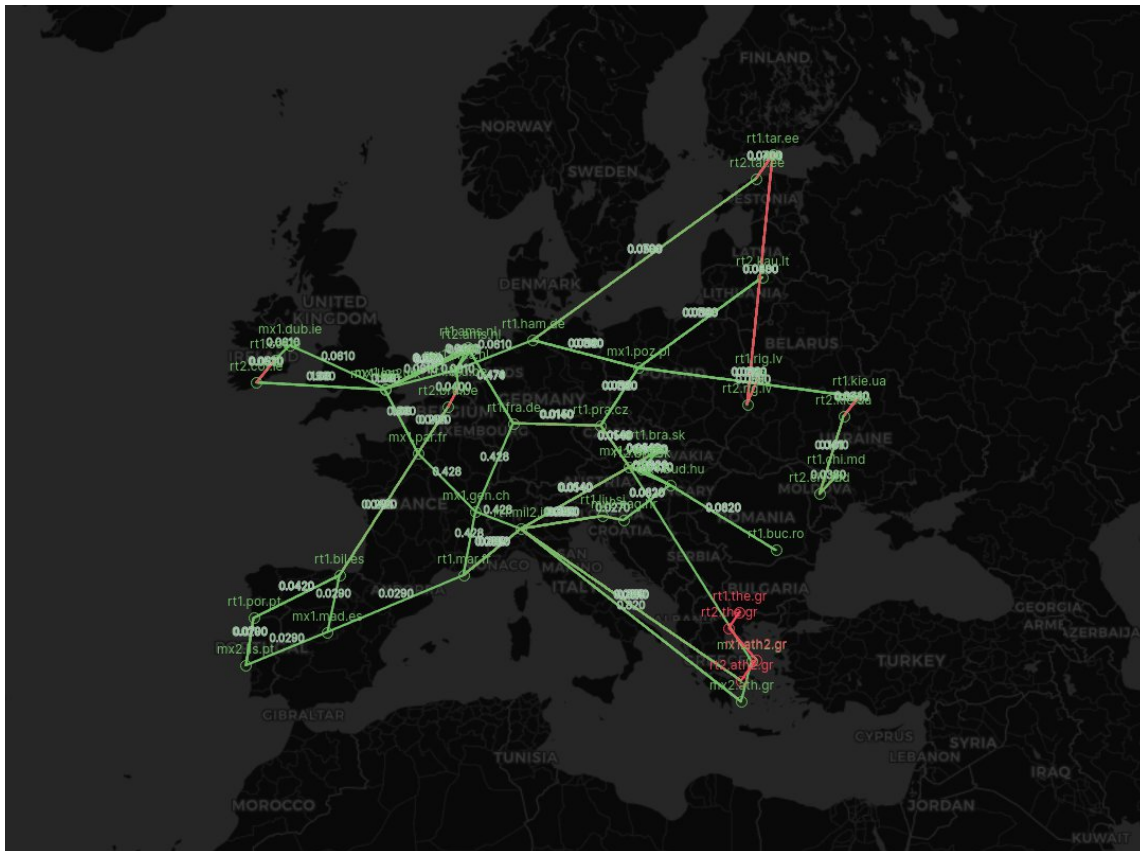
On-going – GeoMap visualization drawbacks



Pros:

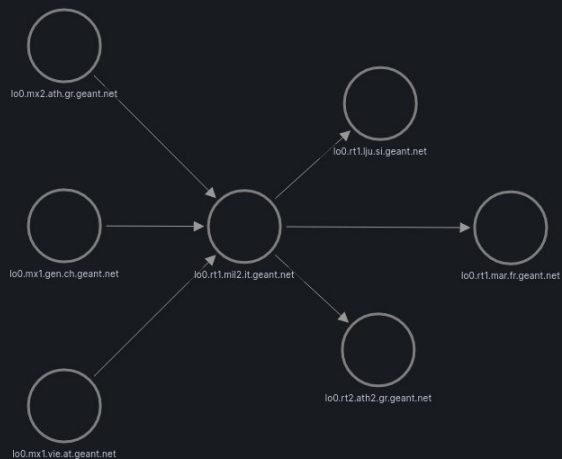
- Topology overlay on geographical map
- No more custom code
- Dynamic topology evolution
- Measurements on display directly the on graph

On-going – GeoMap visualization drawbacks



Cons:

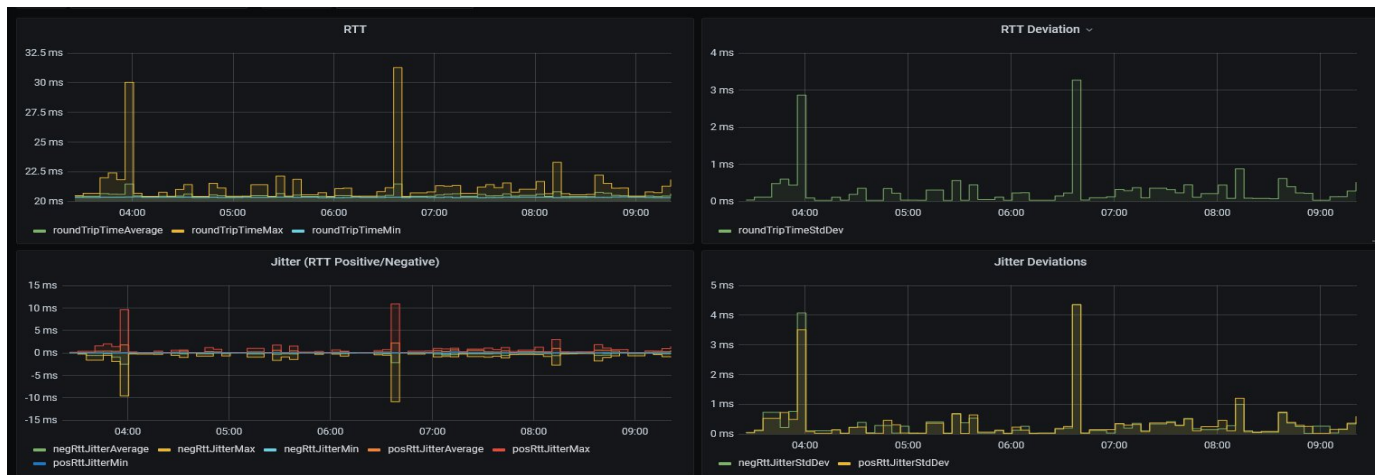
- Data pipelines have to be compliant with Grafana inputs
- The Grafana network layer visualization is still in beta



On-going - GUI with Grafana NodeGraph

In addition to the normal link measurements visualization

- Preview of the **dynamic** sub-graph on Milan



On-going - GUI with Grafana NodeGraph

Node graph Beta



- **Router sub-graph**

Maintains local spatial information about the topology also the detailed metrics dashboard

— Average response time — Transactions per minute — Success — Faults — Errors — Throttled

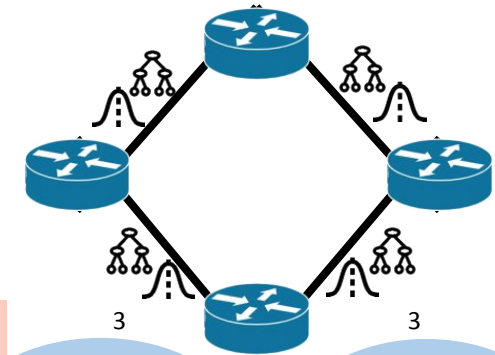


Anomaly Detection in Timemap – current toolset

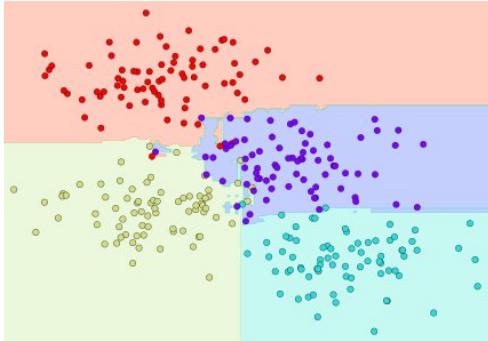
- Anomaly Detection, in short

- Std.Dev classification
- Unsupervised
- Sensible to overfit

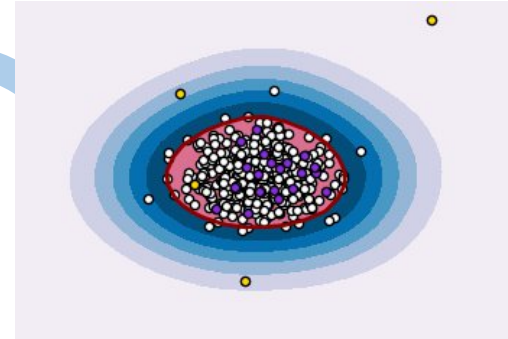
- Streaming Machine Learning
- Light footprint
- Python <https://riverml.xyz>



Half-space Random Trees



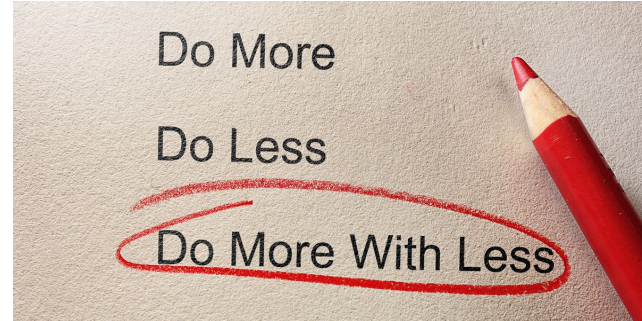
One-class Support Vector Machine



Model bagging

Improving TimeMap current data handling toolset

- Areas of improvement
 - Data handling
- Opportunities
 - Pandas data workflow

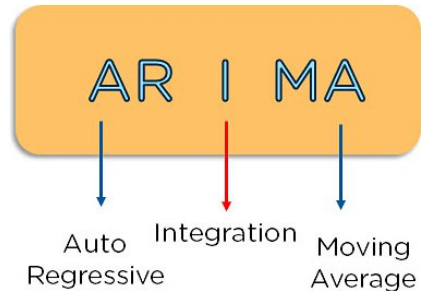
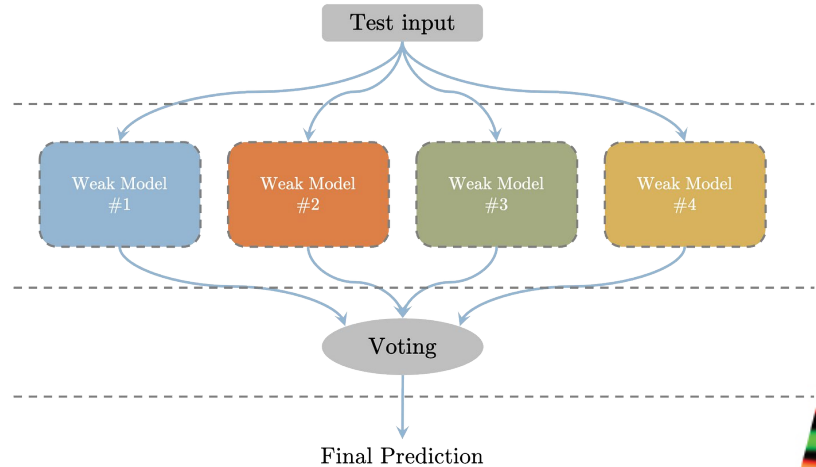


- Upsides:
 - Better readability
 - Less code, less effort



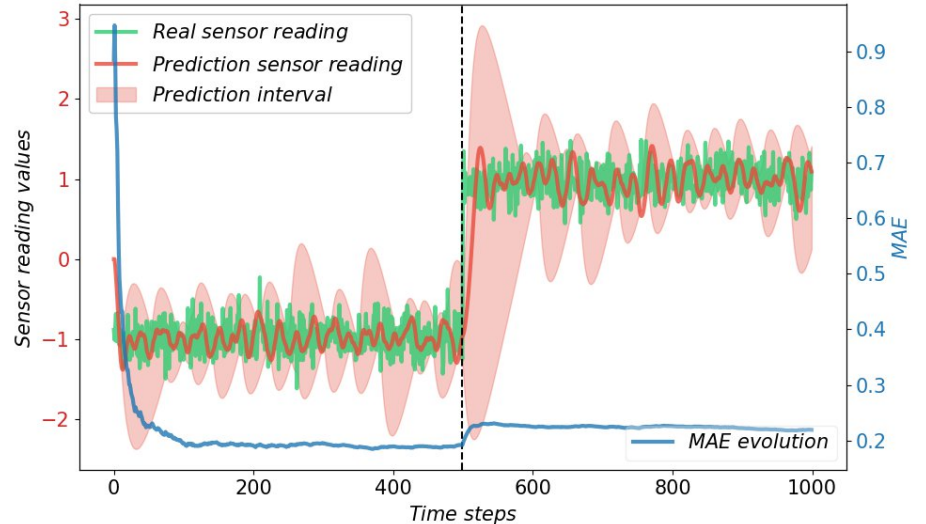
Improving Anomaly Detection in TimeMap

- Areas of improvement
 - Tackling overfitting
- Opportunities
 - Ensemble multiple models
 - Include generalized time series models



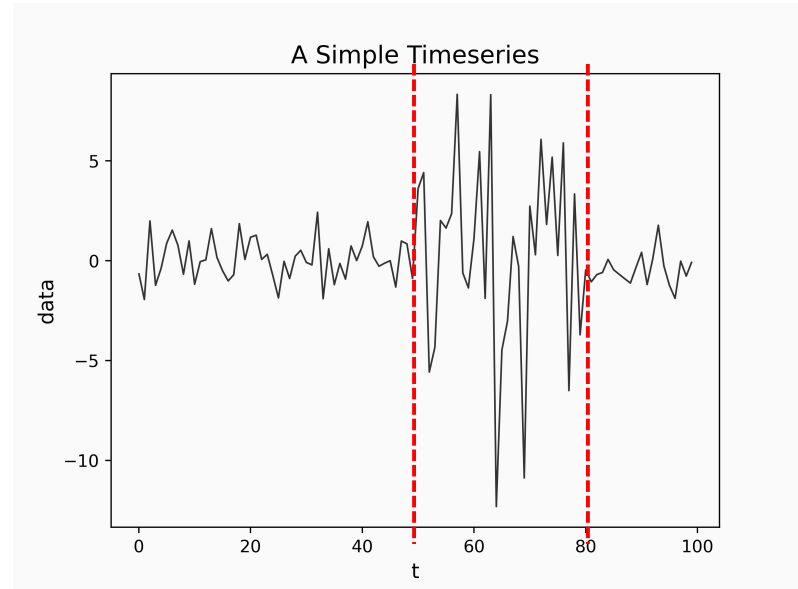
Improving Anomaly Detection in TimeMap

- Areas of improvement
 - Concept drift and data drift
- Opportunities
 - MLOps
 - Model retraining
 - Online learning
 - Model and data observability
 - Measure data distribution parameters
 - Measure model performance



Improving Anomaly Detection in TimeMap

- Areas of improvement
 - Identification of anomaly end
- Opportunities
 - Time series changepoint detection
 - Python changepoint lib



Future of Anomaly Detection in TimeMap

- Scouting novel deep learning approaches
 - Digital twin through Temporal Graph Neural Network



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Network Digital Twin

Publication Date
January 2024

Manuscript Submission Deadline
15 July 2023

Special Issue

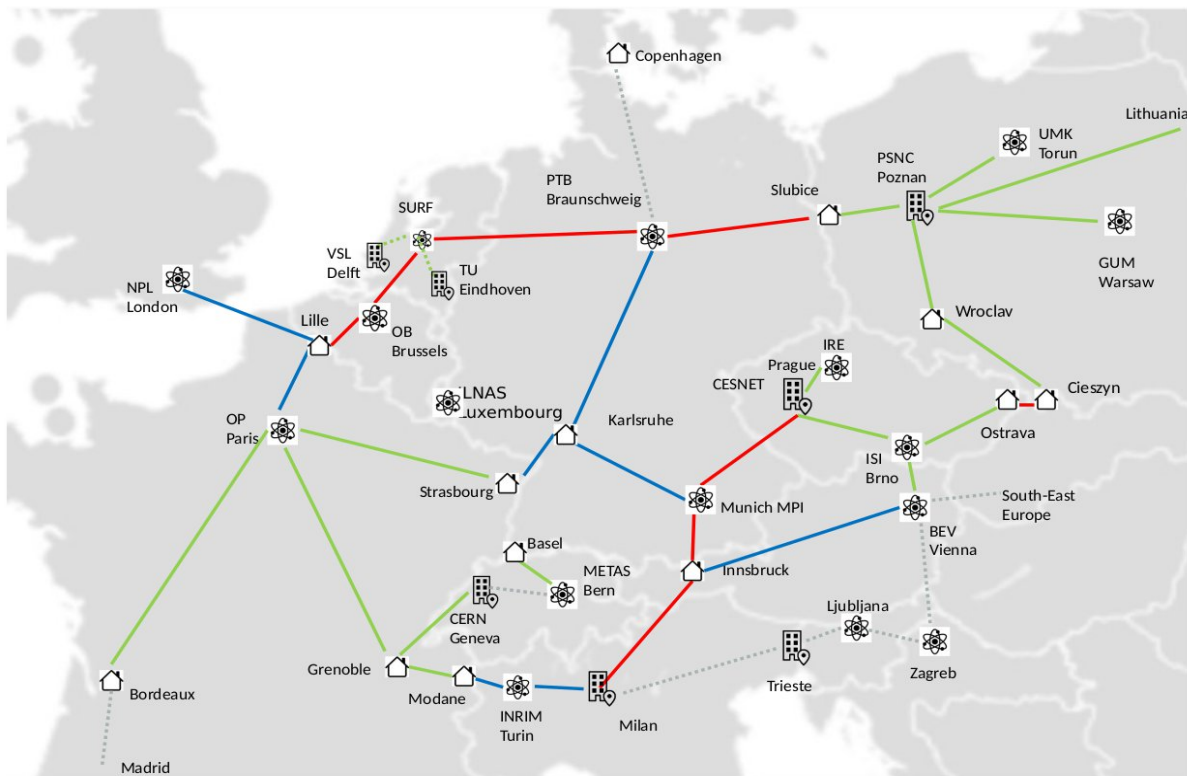
Call for Papers

[SUBMIT A PAPER](#)

“Network digital twin aims at providing a virtual representation of a physical network system that is used to simulate various design scenarios, validate policies, and assess the behavior of the network system.”

New TimeMap use cases: OTFN testbed monitoring

Proposed C-TFN

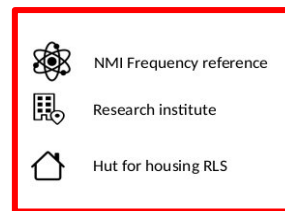


Included:

- 10-year IRU for fibre on red routes
- Bidirectional amplifiers as needed to light the fibre on the red routes

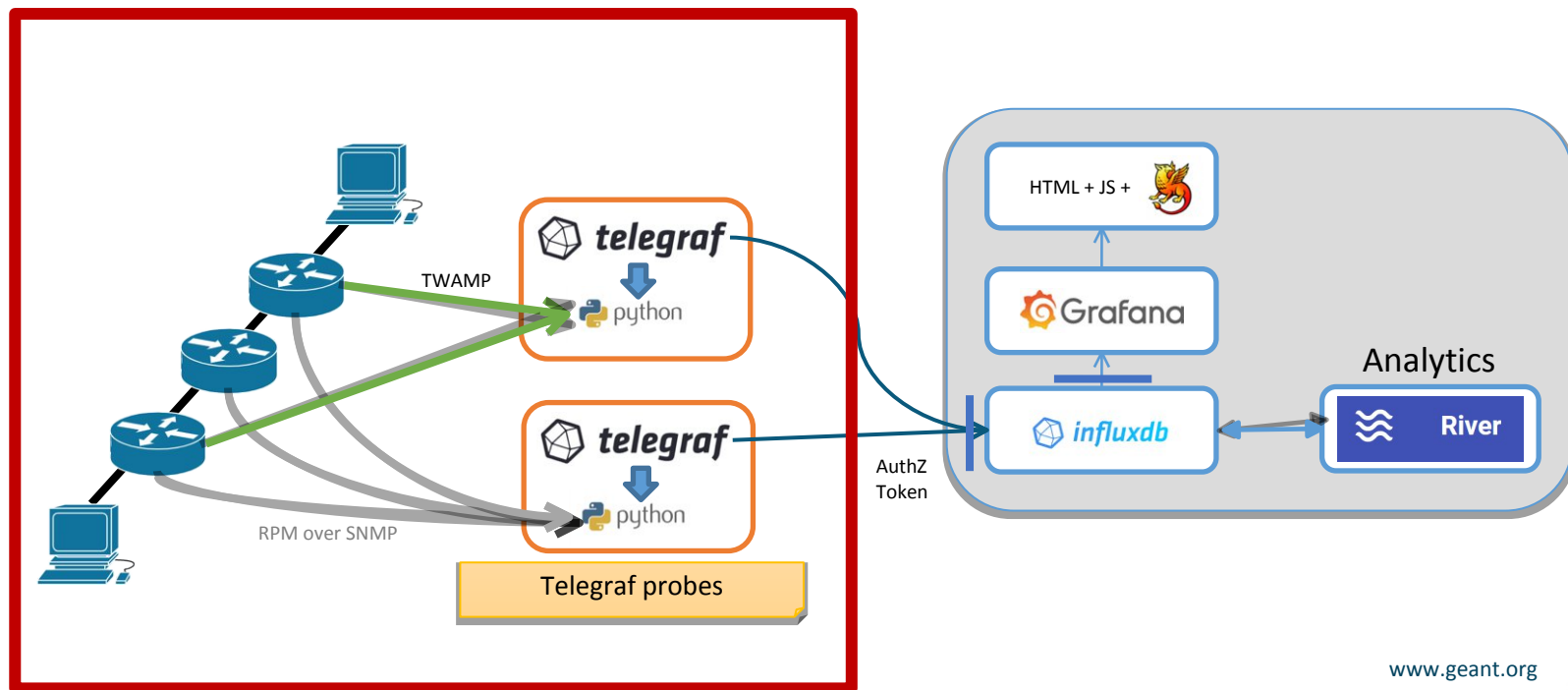
Excluded:

- Green lines – fibre built by NRENs
- Blue lines – fibre built by NMIs
- Dashed grey – proposed future links
- flywheels, counters frequency combs needed are to be funded by the national time/frequency providers
- Time/Frequency overlay services



How TimeMap architecture extends to multiple usecases:

New data probes for OTFN devices will plug seamlessly into the architecture



I want to deploy TimeMap to my network, how?

- Find the source code on:
https://gitlab.software.geant.org/gn4-3-wp6-t1-lola/timemap_public
- Deploy the observability stack
- Enable TWAMP on your network devices and set up your data probes
- Need some help? timemap-dev@lists.geant.org

Idea: TimeMap on LANs, any volunteers?

Conclusions

- TimeMap **continuous improvements**
 - Simpler code-base, less effort on technicalities
 - Focus on ML models and new use-cases
- TimeMap as a **solution to adopt and adapt**
 - Not just a service to consume
 - Different deployments built on top of the available code
- Next steps for Géant deployment
 - T/F pilot
 - Next generation Géant backbone routers

Thank you!

Questions?

timemap-dev@lists.geant.org

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