

# TimeMap: status and on-going upgrades

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**TimeMap**

# Outline

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

# Why TimeMap

## We need to monitor "the hidden"

- latency
- jitter

## We need to keep track of "the hidden"

- historic series

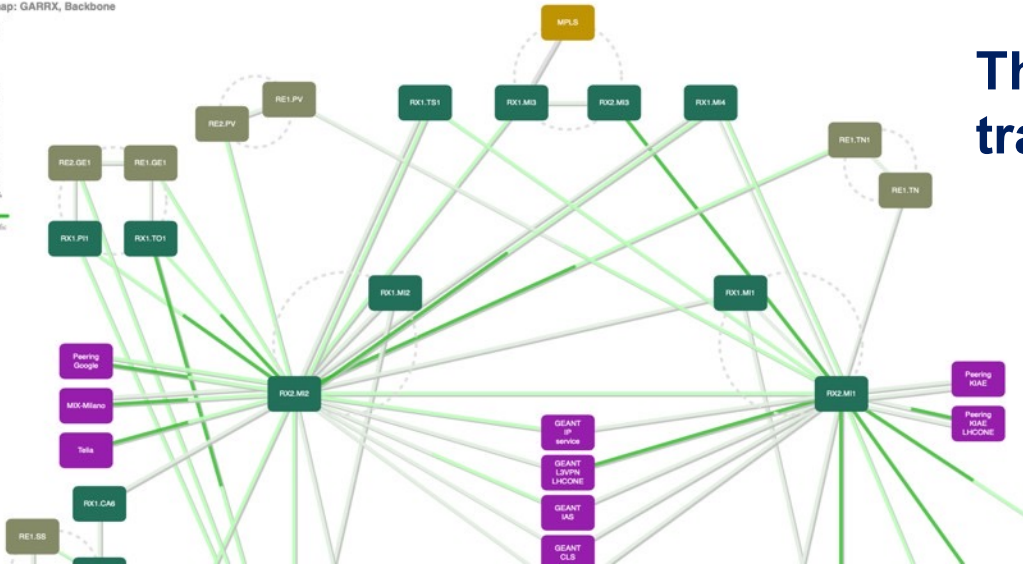
## We need to find anomalies in "the hidden"

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



# Network Traffic: what do we usually have?

GARR Weathermap: GARRX, Backbone

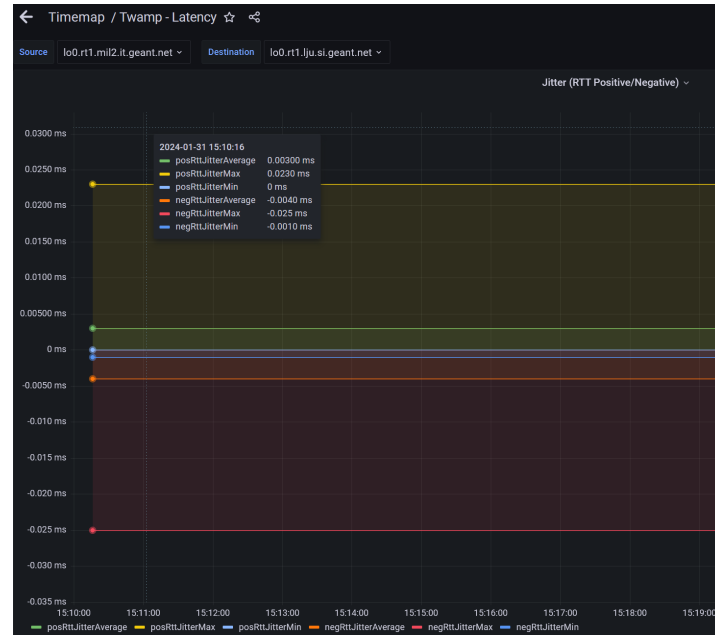
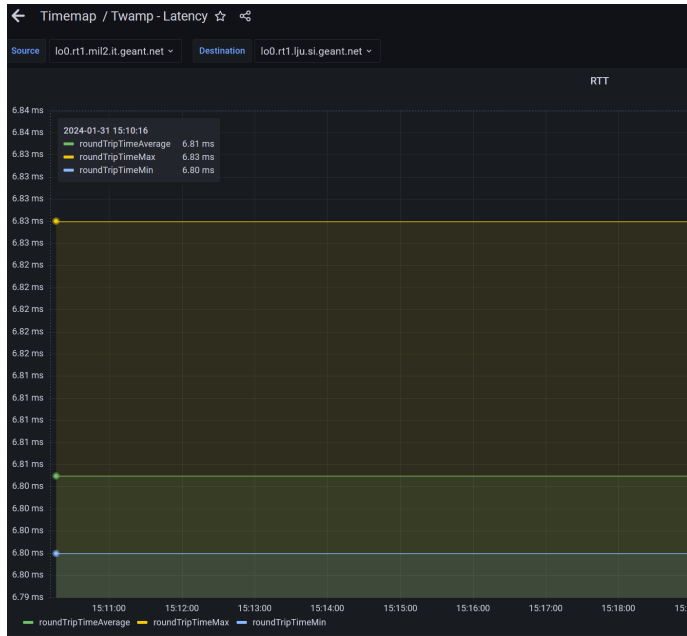


This is OK for bulk data transfers

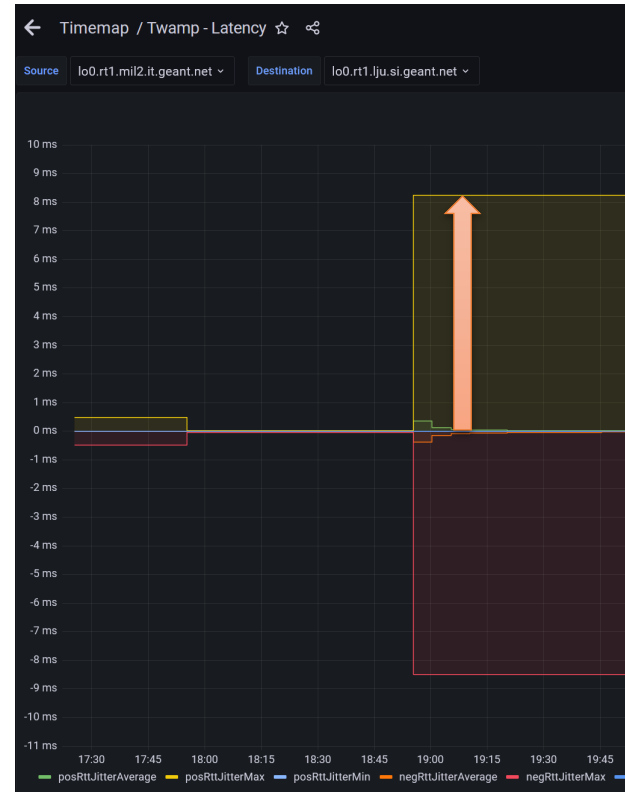
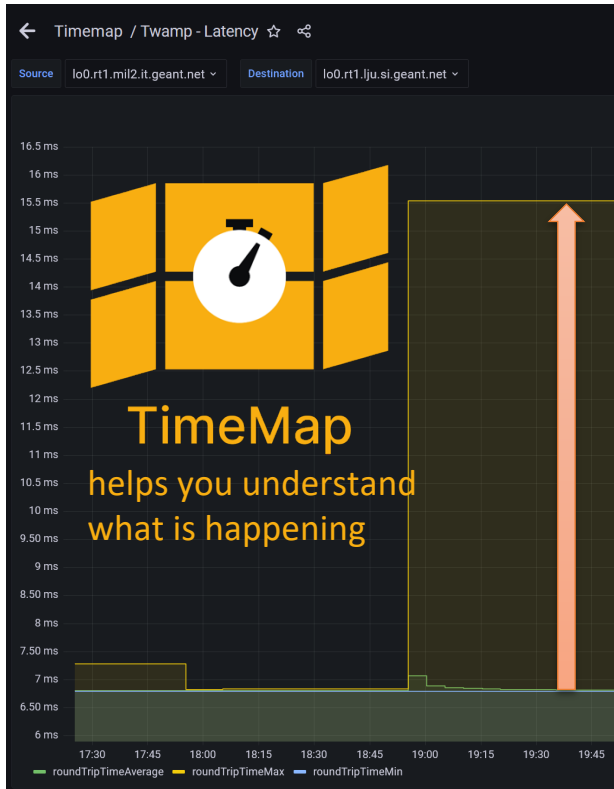
# LOLA, a real-time application sensitive to Latency & Jitter



# Active measurements – all network segments good



# During the rehearsal... 🤔

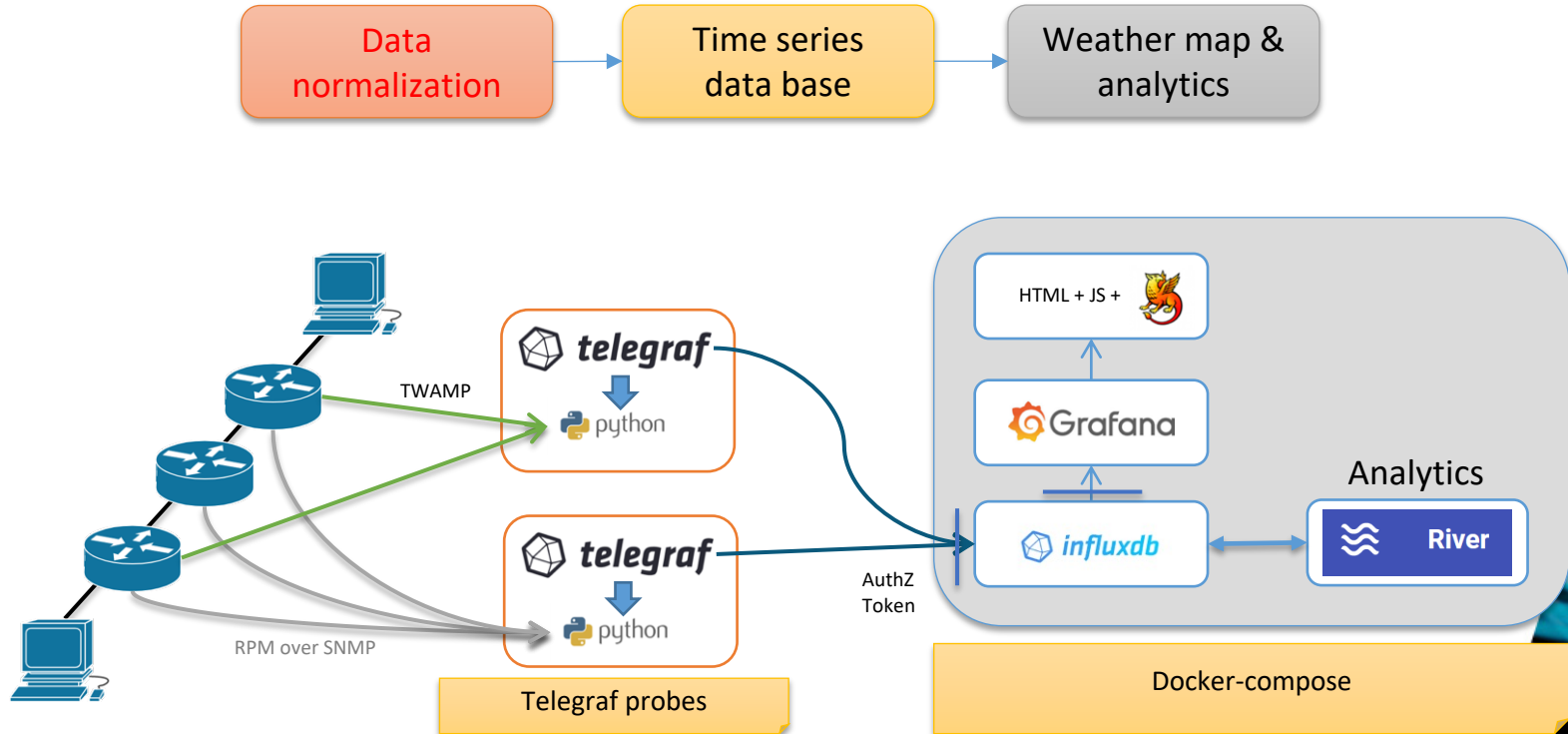


# TimeMap technical requirements

- 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



# TimeMap instance for the GÈANT backbone

- The service on GEANT backbone

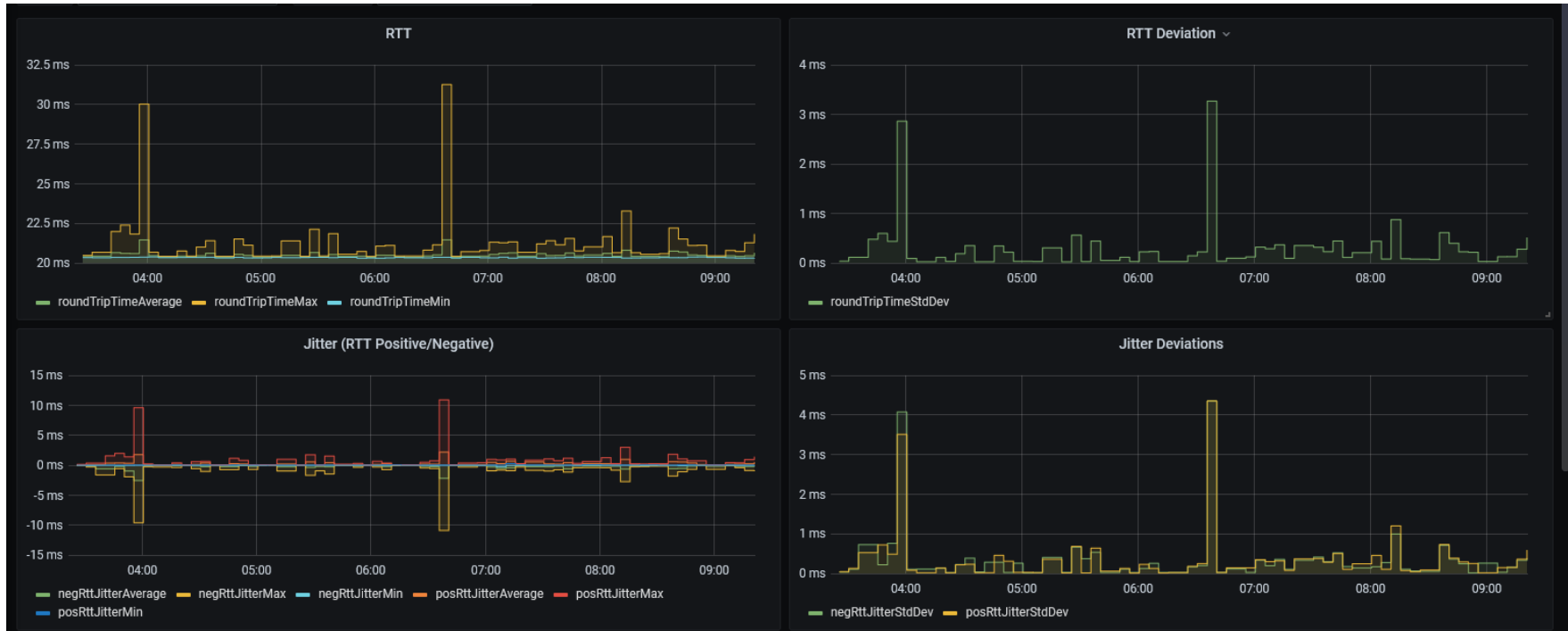
<https://timemap.geant.org/>

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

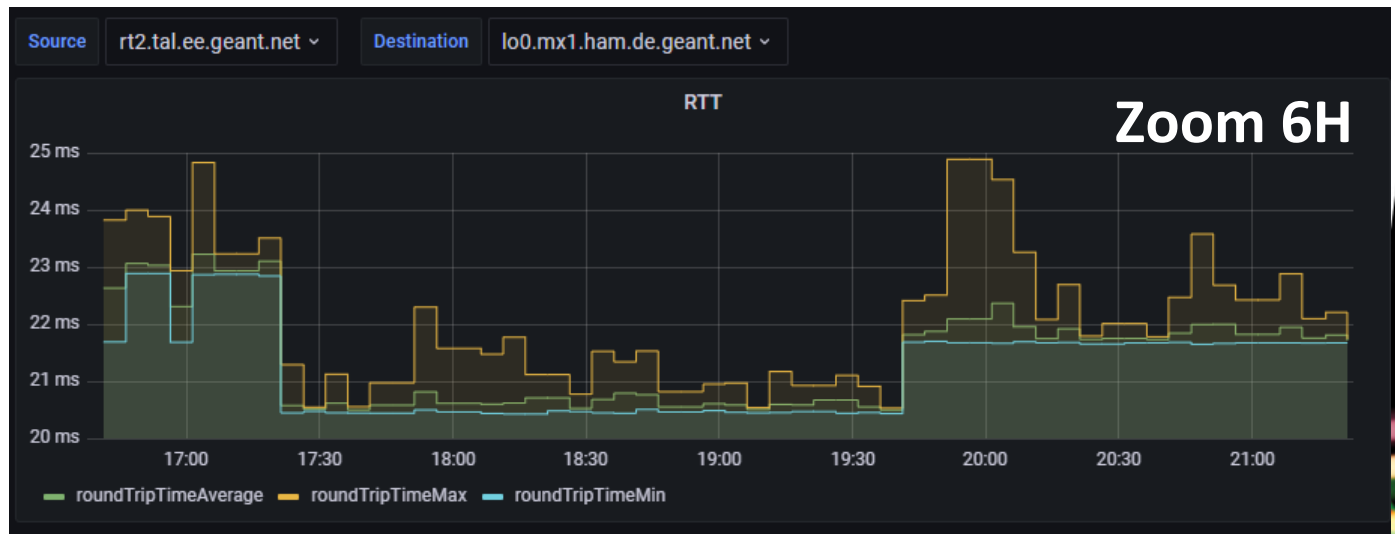
[https://gitlab.software.geant.org/gn4-3-wp6-t1-lola/timemap\\_public](https://gitlab.software.geant.org/gn4-3-wp6-t1-lola/timemap_public)



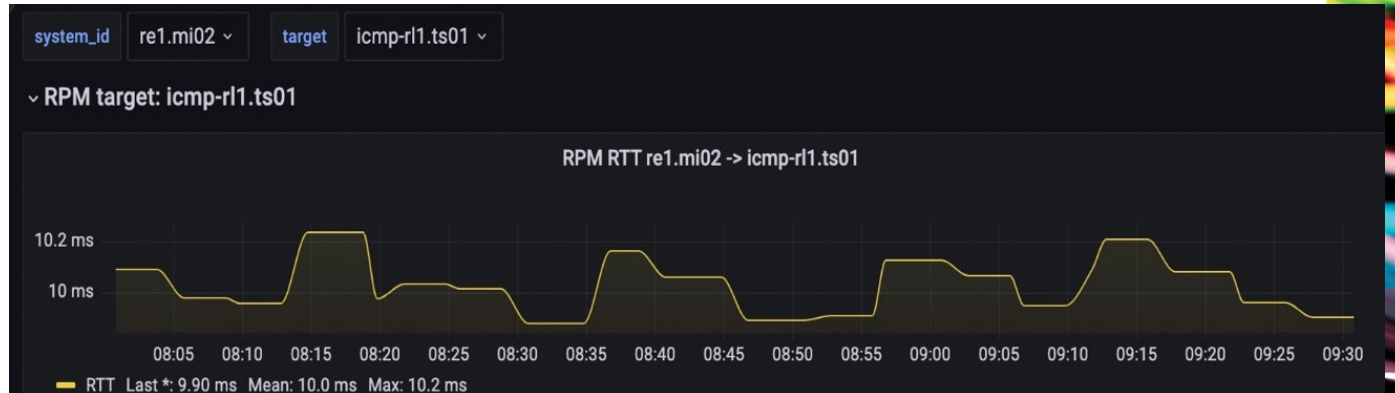
# Observations



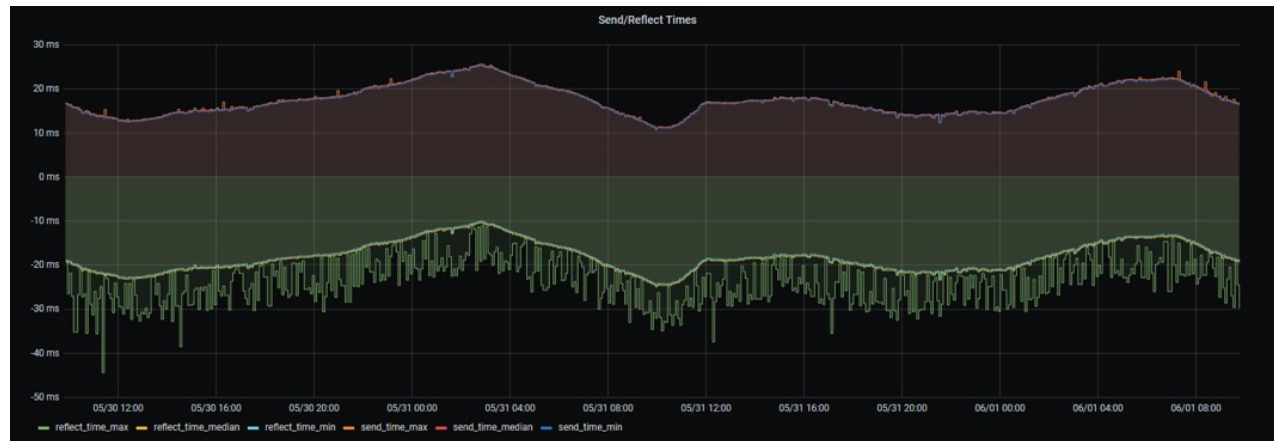
## Re-routing



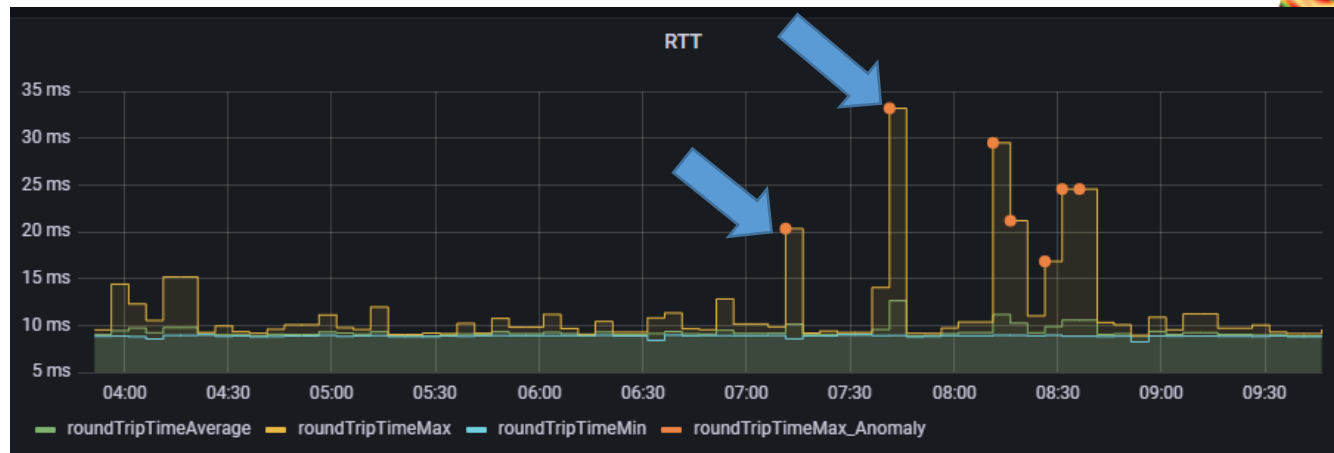
## ECMP effects



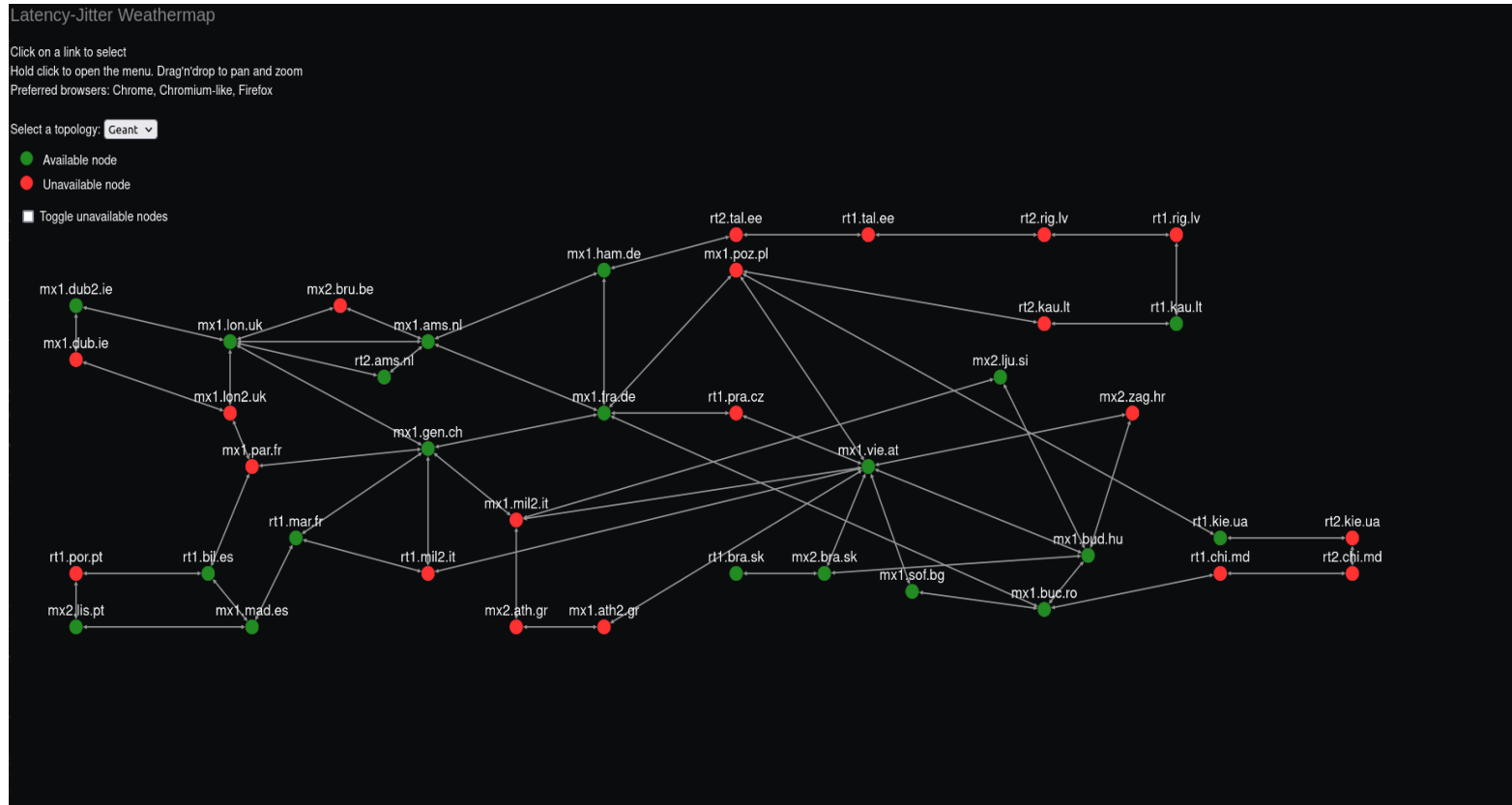
## Trends (clocks shifting?)



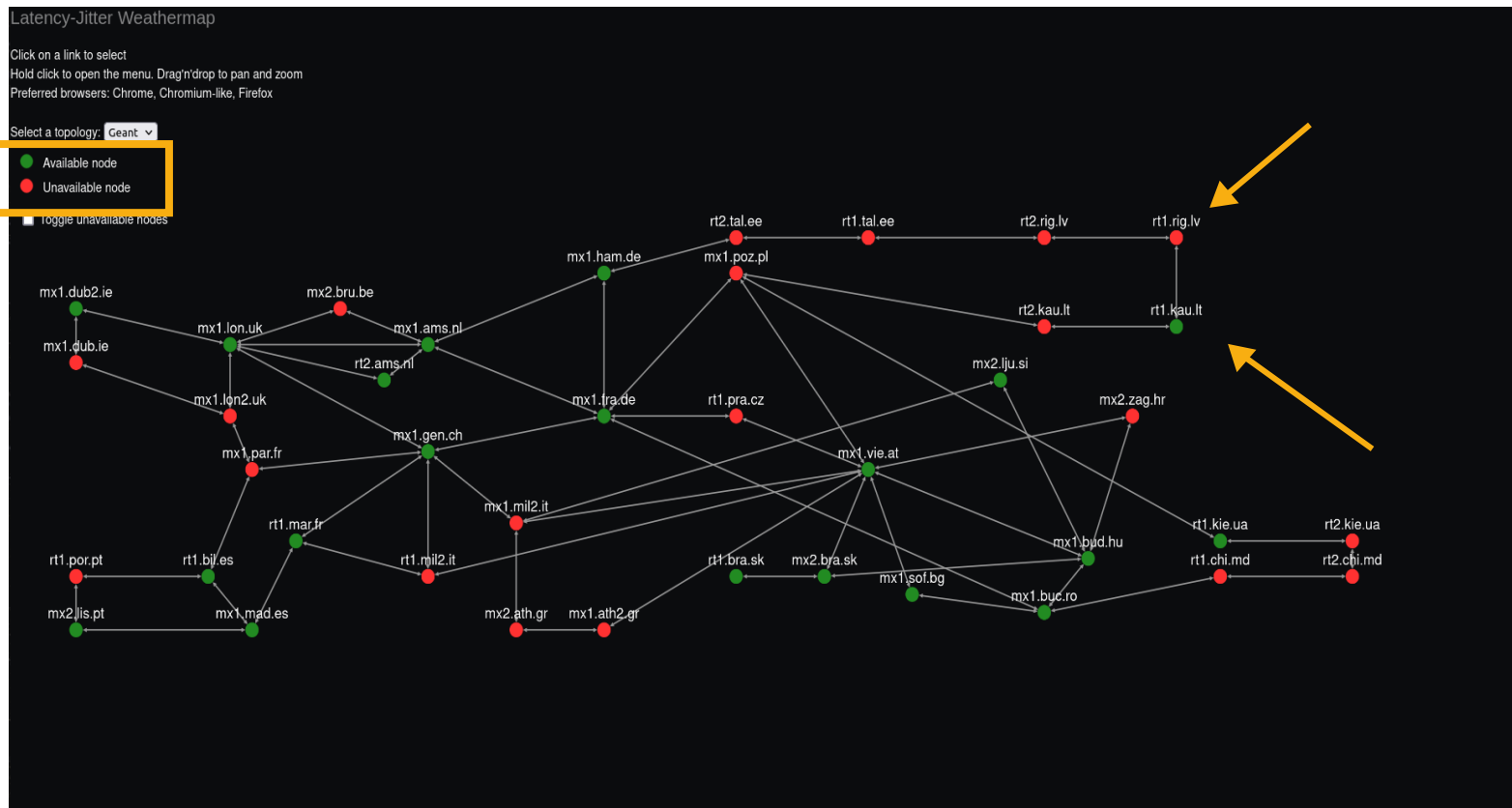
## Anomaly Detection in action



# On-going - GUI feature to support new use-cases

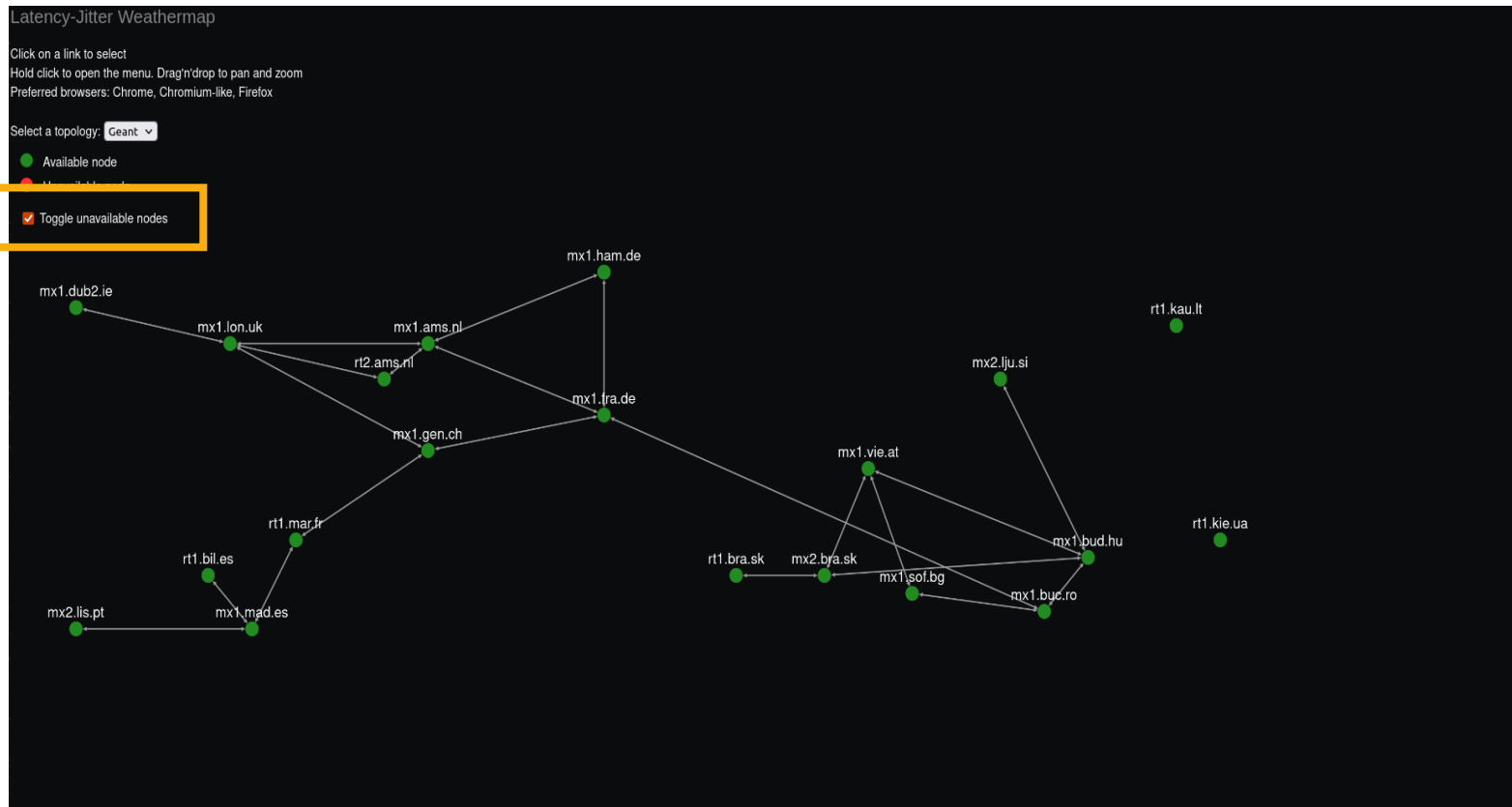


# On-going - GUI feature to support new use-cases



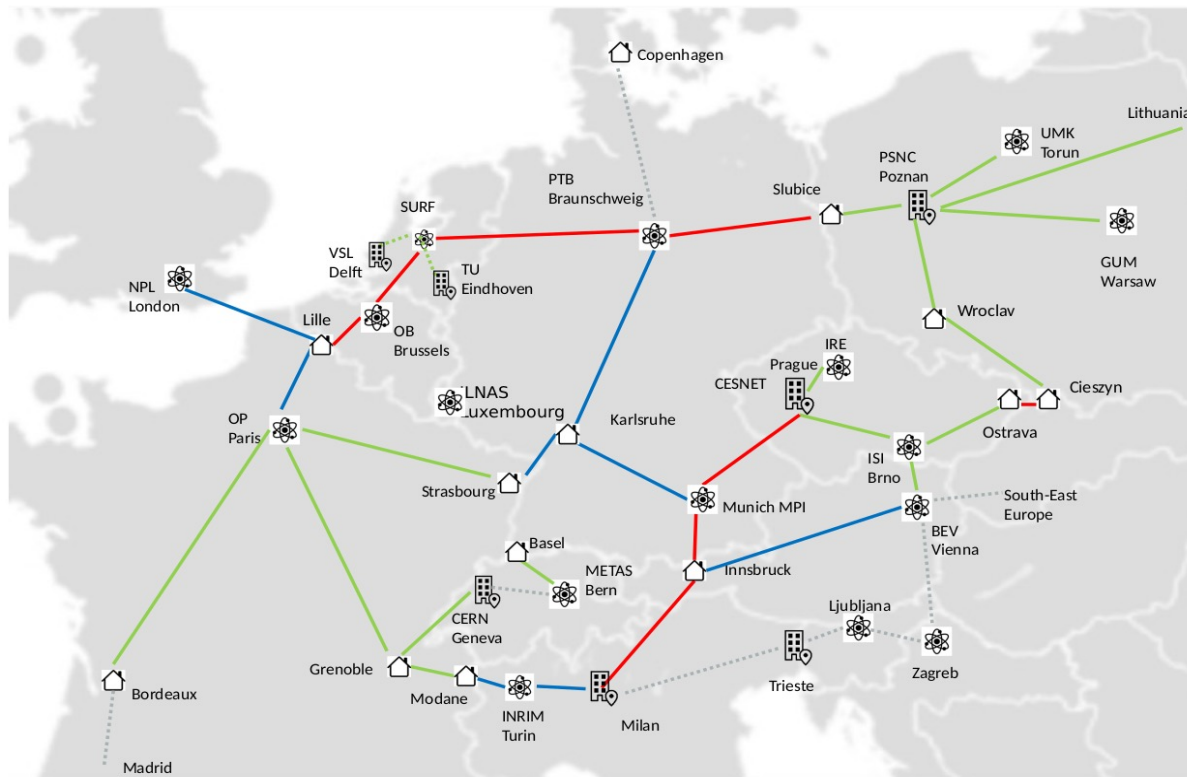


# On-going - GUI feature to support new use-cases



# On-going - GUI feature to support new use-cases

## 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



NMI Frequency reference



Research institute



Hut for housing RLS

# On-going - GUI feature to support new use-cases

Latency-Jitter Weathermap

Click on a link to select  
Hold click to open the menu. Drag'n'drop to pan and zoom  
Preferred browsers: Chrome, Chromium-like, Firefox

Select a topology: **OTFN** ▾

Select a topology: **OTFN** ▾

- Available node
- Unavailable node
- Flywheels
- NMI Frequency reference
- RLS (Regenerator Laser Station)

- Toggle unavailable nodes
- Toggle Flywheel
- Toggle NMI
- Toggle RLS

Cieszyn2

Poznan2

Slubice2

PTB2

Slubice

Poznan

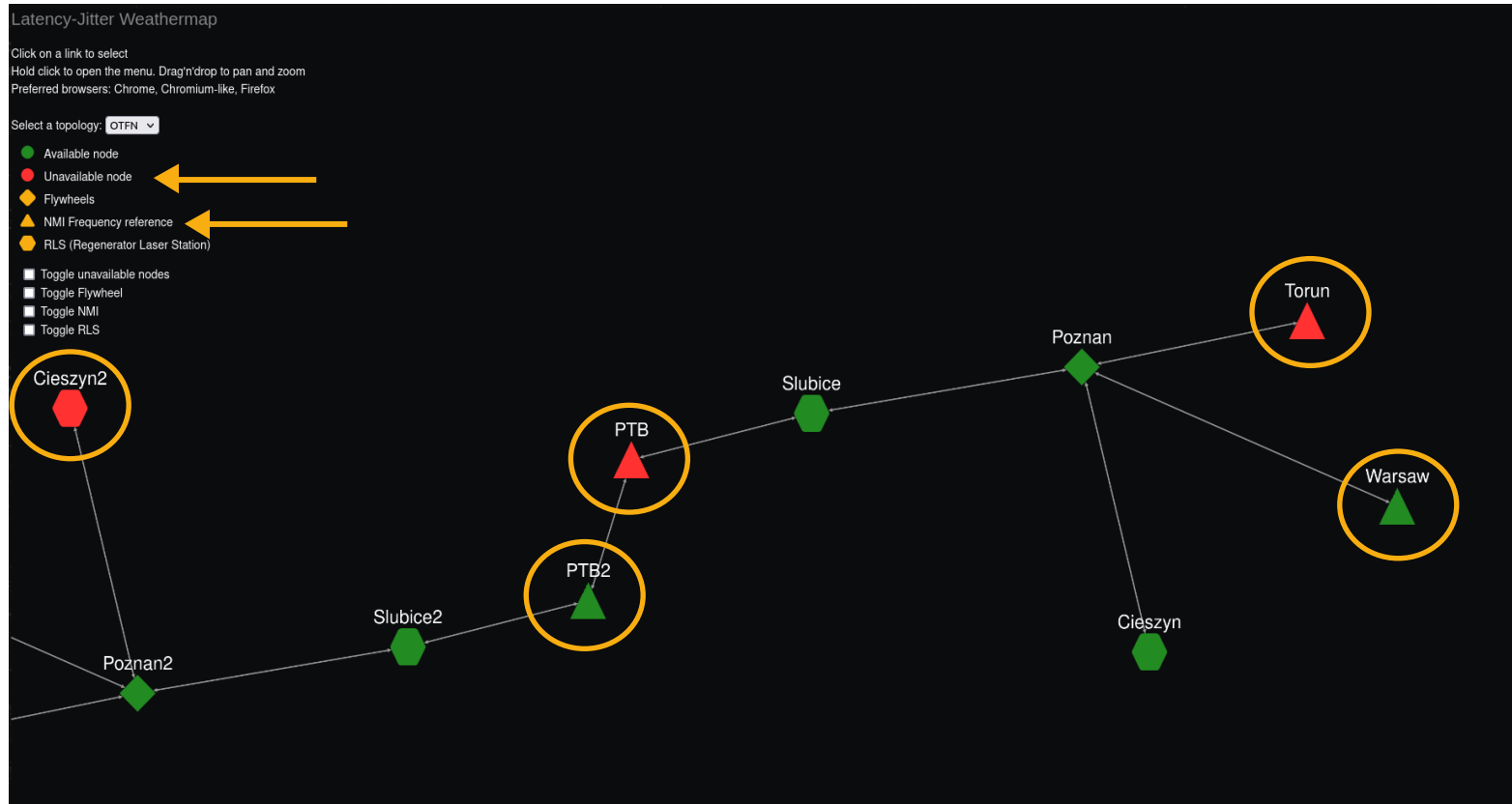
Cieszyn

PTB

Torun

Warsaw

# On-going - GUI feature to support new use-cases



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```
graph TD; Slubice --- Poznan; Poznan --- Cieszyn; Slubice2 --- Poznan2; Slubice2 --- Poznan;
```

Poznan

Slubice

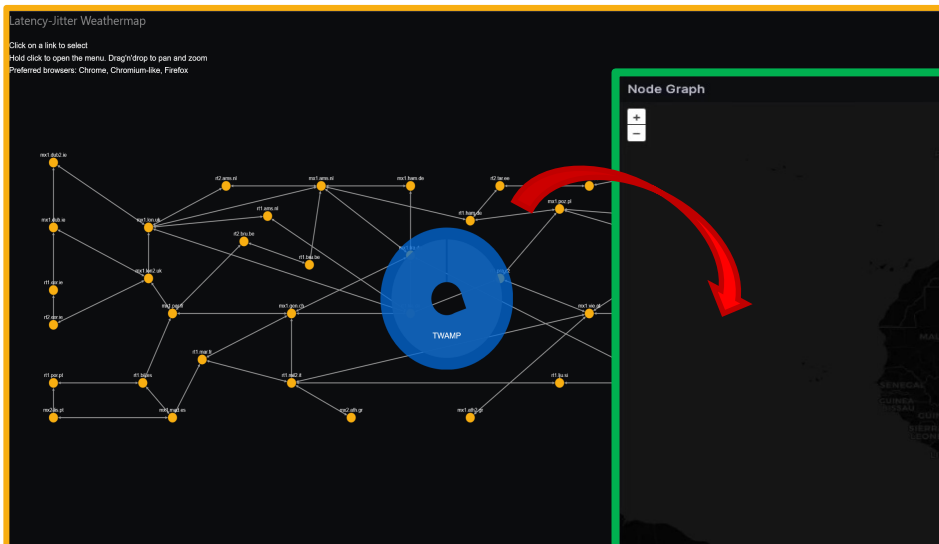
Slubice2

Poznan2

Cieszyn

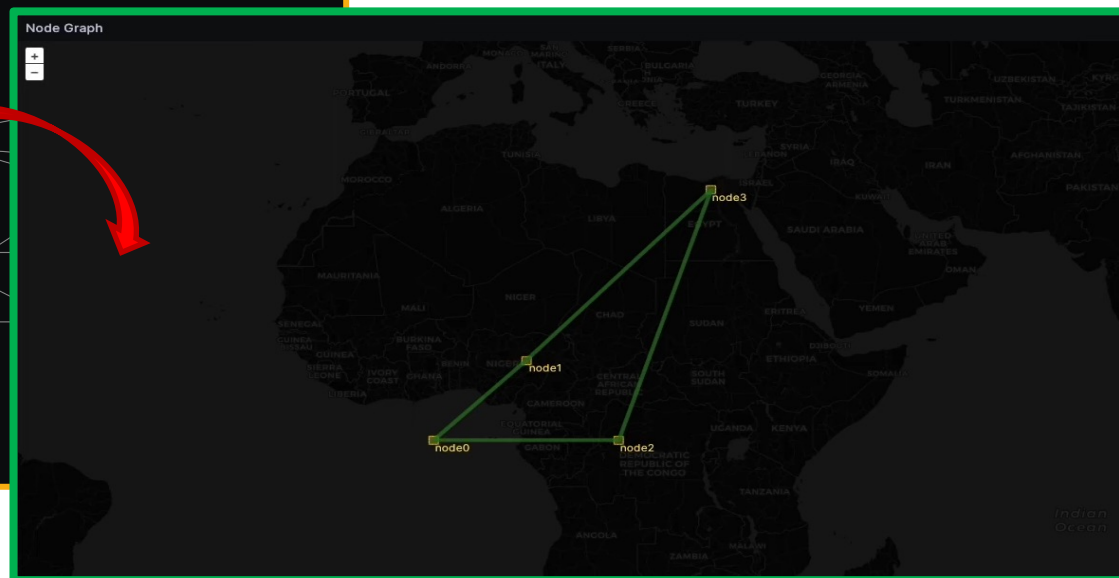
# Future of the Graphic User Interface?

Keep improving our implementation?



VS

Grafana 10.1 Geomaps?



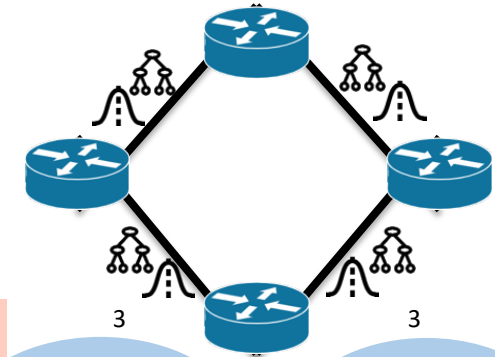
<https://grafana.com/docs/grafana/latest/panels-visualizations/visualizations/geomap/#network-layer-beta>

# Anomaly Detection in Timemap – current toolset

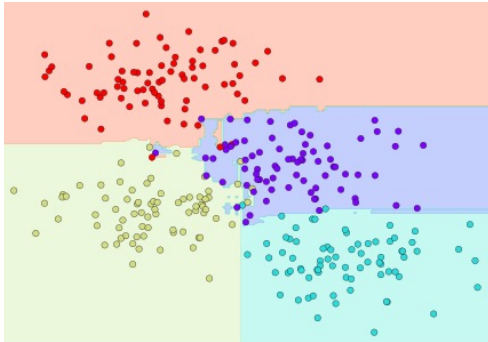
- Anomaly Detection, in short

- Std.Dev classification
- Unsupervised
- Sensible to overfit

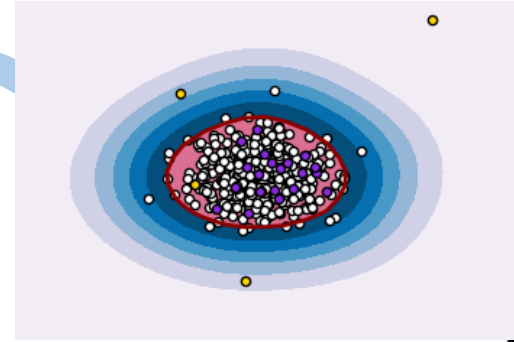
- Streaming Machine Learning
- Light footprint
- Python <https://riverml.xyz>



Half-space Random Trees



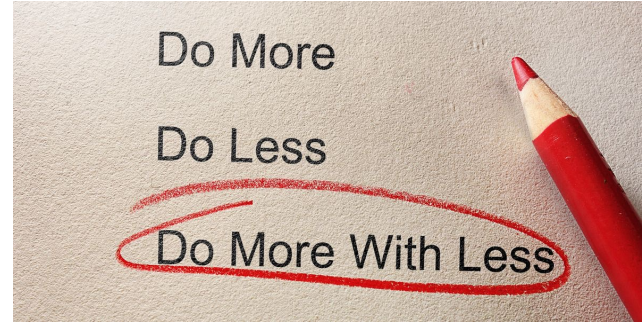
One-class Support Vector Machine



Model bagging

# Improving Timemap current data handling toolset

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



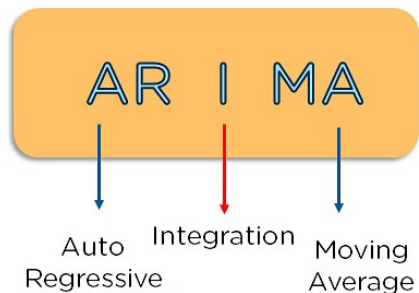
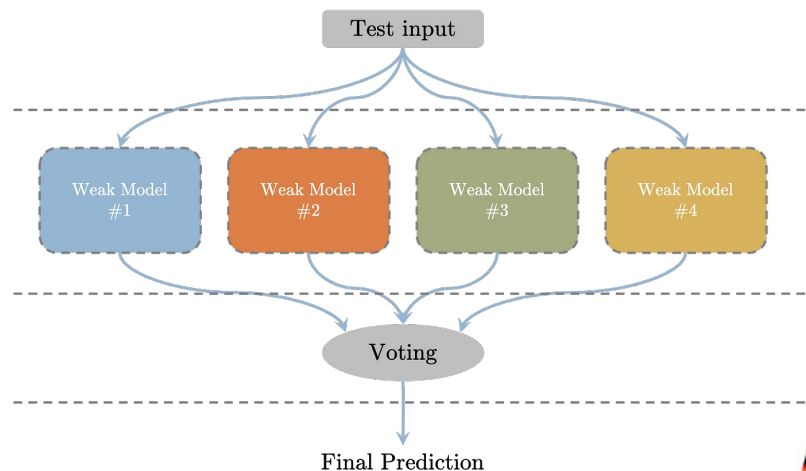
- Upsides:
  - Better readability
  - Less code, less effort





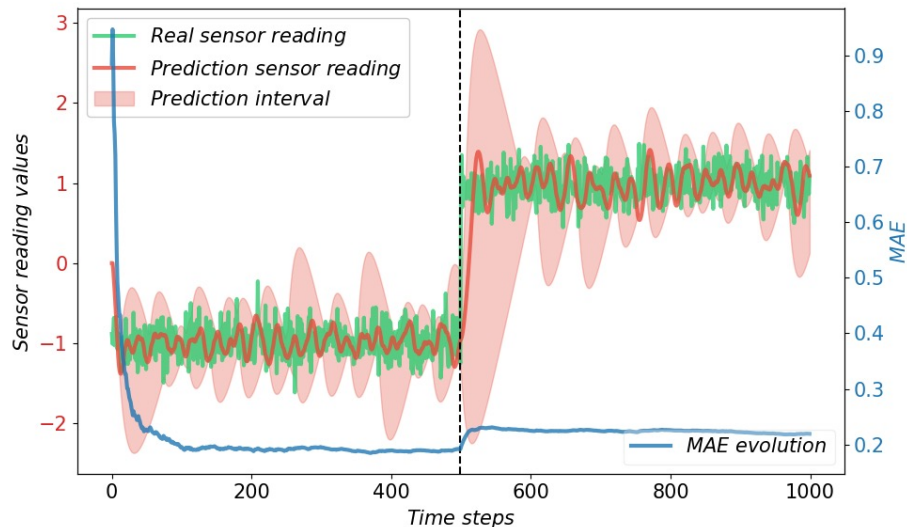
# Improving Anomaly Detection in TimeMap

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



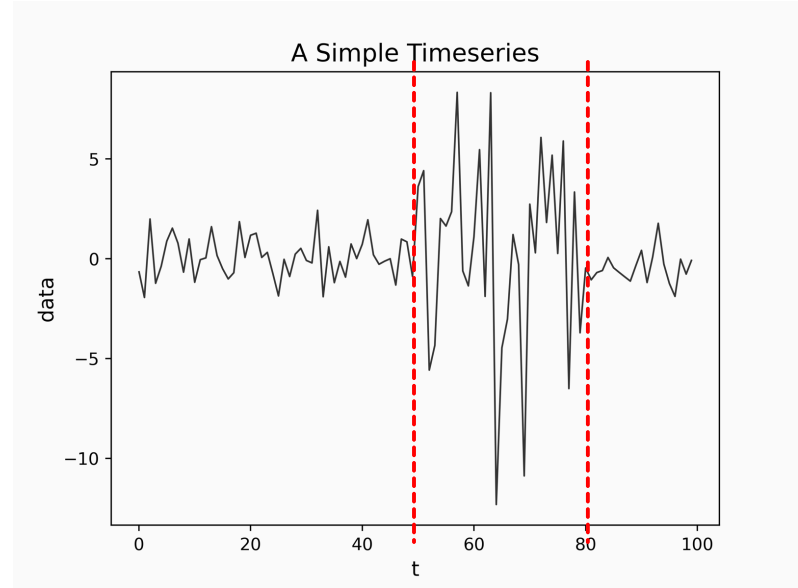
# Improving Anomaly Detection in TimeMap

- 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.”*

# 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?

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