# TimeMap Update

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# Outline

- Why TimeMap
- Current status
- Recent developments on
  - Data acquisition
  - Anomaly detection

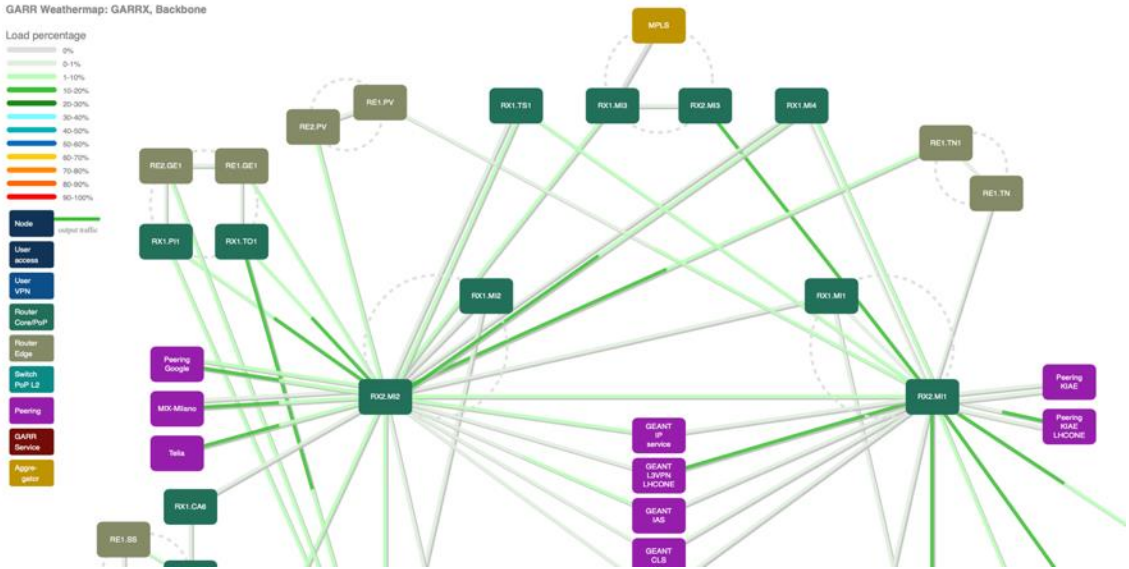
# Why TimeMap: the road-trip analogy

**How is the road ahead today?**
**And how is it is in average?**

**it may be nice …**


**Or lots of Stop & Go**

# Network Traffic: what do we usually have?

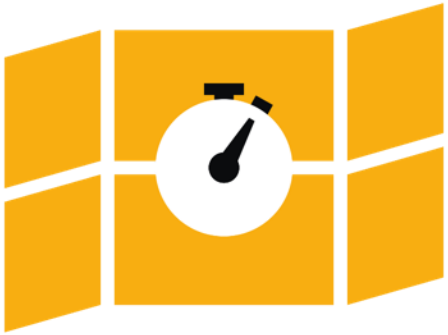



**But this is OK for bulk data transfers**

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

## 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 right NOC for the right network segment



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# TimeMap instance for the GÈANT backbone

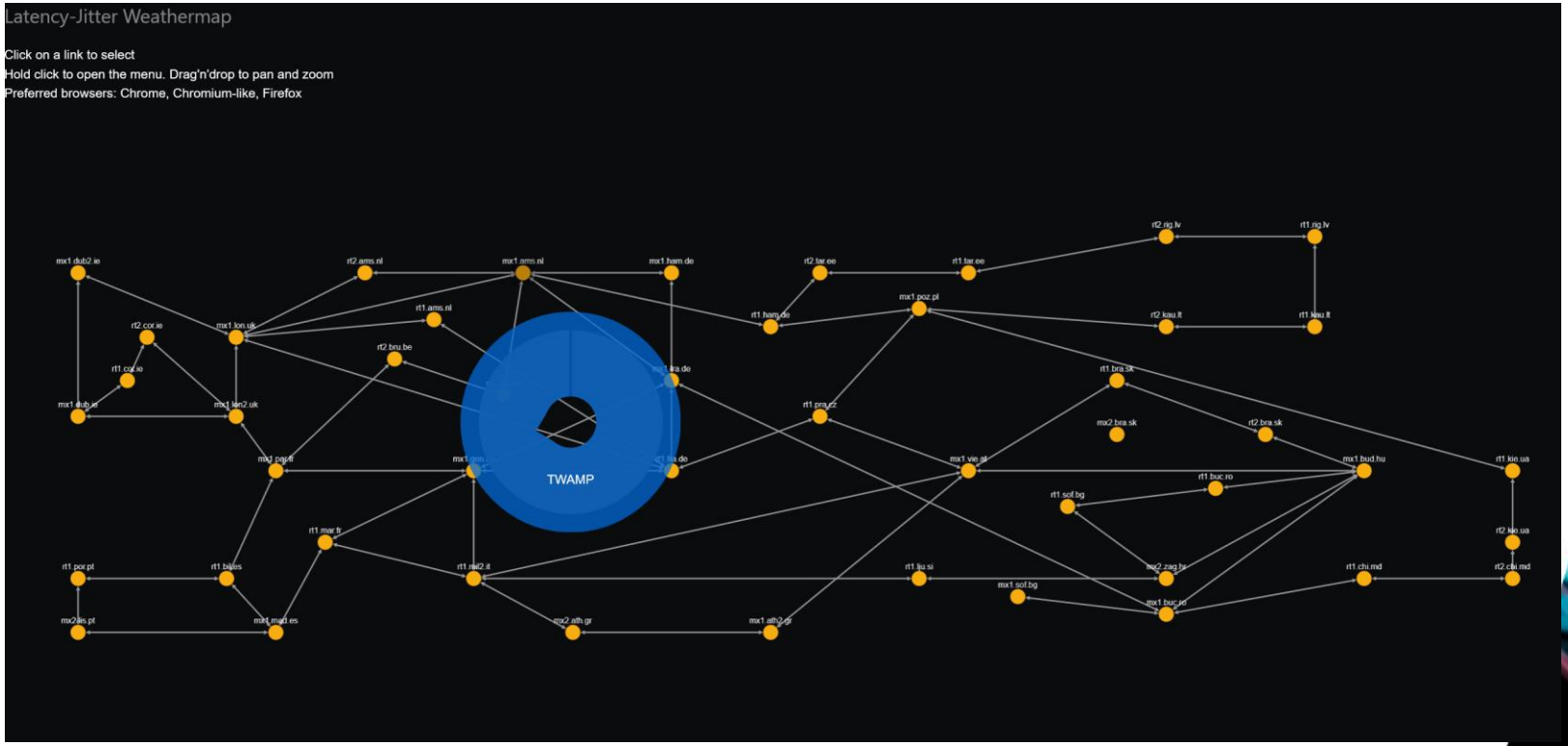
- The service on GEANT backbone

**https://timemap.geant.org/**

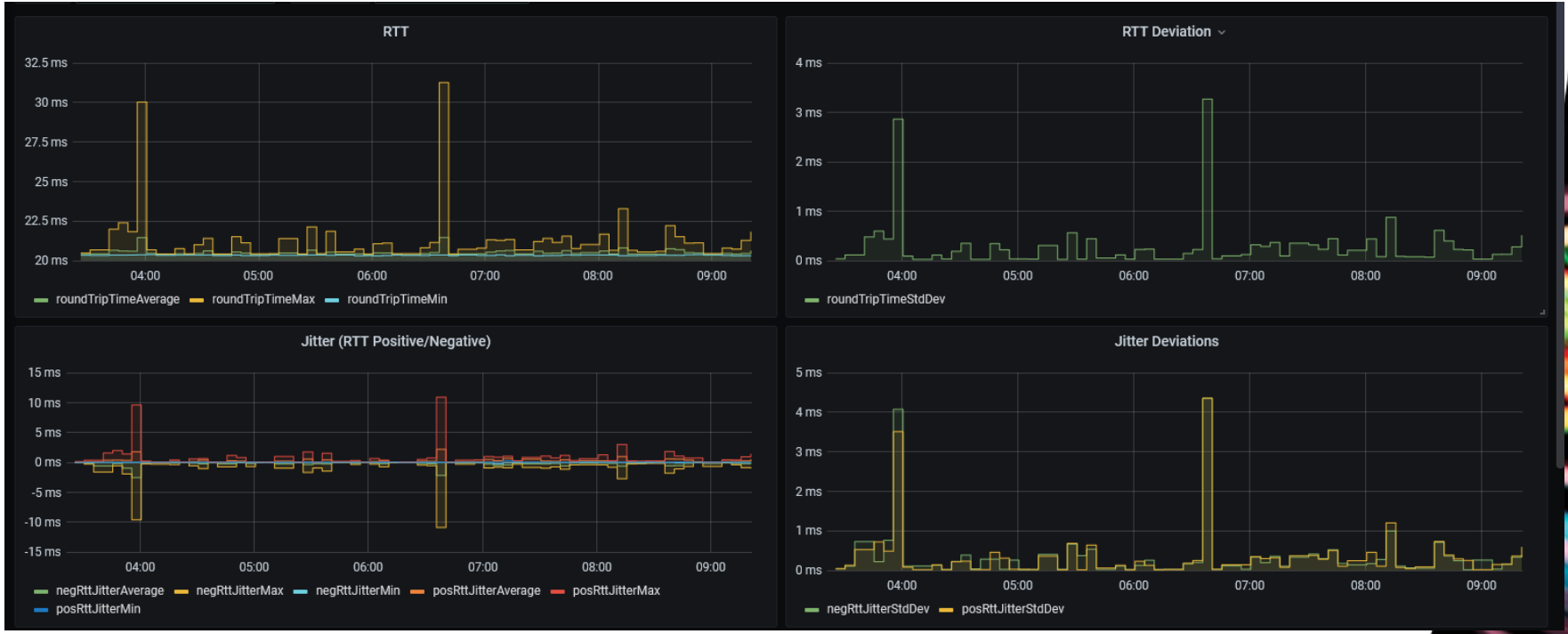
- Documentation: source code, user and admin guides, customization

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

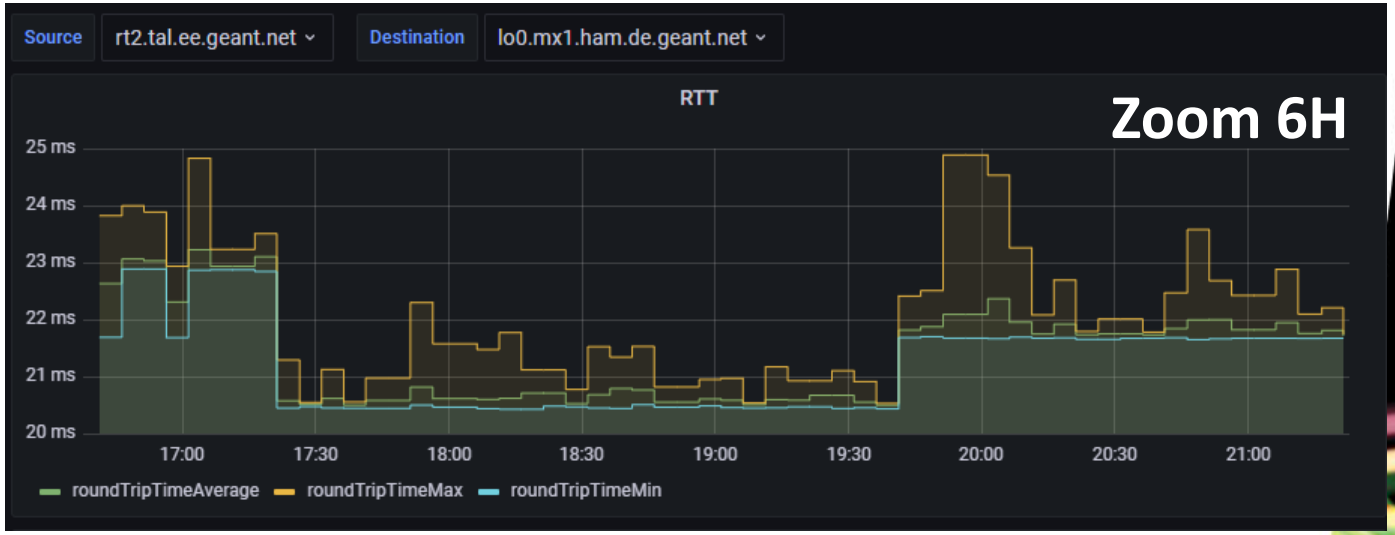
# The entry map page: click on link



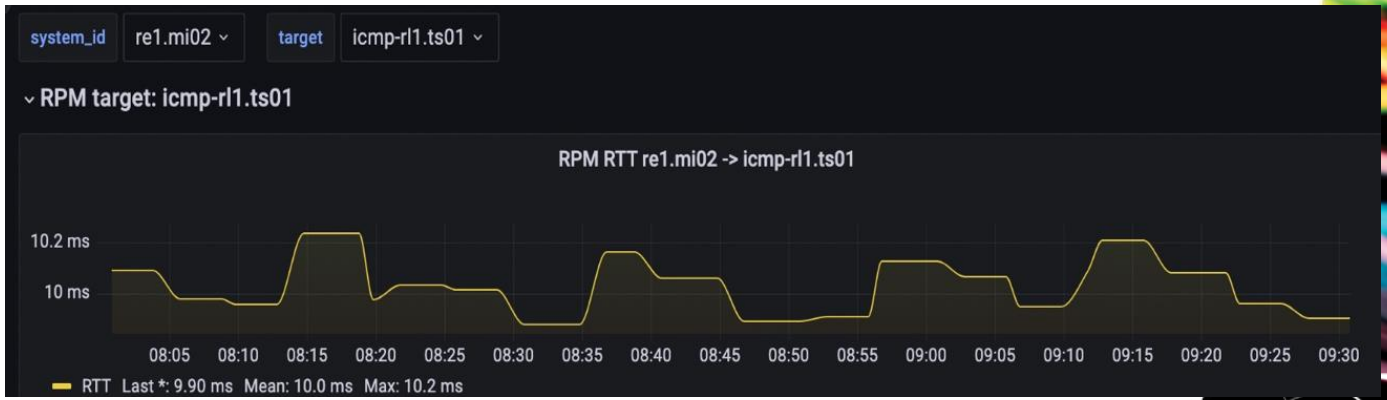
# Observations



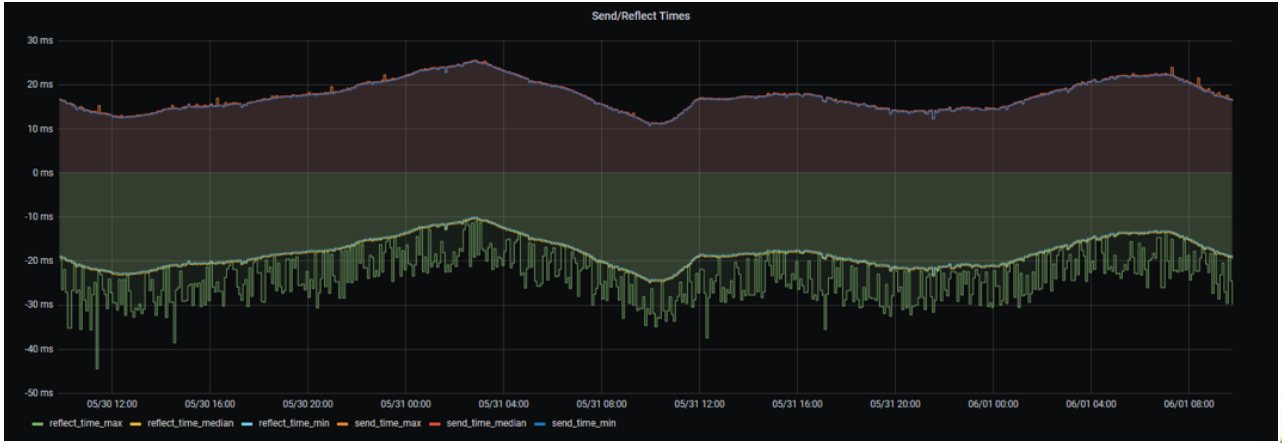
# Re-routing



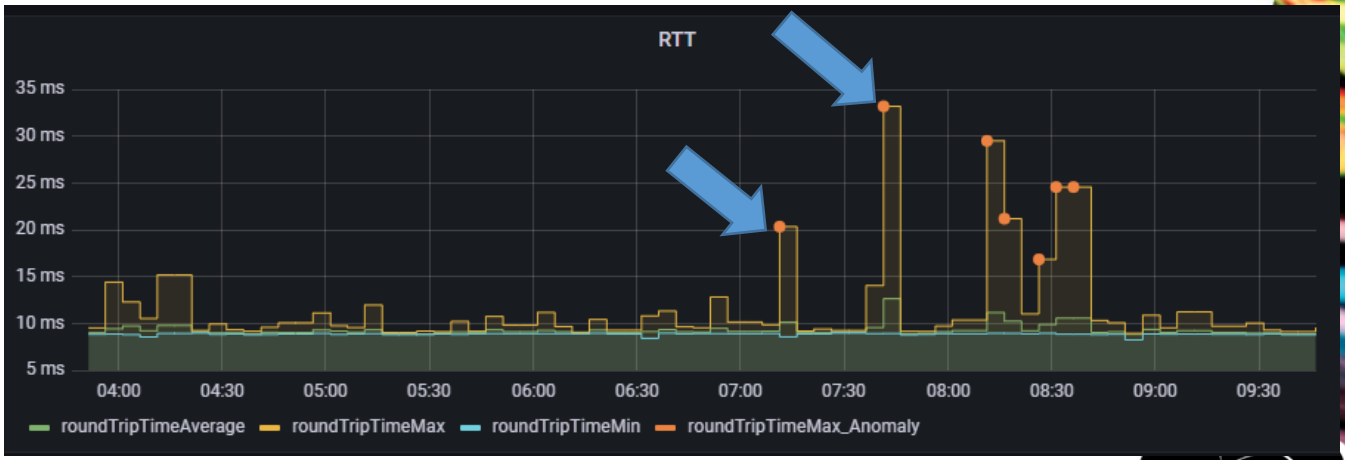

# ECMP effects



# Trends (clocks shifting?)




# Anomaly Detection in action



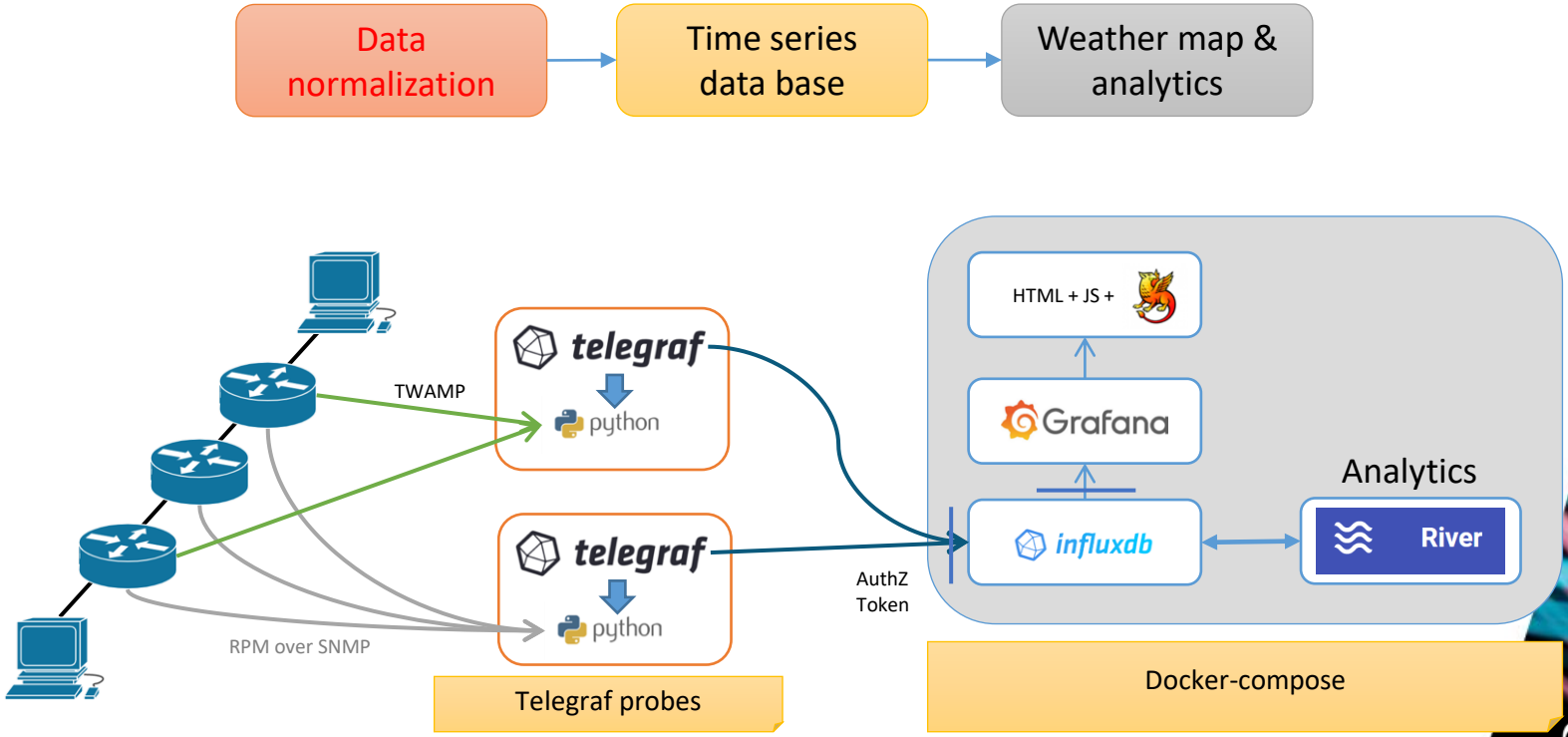
# TimeMap technical requirements

- 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 – 1+ year of data taking

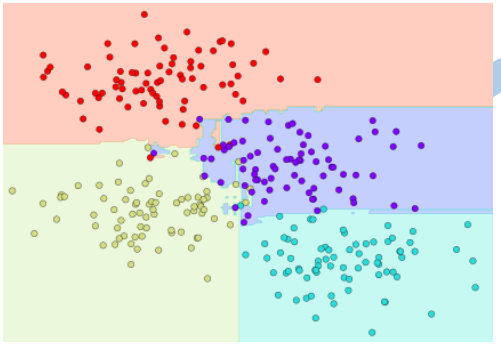


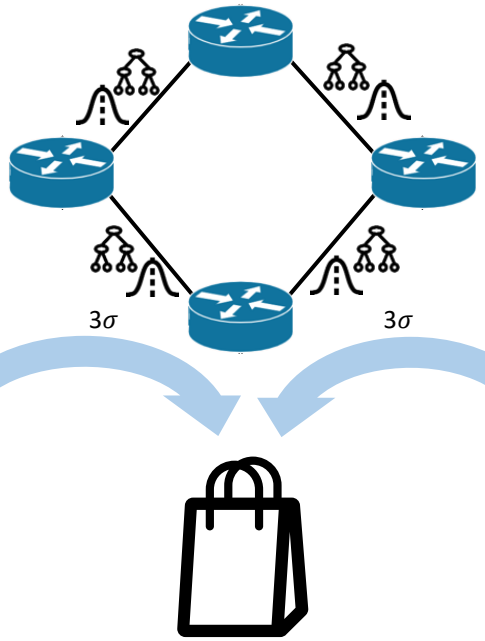
# Anomaly Detection in Timemap – toolset

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

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

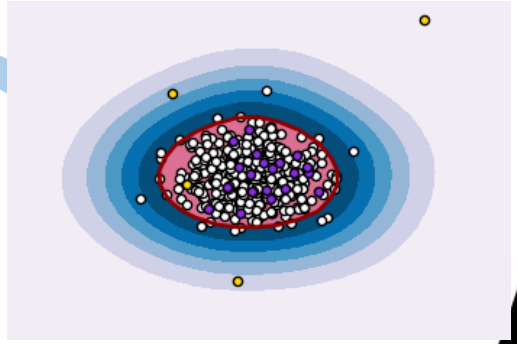
Half-space Random Trees






Model bagging

One-class Support Vector Machine



# On-going – Juniper Twamp probes refactoring

- Benefit from latest libraries for SNMP, gNMI, TWAMP
- Reduce further the ad hoc code
  - Same features, from 250 to 100 lines of code
  - Simpler to read and maintain
- Baseline code for new probes

# On-going: preparing for upcoming new use cases

- Codebase fork for T/F use case
  - New probes for the Flywheels, and other devices if needed
  - Dedicate topology with custom dashboards

- Paving the way for the next GÈANT backbone
  - Adapt Twamp probe to support Nokia devices
  - Interoperability tests
    - Juniper -> Juniper: TWAMP
    - Juniper -> Nokia : TWAMP (Juniper Client, Nokia Server)
    - Nokia -> Nokia : TWAMP-lite

# On-going: Anomaly Detection

- Issues with current models
  - Overfitting and concept drifting
  - Identify when anomalies end
- Enhanced ML models
  - Augment current models with Nowcasting
  - Short range timeseries prediction – training/inference loops
  - Models selection & hyperparameters optimization
- Scouting novel deep learning approaches
  - Digital twin through Temporal Graph Neural Network

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# Thank you!

# Questions?

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As part of the GÉANT 2020 Framework Partnership Agreement (FPA), the project receives funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No. 856726 (GN4-3).