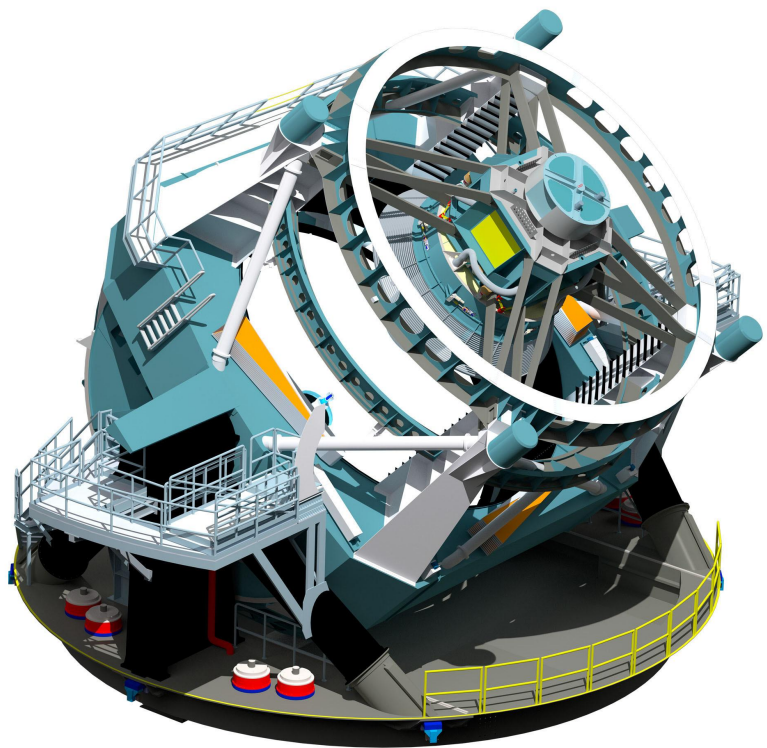


# LSST alerts: Who, What, When, Where & Why.

Julien Peloton - CNRS/LAL

# LSST Data Products



Now

## Raw Data

Sequential 30s image, 20TB/night

60s

## Prompt Data Product

Difference Image Analysis  
Alerts: up to 10 million per night

24h

## Prompt Products DataBase

Images, Object and Source catalogs from DIA  
Orbit catalog for ~6 million Solar System bodies

Year

## Annual Data Release

Accessible via the LSST Science Platform &  
LSST Data Access Centers.

End

## Final 10yr Data Release

Images: 5.5 million x 3.2 Gpx  
Catalog: 15PB, 37 billion objects

Public data!

# LSST Alert System

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01

Detection  
algorithm  
(DIA)



02

Source detected  
SNR > 5  
C: 90%, P: 95%



03

Associate  
source/history  
by location



04

Measurement &  
characterisation



05

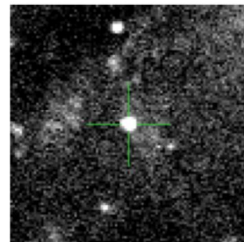
Alert sent!

# Alert packet anatomy

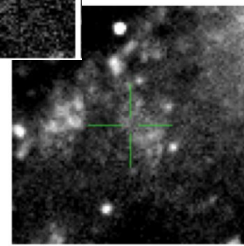
## Alert packet

- DIA Source record that triggered the alert
- Associated DIA object or SS object record
  - Timeseries features
  - Crossmatches to nearby LSST detected object
- 12 months of DIA source history
- Science and template cutouts (30x30 pixels).
- Serialisation using Apache Avro
- Transport using Apache Kafka
- Tested currently for the ZTF experiment.

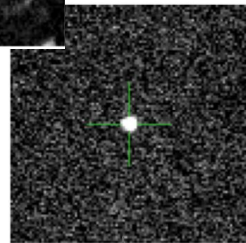
Credits: E. Bellm



Observation



Template



Difference

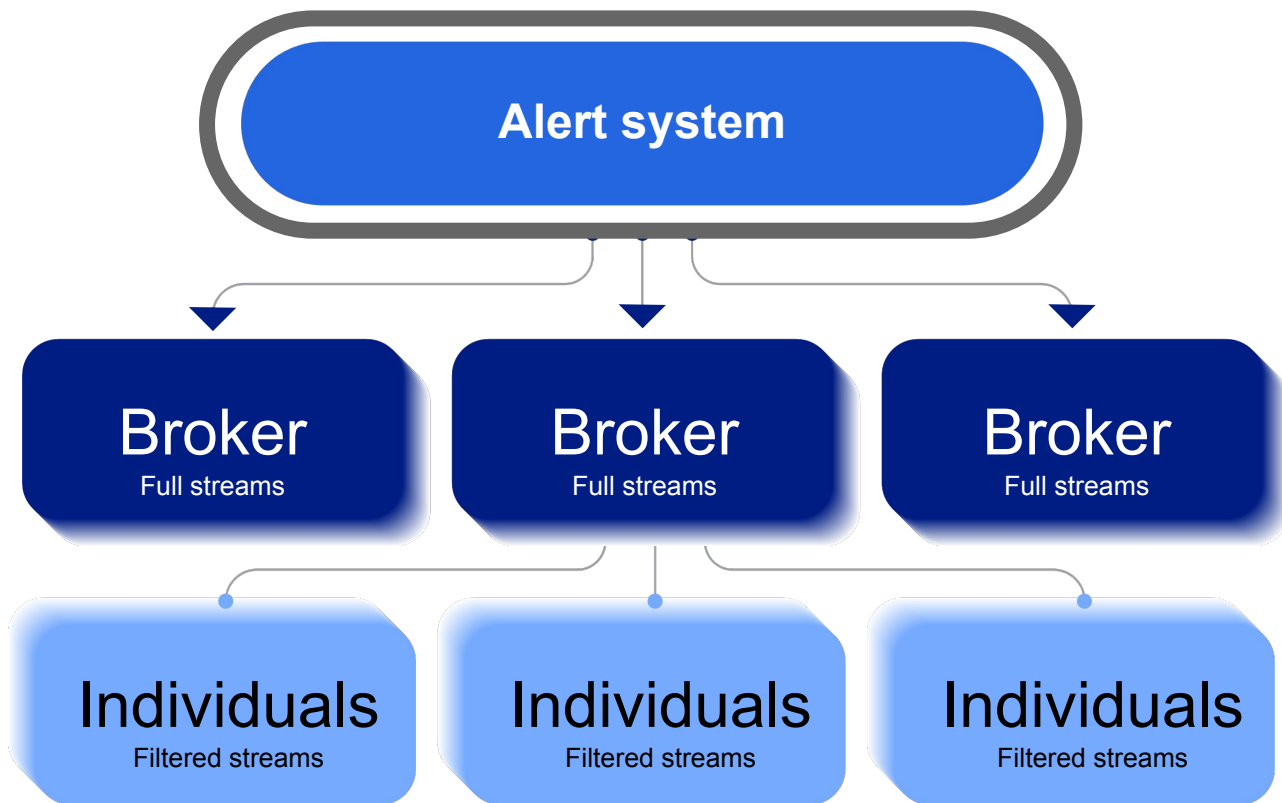
*Alert packets and their contents are world-public and can be freely shared with anyone.*

# Some Data Challenges...

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- Forecasted: 10 million alerts per night...
  - Current serialisation implies ~82KB/alert, 800 GB/night, 3PB in 2030.
- 98% of alerts must be transmitted with 60 seconds of readout...
  - ... and processed before the next night!
- Wires to send alerts worldwide are not infinitely big...

# How to get alerts?



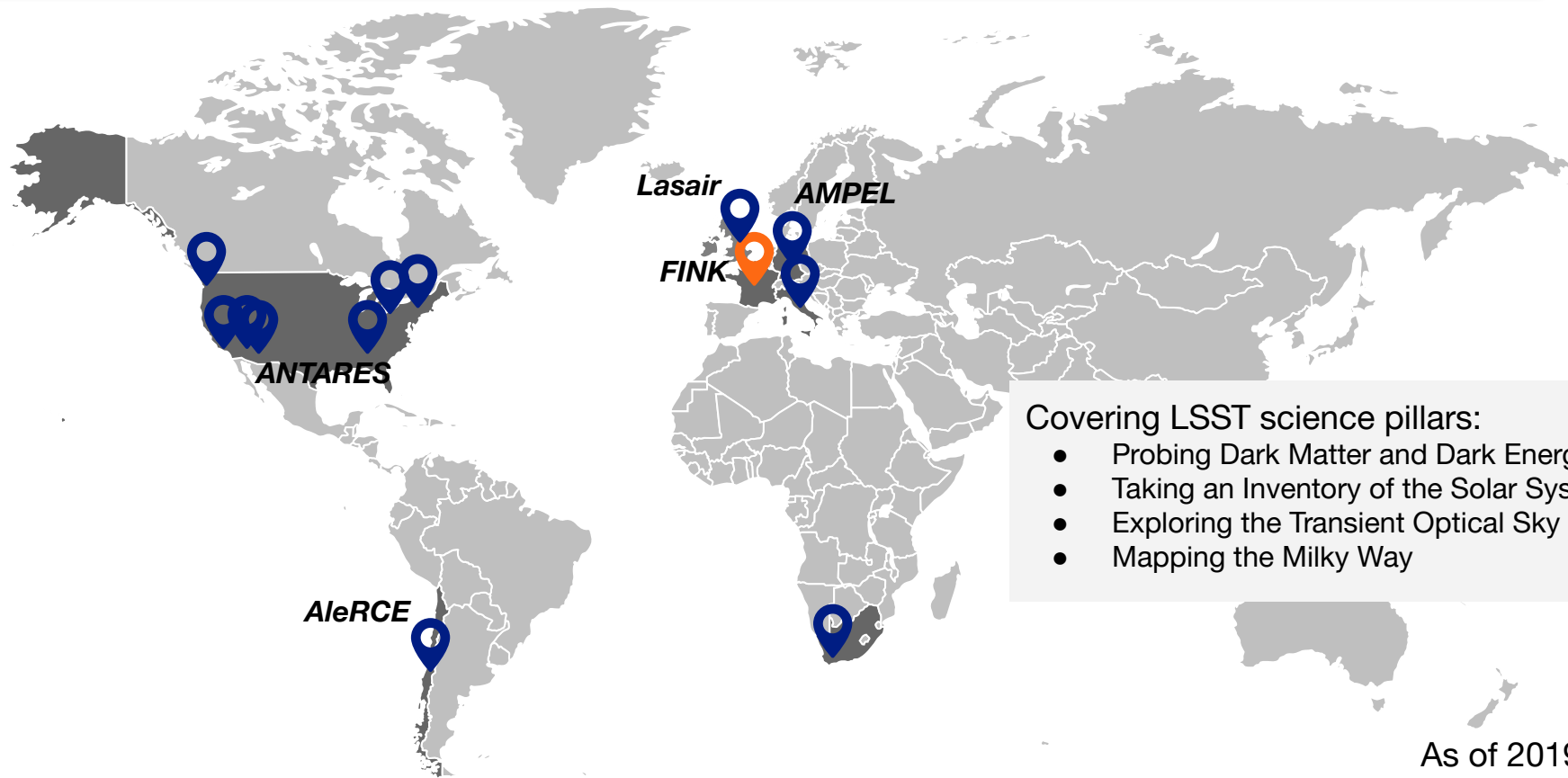
## Brokers **MUST**:

- **Digest** the alert stream.
- **Add** value to alerts: enrich each alert with extra information, either from connection with existing catalogs or from preliminary ML classifications.
- **Distribute** alerts to the community.

## Brokers **CAN**:

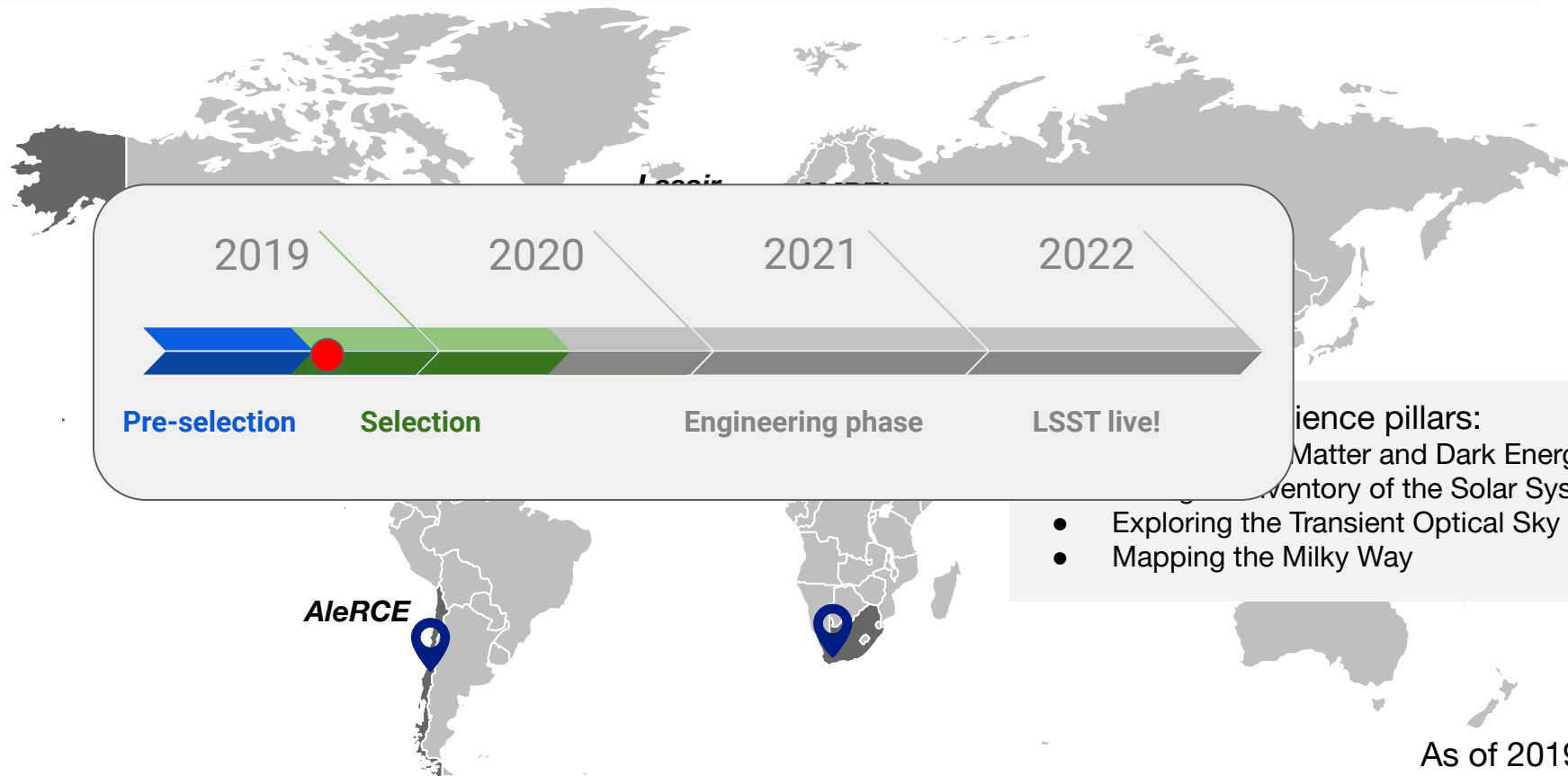
- **Adapt** the filtering algorithm to their interest as the survey evolves.
- **Coordinate** follow-up allocation for a particular science case.

# LSST Broker landscape



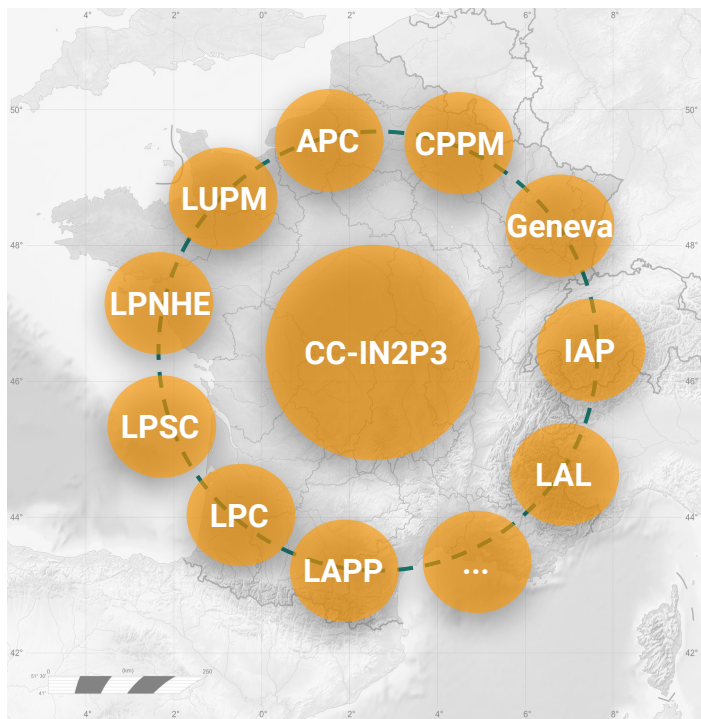
- Covering LSST science pillars:
- Probing Dark Matter and Dark Energy
  - Taking an Inventory of the Solar System
  - Exploring the Transient Optical Sky
  - Mapping the Milky Way

# LSST Broker landscape





# Fink Collaboration



## WHAT WE DO (OTHER THAN STANDARD BROKER)

- **Science:** Supernovae, microlensing, anomaly detection, and multimessenger astronomy: GRB alerts, gamma ray, GW events, ...
- **Methods:** Adaptive learning, Bayesian NN.
- **Technology:** big data, cloud.

## OUR GOALS FOR THIS MEETING

- Accommodate our infrastructure for your needs and science cases (selection function, distribution, coordination, ...)
- Integration of Fink within existing efforts

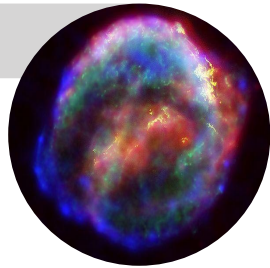
## WE CAN HELP YOU WITH

- Joining Fink and develop your science!
- Stay tuned for beta testing in Autumn.

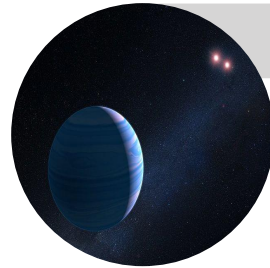
# Fink Science Focus

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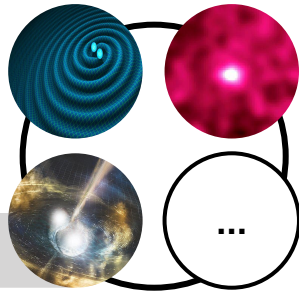
Supernovae



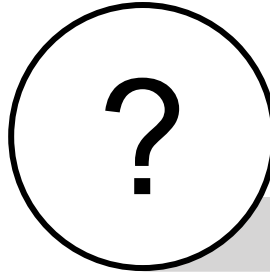
Micro-lensing



MM astronomy

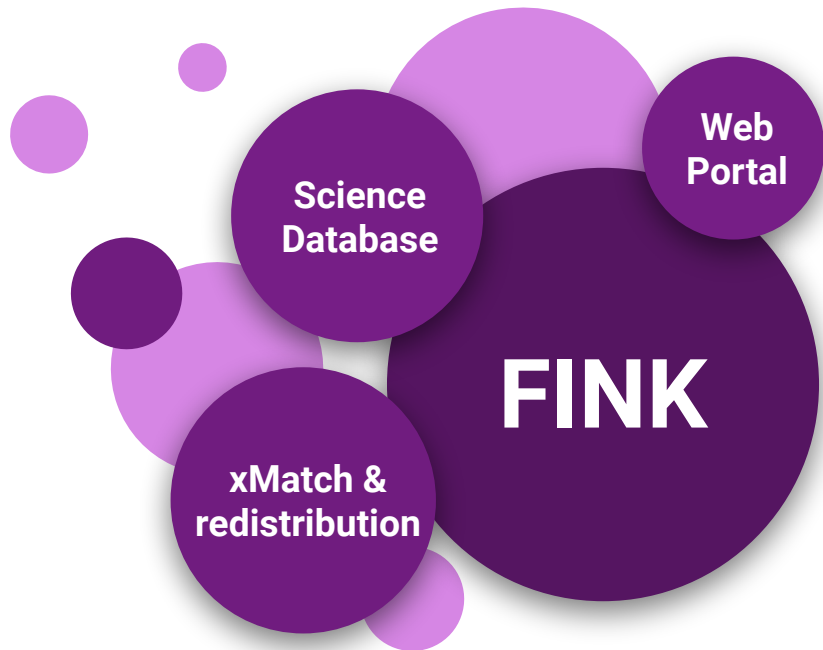


Anomaly detection



# Data Products & Services

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- Deployed prototype in the Cloud (@UPsud).
  - Ongoing discussions with CC IN2P3.
- Enabling Adaptive Learning
  - Possibility to access continuously updated classification and anomaly scores.
- Envisaged Data Products & Services:
  - Cross-match with existing catalogs and other experiment alert streams.
    - Forward-filtering and data mining platform.
  - Output from ML-based algorithms.
  - List of targets which should be prioritized by follow-ups.
  - Remote client & web portal to access broker data.

# Coordination

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- Identifying interesting LSST alerts is only part of the story: we need **coordination** with other follow-up resources (e.g. spectroscopic) and existing networks.
  - Your expertise is important to us!
- We will regularly **publicize a prioritized list of targets** for each science case that should be followed in order to improve future estimates.
  - How to integrate this in the current landscape?
- The future is now: let's discuss on how to coordinate with existing follow-up resources (ToO, TOM or TNS) and surveys.

**We need you!**

# To conclude...

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- White paper for the Prospectives IN2P3 GT04 (astroparticules)

# To conclude...

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- White paper for the Prospectives IN2P3 GT04 (astroparticules)

**“Viendez les copains!”**

*JCT, TS2020 III*