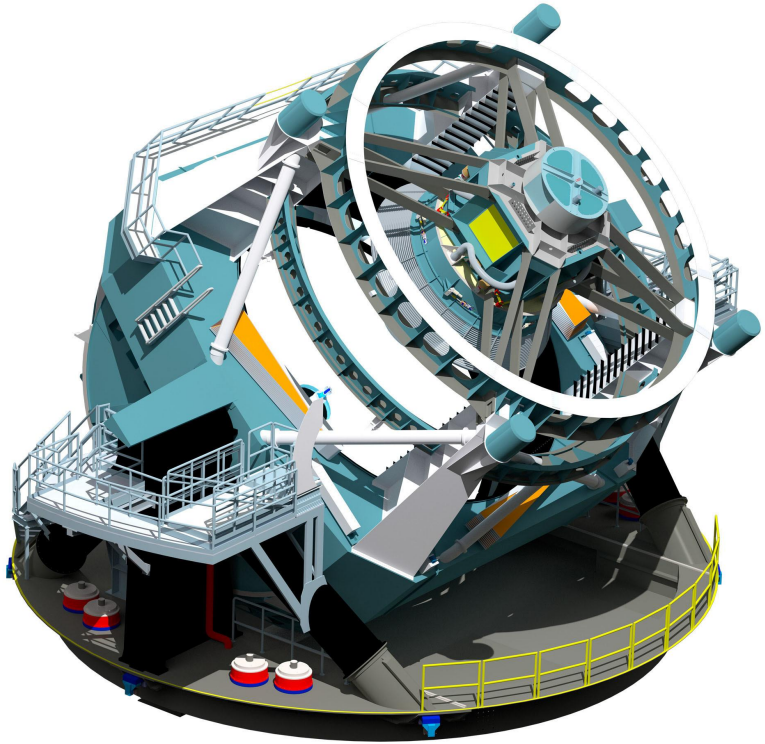
LSST alerts: Who, What, When, Where & Why.

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

Public data!

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

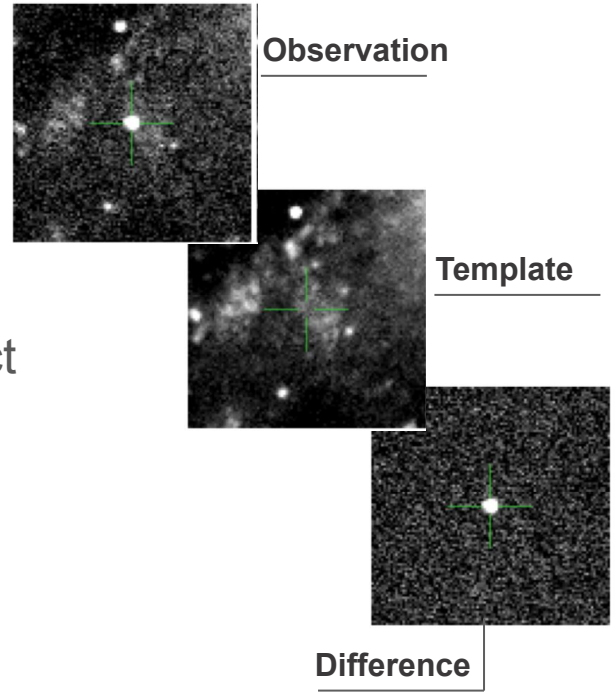
Final 10yr Data Release
Images: 5.5 million x 3.2 Gpx
Catalog: 15PB, 37 billion objects

Alert packet anatomy

Alert packet

- Source record that triggered the alert
- Other measured source properties
  - Timeseries features
  - Crossmatches to nearby LSST detected object
- 12 months of 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



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

Some Data Challenges...

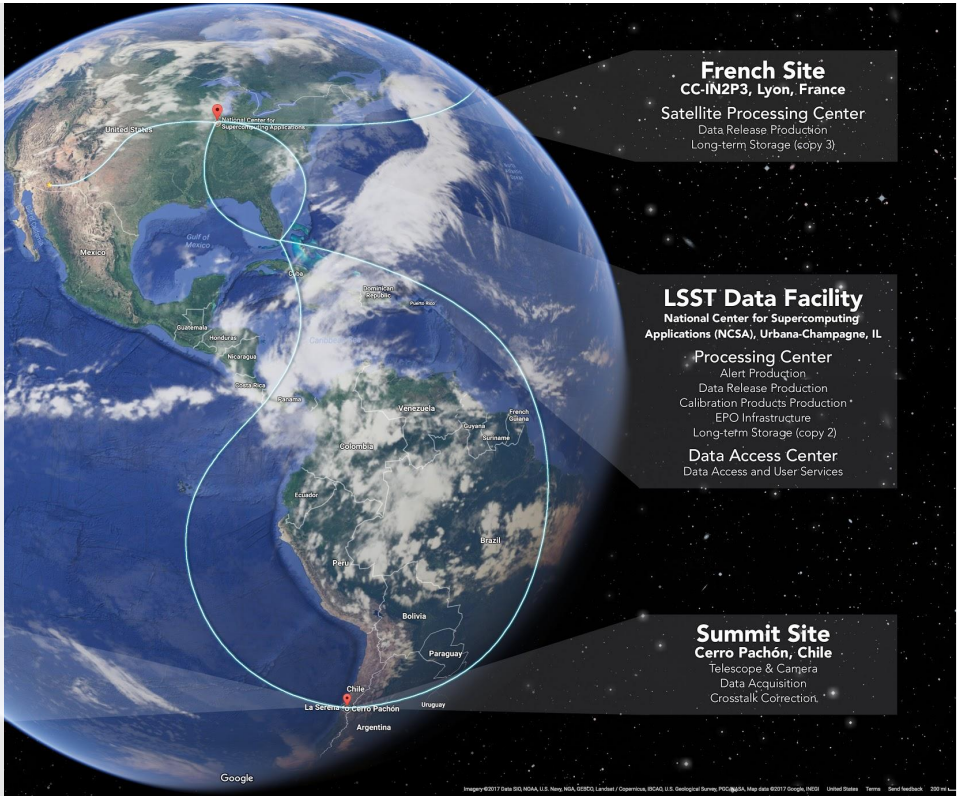
Forecasted: 10 million alerts per night…

- Current serialisation implies ~82KB/alert, 800 GB/night, 3PB in 2030.

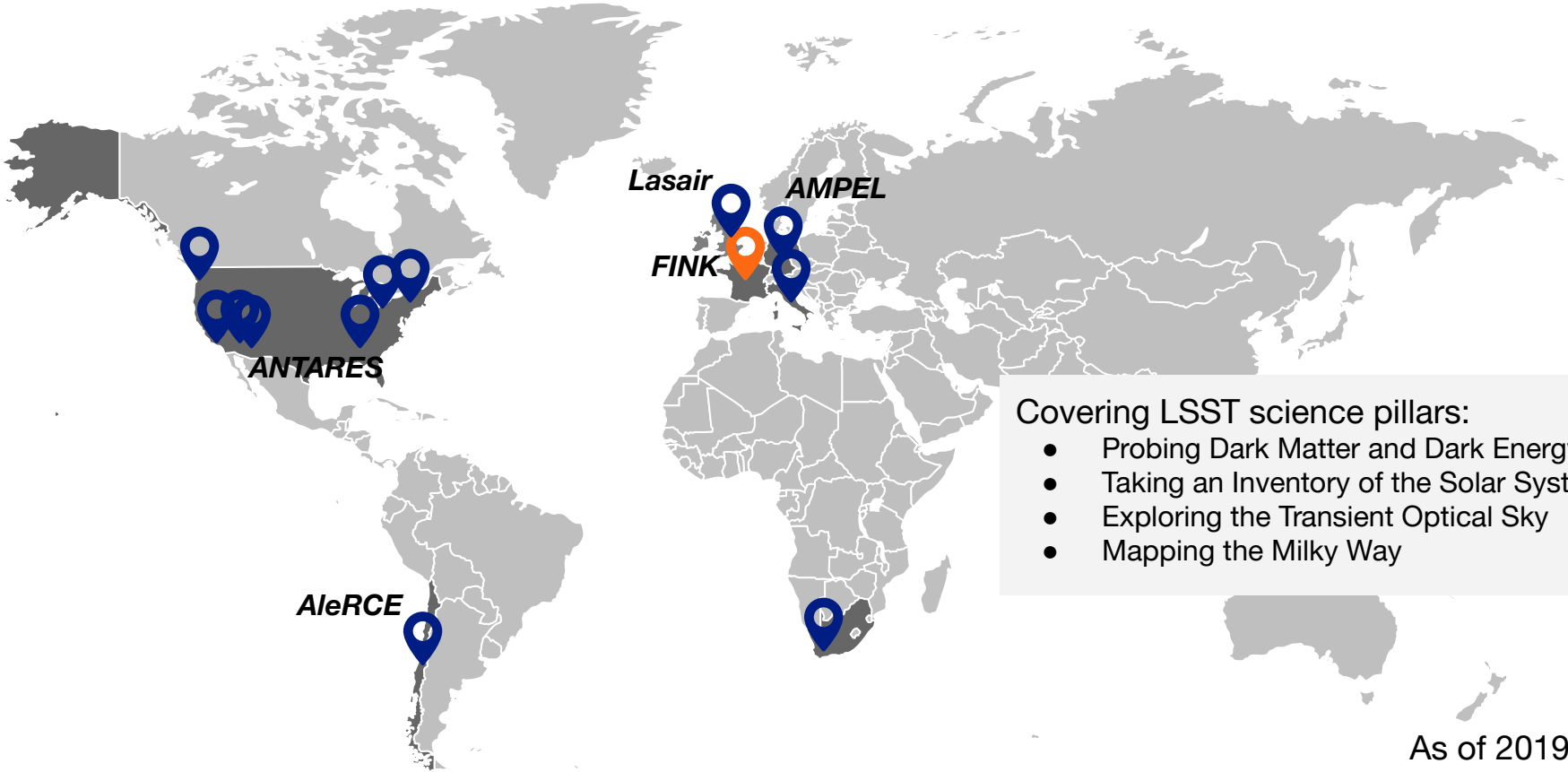
98% of alerts must be transmitted with 60 seconds of readout…

- … and processed before the next night!

Wires to send alerts worldwide are not infinitely big...



LSST Broker landscape

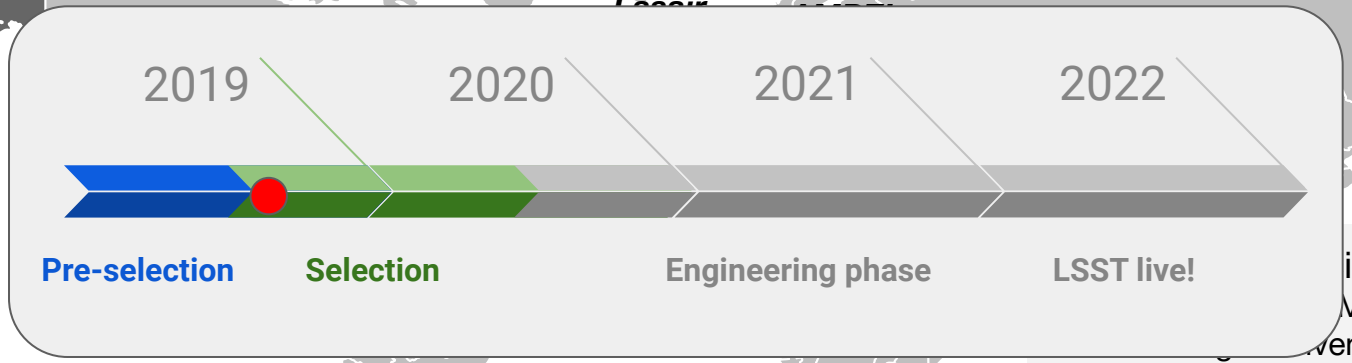


Covering LSST science pillars:

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

As of 2019

LSST Broker landscape



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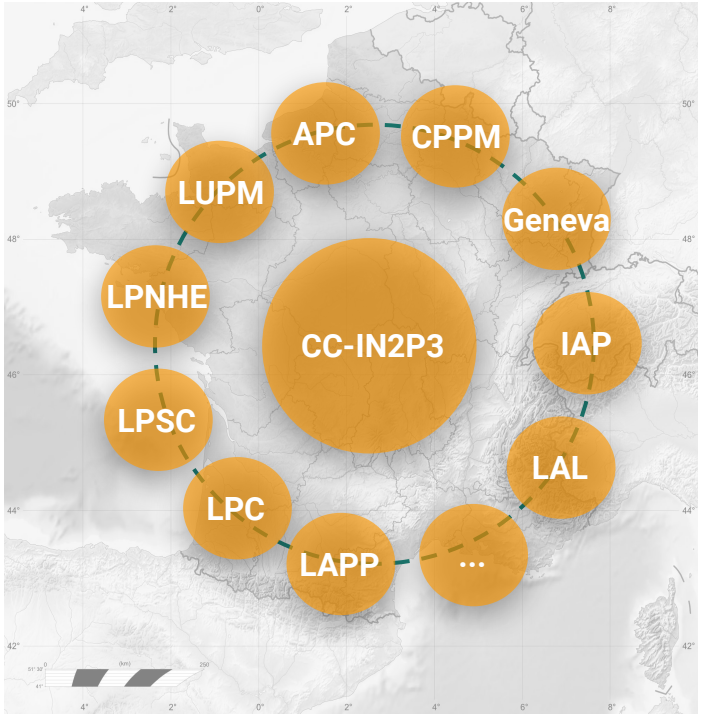
AleRCE

As of 2019

Fink Collaboration

IN2P3 initiative to propose a broker to serve the need of LSST-France as well as the different french multi-messenger astronomy actors.



Our added values (other than std broker)

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

Fink in few dates

02/19: Start

- LAL & LPC

05/19: Letter of Intent.

- ~30 endorsers (IN2P3, INSU). ⅓ non-LSST.

06/19: LSST broker workshop

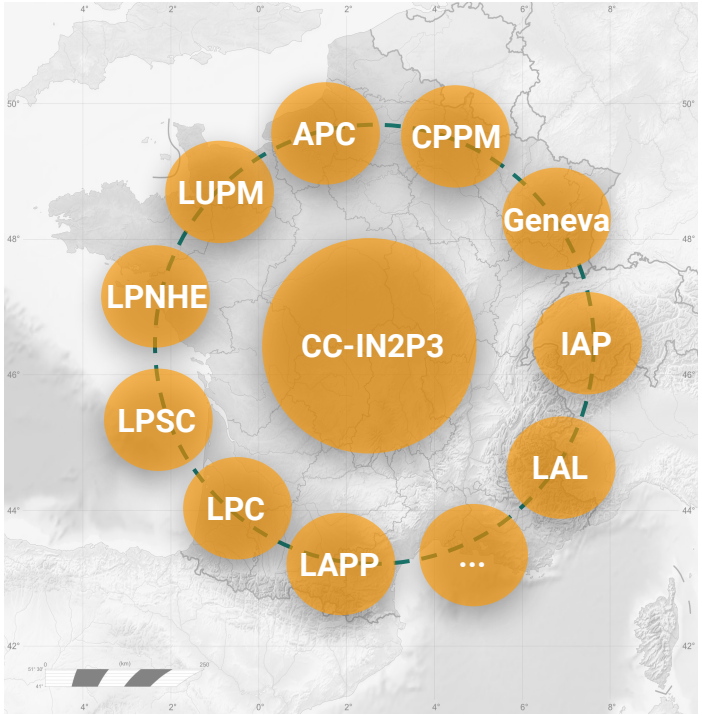
- Official presentation

08/19: Pre-selection by LSST

- Full proposal by Q2 2020

09/19: GT04 IN2P3 prospectives

- IN2P3 + INSU, CEA. ⅓ non-LSST.



Current prototype

Deployed broker instance for R&D in the VirtualData Cloud (UPSud)

- **Communication**: Apache Kafka cluster (5 machines, 20 cores)
- **Processing**: Apache Spark cluster (11 machines, ~200 cores)
- **Science DB**: Apache HBase (1 machine, 6 cores).

Science storage: 35TB distributed storage (HDFS, Ceph + s3)

Tests in near-real condition with good scalability:

- **LSST rate:** 10,000 alerts/30 seconds (tested up to 10x this with margins).
- **LSST science content:** Alerts coming from ZTF (LSST pathfinder).
- **Science filters:** Only simple filters active so far.

Client for physicists under tests.

Fink for all

Done

Individuals

Subscribe to filtered streams and play with alerts.

Ongoing

Telescopes

communicate filtered streams, collect other streams and cross-match.

Ongoing

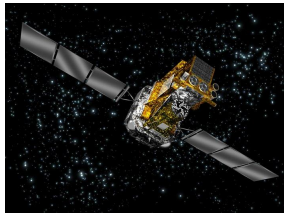
TOM, TNS, ...

Communicate filtered streams and publish new results.

CDS
CENTRE DE DONNÉES ASTRONOMIQUES DE STRASBOURG

TOM
TOM TOOLKIT Las Cumbres Observatory LCO

GRANDMA



SVOM

KM3NeT

Keys for success

- The structuration of communities beyond individual experiments.
- Insure a stable, long lasting solution for coordination of alerts in MMA landscape.
- Connect different communities with efficient frameworks.
- Sustain and benefit from activities already deployed or under development.
    - IVOA, standard tools, communication protocols, networks of telescopes

We need you!

How to contribute?

- **LSST -> You**
  - Co-designing modules to narrow down the stream for your science. Useful to plan follow-up observations as well.
  - Modules range from simple filters to more complex object identification.
  - Protocol of distribution: Kafka (ready), or VOEvent (planned). Examples shall be ready soon. Contact us!
- **You -> LSST**
  - We can cross-match your alert flux with LSST one, and you can be informed of LSST counter-parts.
  - We need to define what “match” means: position, or other properties?

To conclude...

By investing now, the **French community** at large would secure a **prominent place** in this global effort, guaranteeing the scientific return on both LSST and collaborating scientists and experiments **for the next decade**.