Astro-COLIBRI

COincidence **LIB**rary for **R**eal-time **I**nquiry for multi-messenger astrophysics

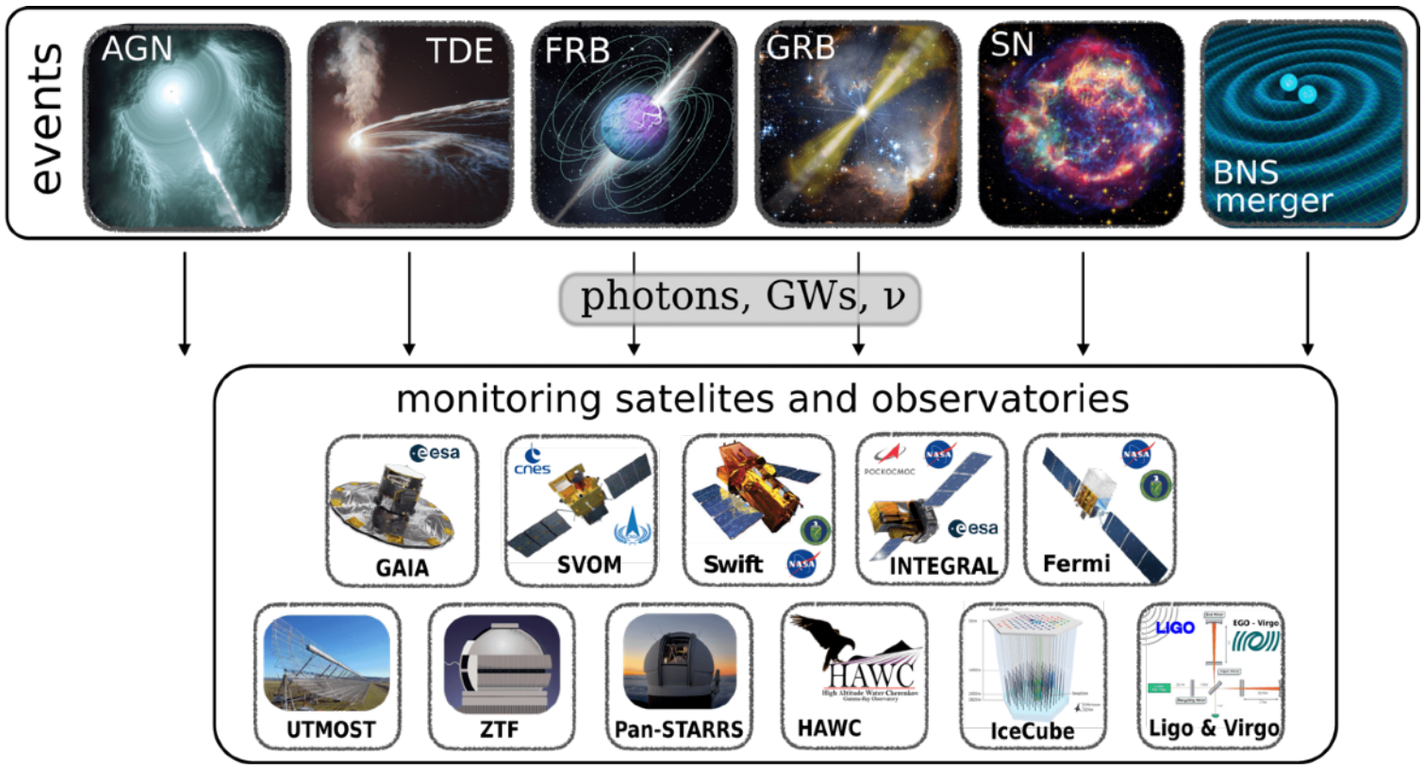
Challenges of time domain astrophysics

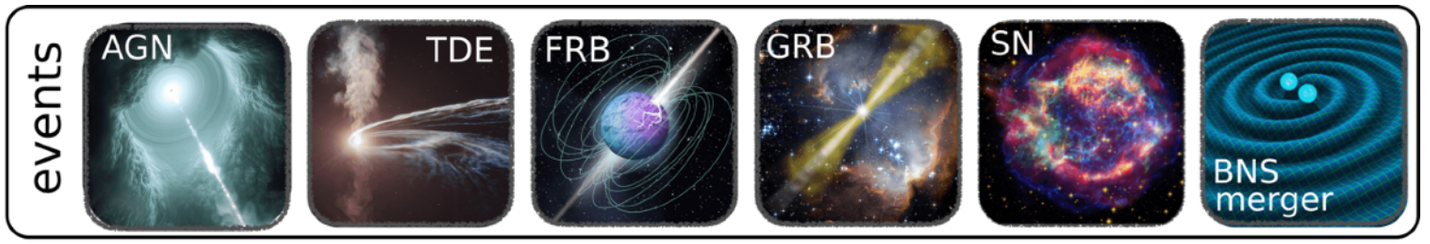
Fabian Schüssler (IRFU, CEA Paris-Saclay)

MOTS

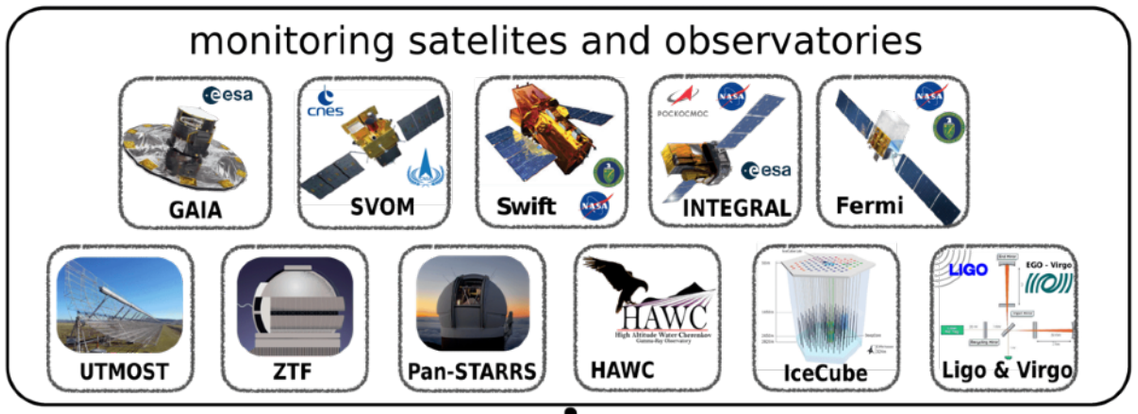
AHEAD 2020

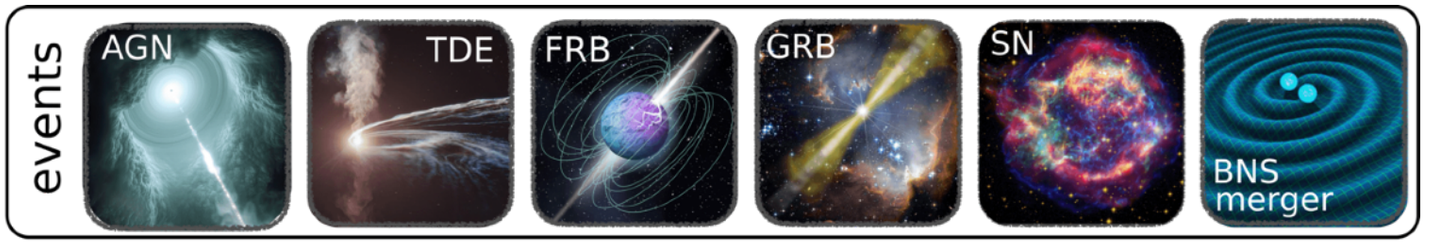
Funded by the Horizon 2020 Framework Programme of the European Union Grant Agreement No. 871158


events
AGN
TDE
FRB
GRB
SN
BNS merger
photons, GWs, ν
monitoring satelites and observatories
GAIA
SVOM
Swift
INTEGRAL
Fermi
UTMOST
ZTF
Pan-STARRS
HAWC
IceCube
LIGO
EGO - Virgo
Ligo & Virgo

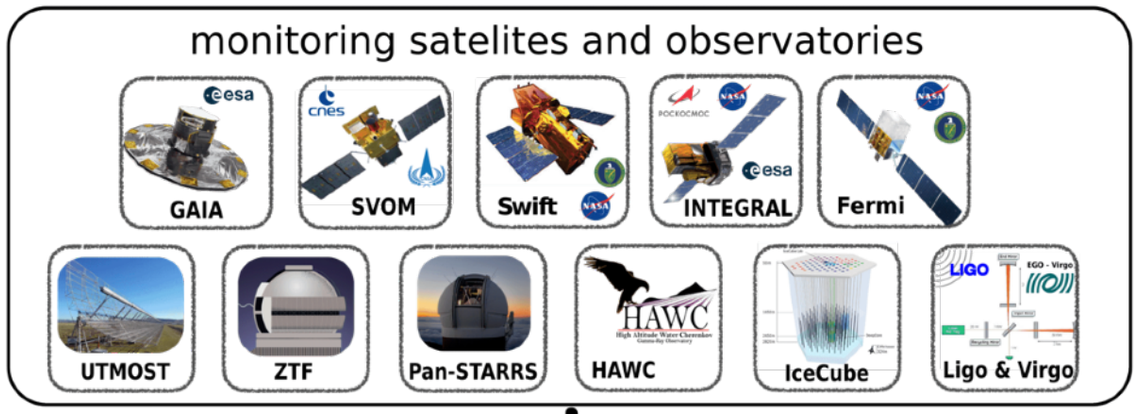


photons, GWs, ν





photons, GWs, ν



follow-up-observ.

The following new classification/s were reported on:

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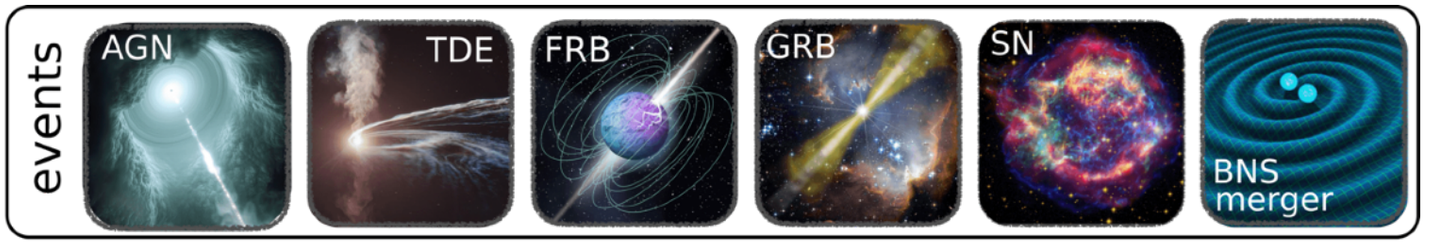


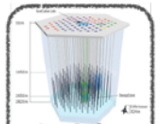
photons, GWs, ν

monitoring satelites and observatories

events

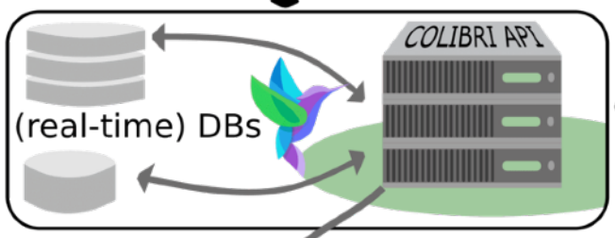
photons, GWs, ν

monitoring satelites and observatories



follow-up-observ.

alert
- creator
- streams
- broker

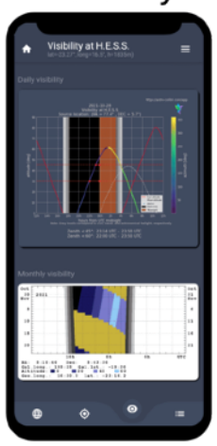


detailed event/src. info

push alerts

cone search

visibility



event info

Astro-COLIBRI App / Website

Web interface

https://astro-colibri.com

Android + iOS

Alert notifications in real-time

https://astro-colibri.science

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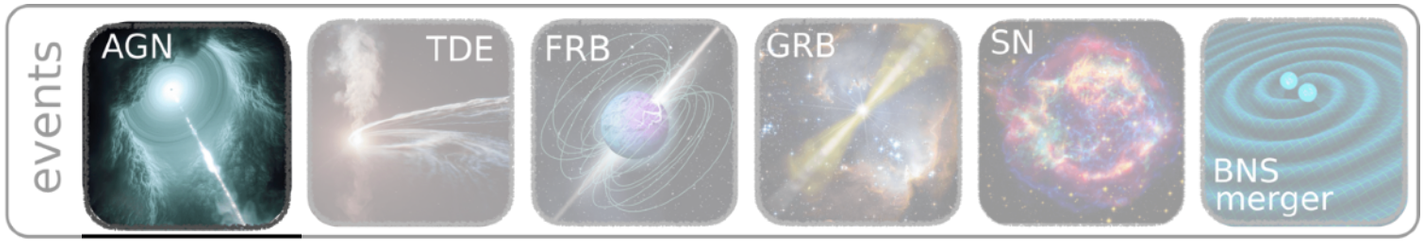
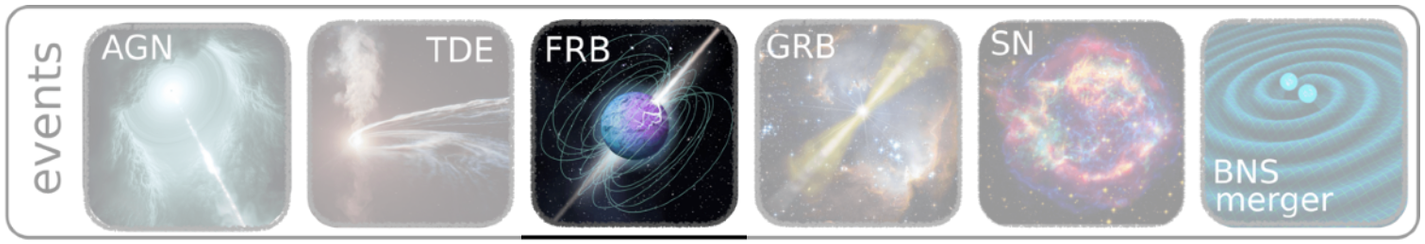


Manual data analyses

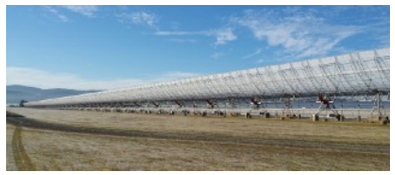
The Astronomer's Telegram

Manual “analyses” (i.e. reading)

Natural language processing ?!?
ChatGPT ?!?



photons, GWs, ν



UTMOST

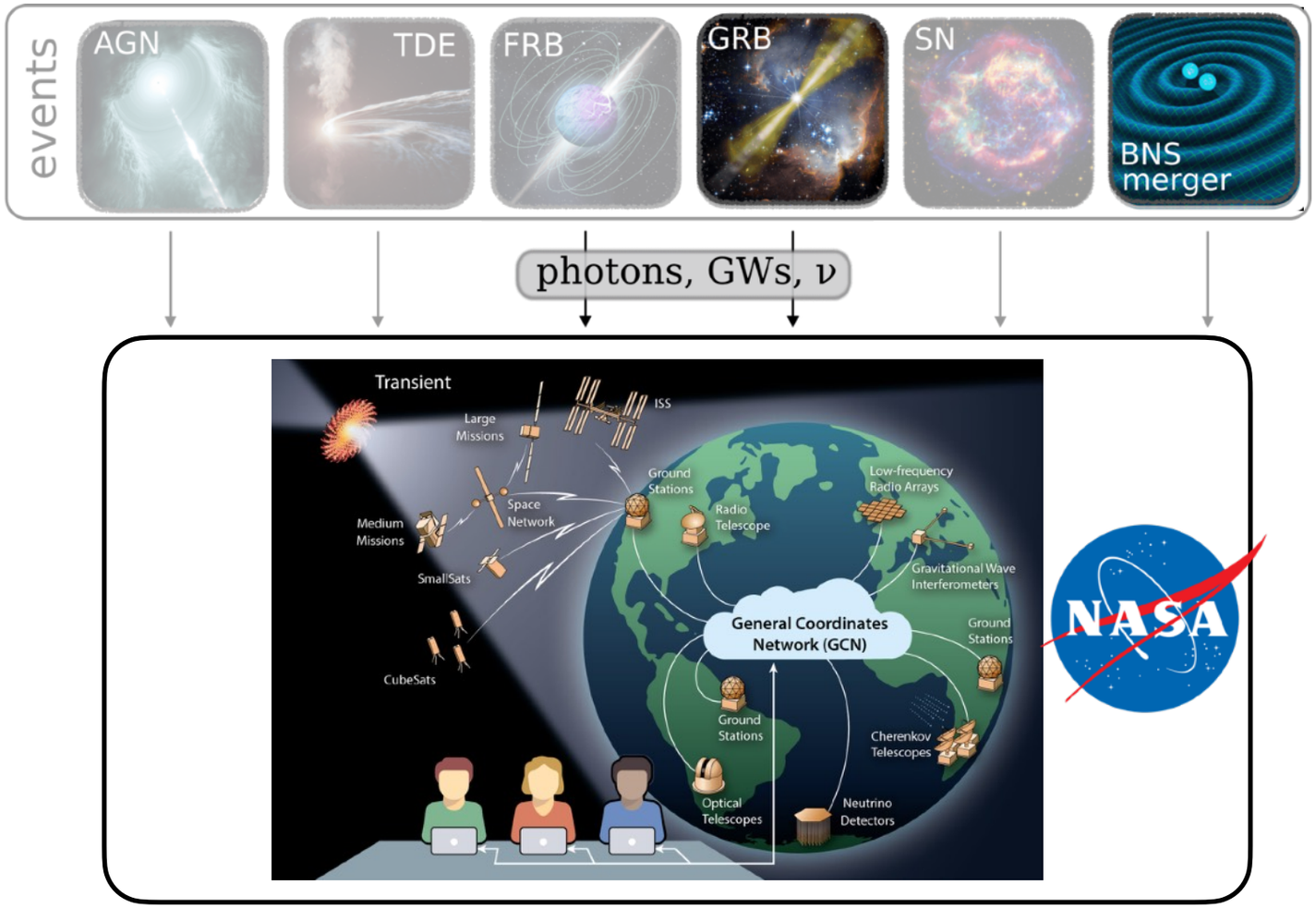
CHIME

Everybody else (?)

Automatized analysis
Alert emission via VoEvents
Currently offline (?)

Automatized analysis
Alert emission via *private* VoEvents

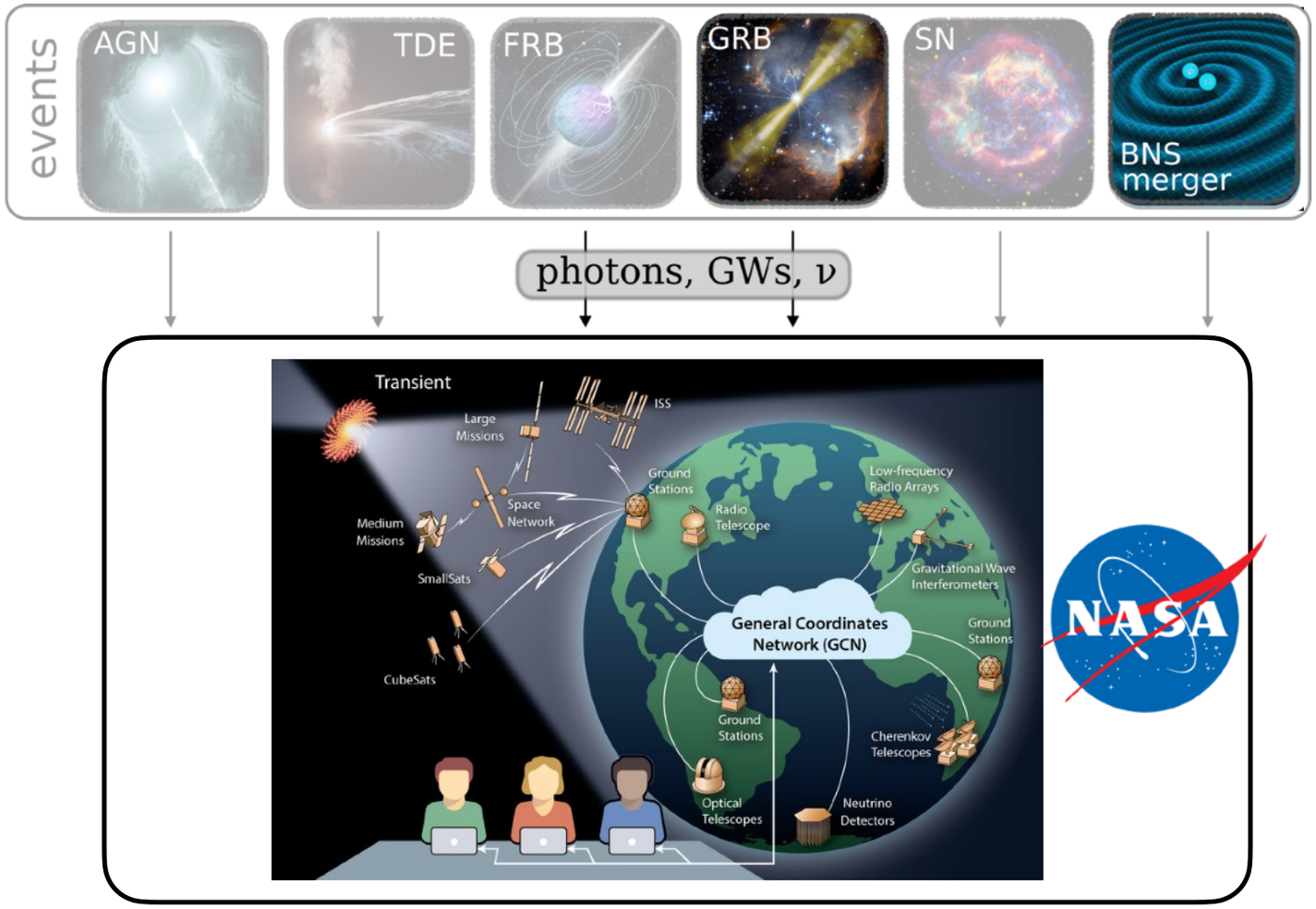
Manual + automatized analyses
Partially submission to TNS
Alerts via email
API access => JSON

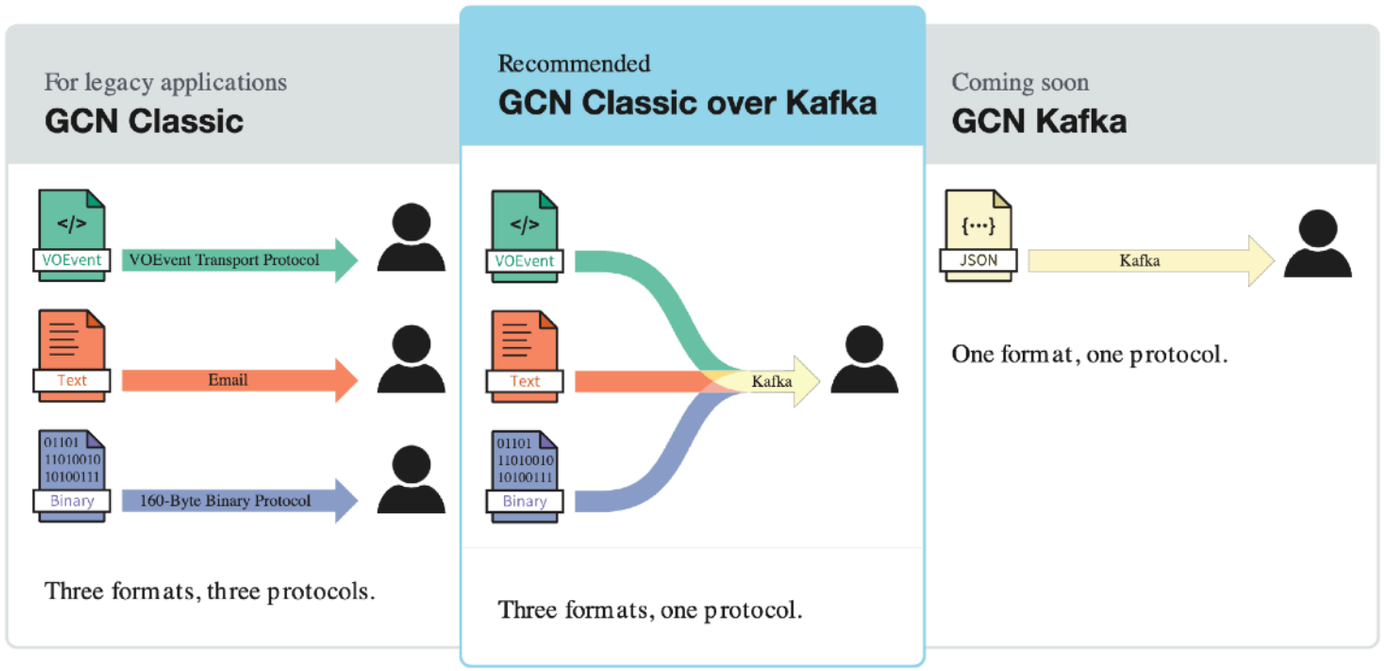


Long history of alerts for GRBs (since 1993)
Currently the default platform for a large range of transients: GRBs, GWs, neutrinos, SGRs, etc.

Different distribution methods:

- VoEvents over VoEvent protocol
- Binary over 160Byte binary protocol
- Text + VoEvents by email





Transition started in summer 2022

link

Summary

- Time domain astronomy relies on efficient and interoperable exchanges of information
- Increasing number of detections and larger variety of phenomena (GRBs, FRBs, TDEs, SNe, OTs, high-energy neutrinos, GWs, etc.)

- New requirements (?) and new developments
- Increasingly fractured landscape of alert formats and transport protocols
    - GCN moving away from VoEvent
    - FRBs: TNS (non-VO) + Chime continuing VoEvent emission (?)
    - LSST: new brokers with new formats (Avro over Kafka)
    - …

Astro-COLIBRI

- Astro-COLIBRI: automatic pipeline providing easy access to
  - transient detections (GRBs, FRBs, TDEs, SNe, OTs, high-energy neutrinos, GWs, etc.)
  - interfaces: Web, Android, iOS + API
  - availability > 99% (fully cloud based architecture)
- Version 1.0 released in August 2021 (>500 users/month at the moment)
  - New releases roughly every 1-2 months
- P. Reichherzer et al., ApJS 256 5, 2021 (link) + Galaxies 11(1), 2022 (link)
- 2nd Astro-COLIBRI Multi-Messenger Workshop: November 20-24, 2023

Astro-COLIBRI

Contact: astro.colibri@gmail.com

- Central webpage: **https://astro-colibri.science**

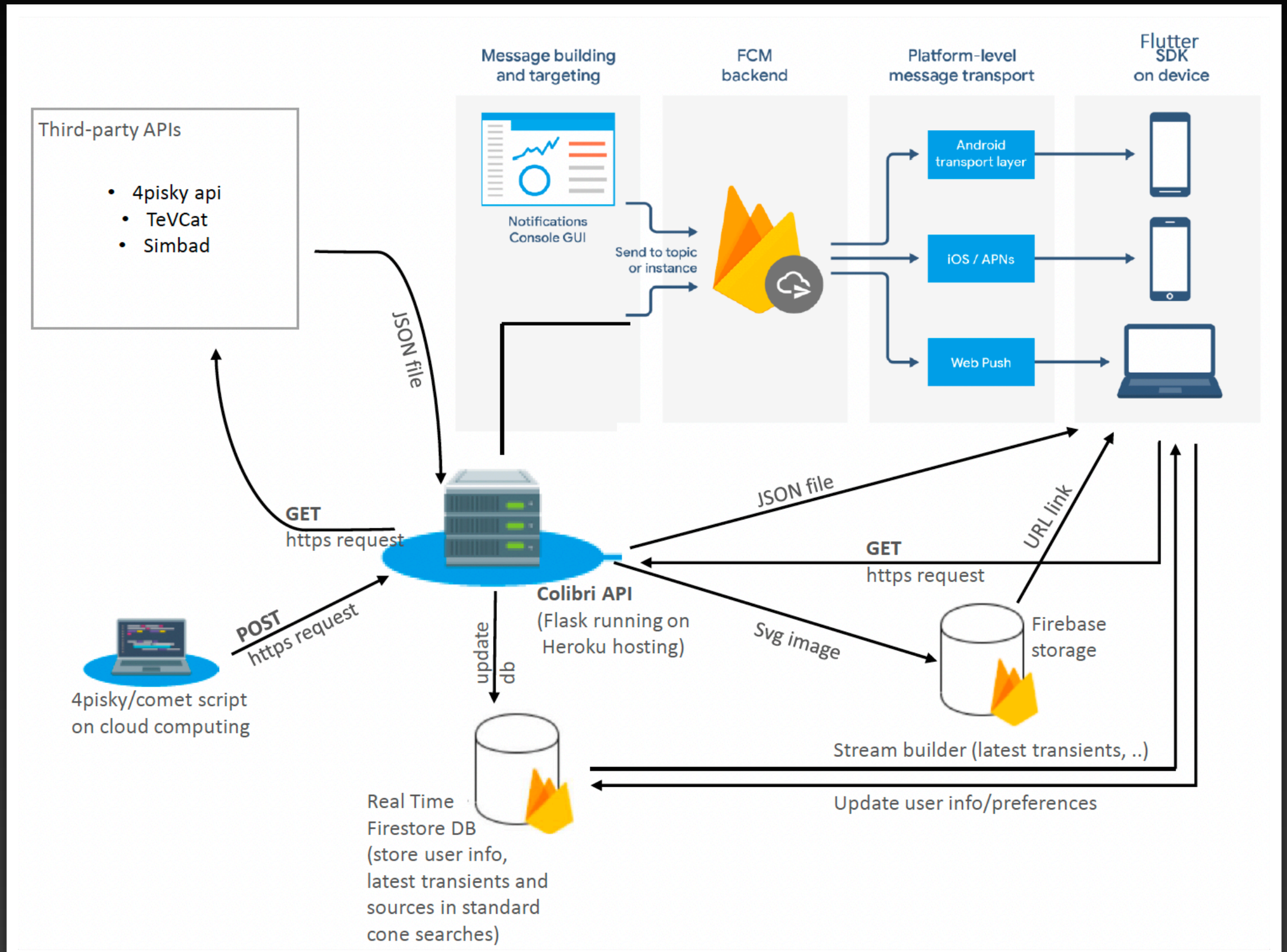
Android Play Store

Apple iOS App Store

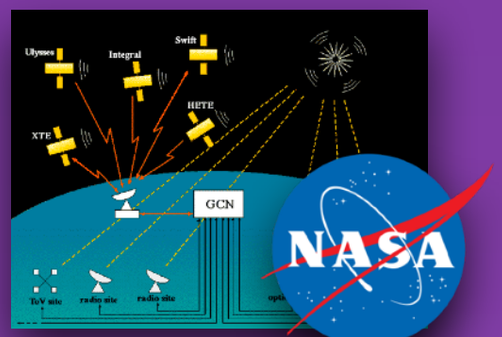
Introductions/tutorials on YouTube

Twitter: @AstroColibri

Architecture



Main idea



TRANSIENT NAME SERVER

four π sky

Fermi Gamma-ray Space Telescope

AMON Astrophysical Multimessenger Observatory Network

LSC LIGO Scientific Collaboration VIRGO

SVOM

FINK

ALeRCE Automatic Learning for the Rapid Classification of Events

...

SIMBAD

ALADIN

Fermi Gamma-ray Space Telescope

SSDC SPACE SCIENCE DATA CENTER

esa

IVOA

NED

...

Gamma-Catcher

- Arcade game with a high-energy + time domain astrophysics background => outreach
- www.gamma-catcher.com + **Android PlayStore**