ZADS

The ZTF Alert Distribution System

Eric Bellm

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Who am I?

2011-2016

postdoc at Caltech

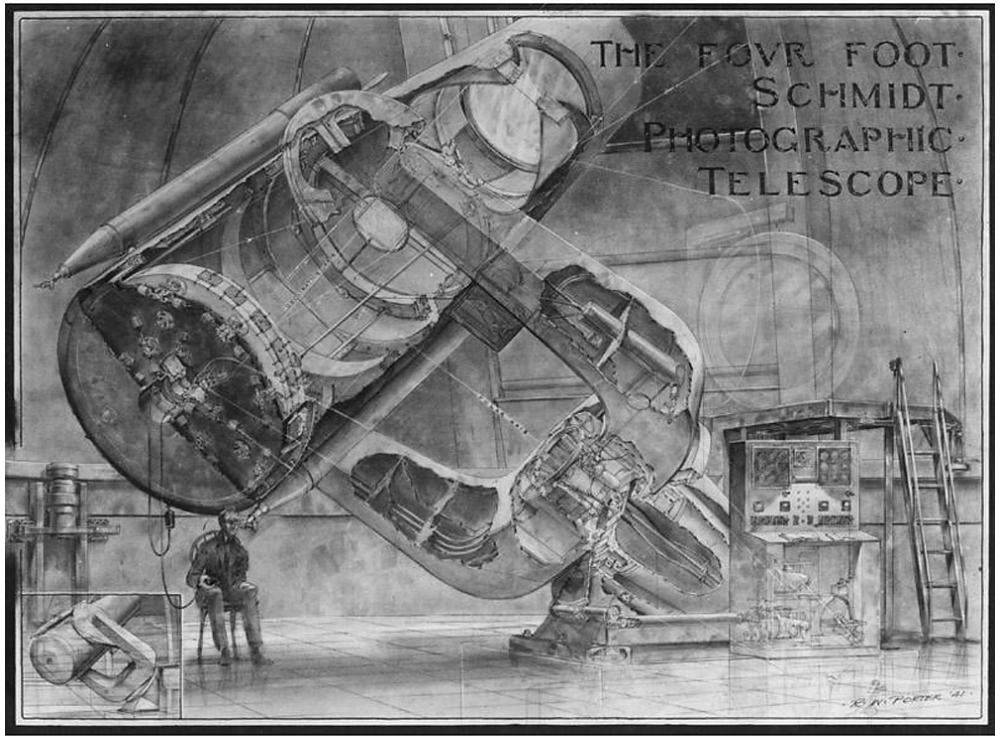
2017-

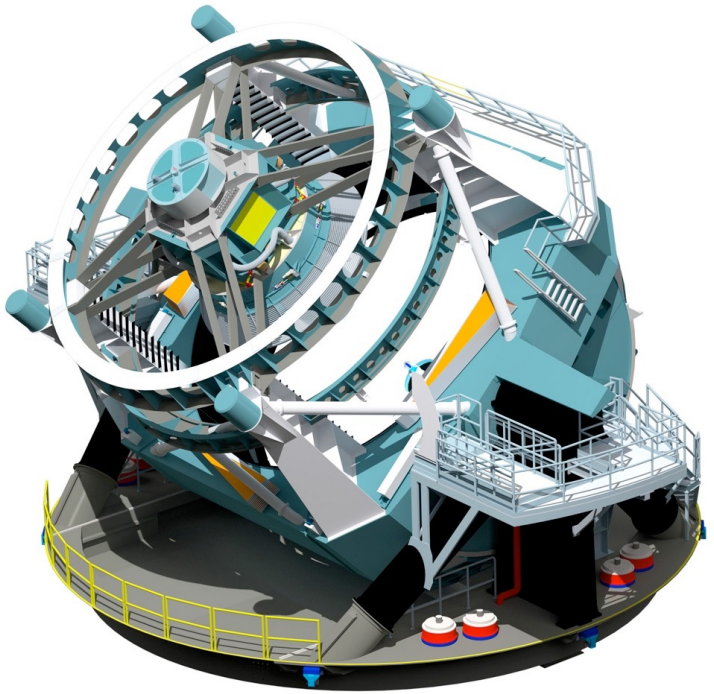
Research Assistant Prof. at UW

ZTF Project Scientist

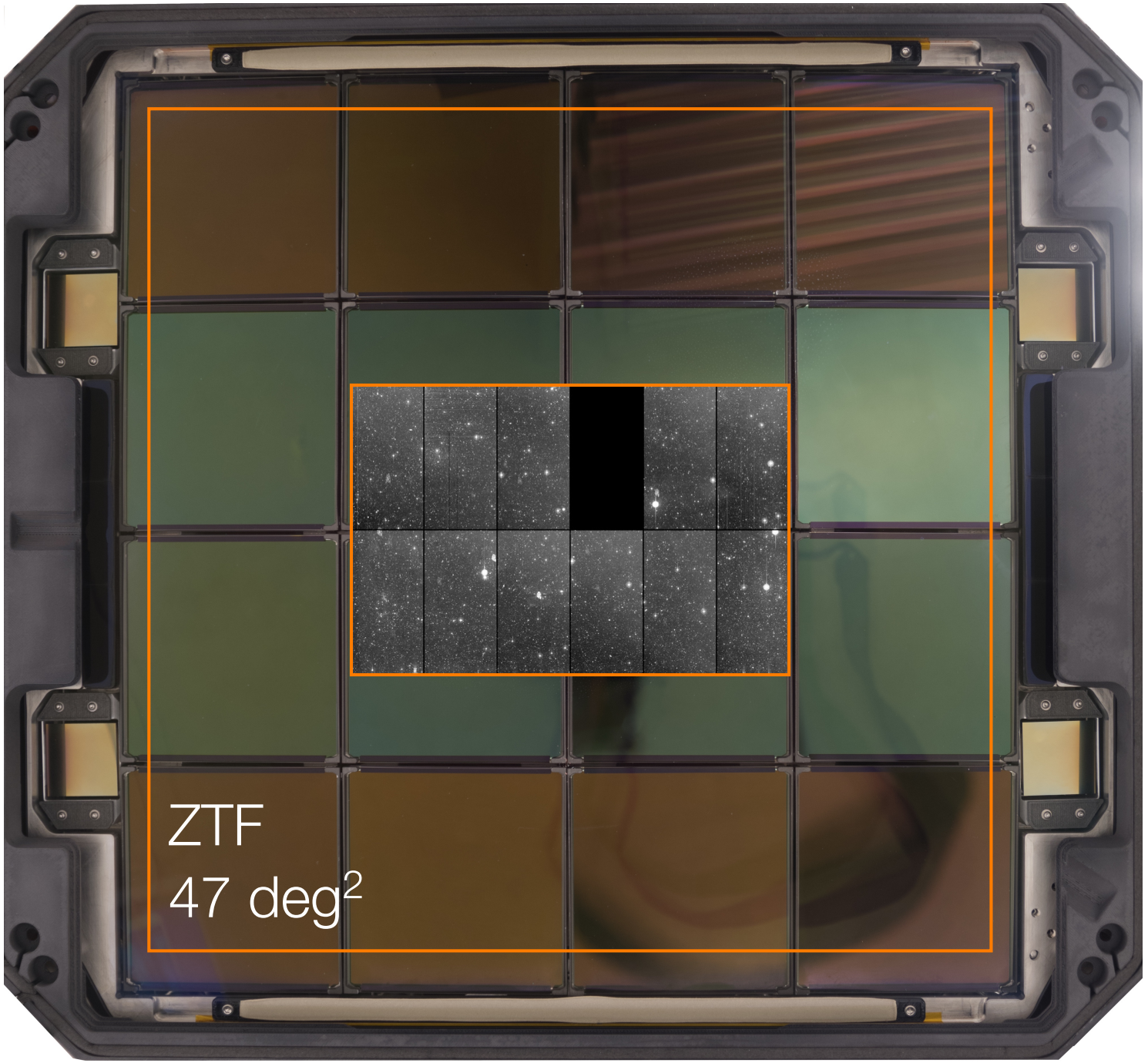
LSST DM Alert Production Science Lead

ZTF Survey Scientist





ZTF's uses a new camera to fill the P48 focal plane.



ZTF will survey an order of magnitude faster than PTF.

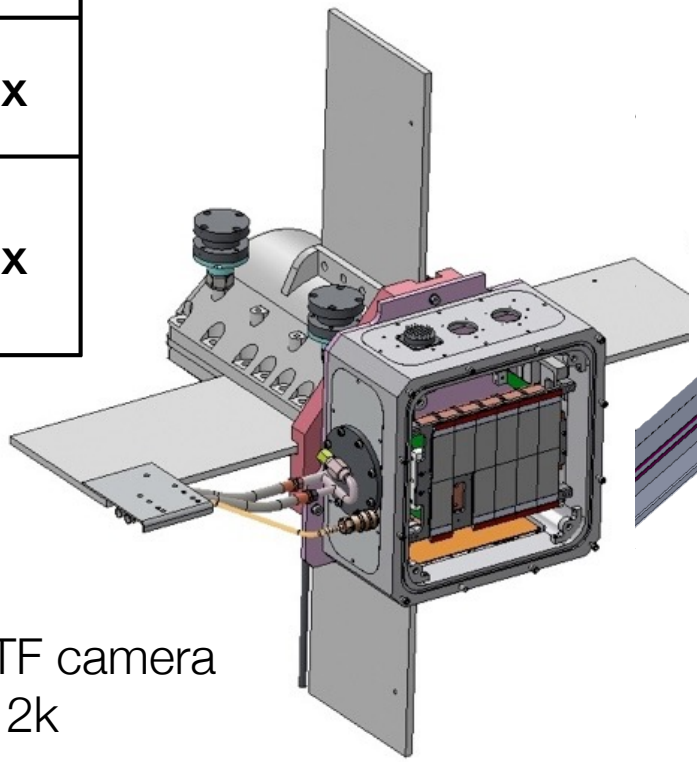
	PTF	ZTF
Active Area	7.26 deg^2	47 deg^2
Overhead Time	46 sec	<15 sec
Optimal Exposure Time	60 sec	30 sec
Relative Areal Survey Rate	1x	**15.0x**
Relative Volumetric Survey Rate	1x	**12.3x**

3750 deg^2/hour

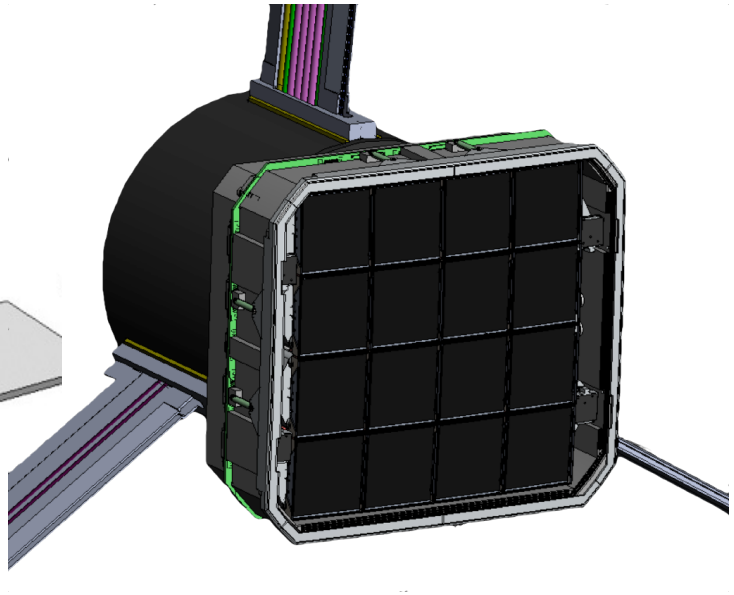
⇒ 3π survey in 8 hours

>250 observations/field/year

for uniform survey



Existing PTF camera
MOSAIC 12k



New ZTF camera:
16 6k x 6k e2v CCDs

ZTF will perform two general purpose public surveys for the US community.

Will use 50% of the collaboration time to survey the visible Northern Sky at all Galactic latitudes

Two visits/night (g+r) for asteroid rejection ⇒ 3-day average cadence

Similar to LSST Wide-Fast-Deep
systematic samples of supernovae, SLSNe, TDE, AGN, variable stars…

Nightly sweep of the Galactic Plane (|b|<7°; nightly g+r)
rare and exotic variables and binaries, CVs and novae, M-dwarf flares, large-scale gyrochronology, young star outbursts, and more

MSIP surveys will be revised with community input after ~18 months.

MSIP funding provides access to PTF, iPTF, & ZTF data.

2015: Complete PTF archive released

see http://www.ptf.caltech.edu/page/data_access

2016: Initial public release of iPTF data & public lightcurve interface

2017: ZTF first light & commissioning

March 1: iPTF decommissioned

September 6: estimated first light

October 2: estimated transition to science validation

2018: Survey start

January 1: Formal ZTF survey begins

Q2: public alert stream starts

2019: Public alerts continue; Y1 data release; revise MSIP surveys

2020: End of MSIP-funded survey; final data releases

Why are we building ZADS?

ZTF promised (as an MSIP deliverable) an “LSST-like” near-real-time alert stream of the public survey to build up community infrastructure

⇒ ZTF needs a production alert stream

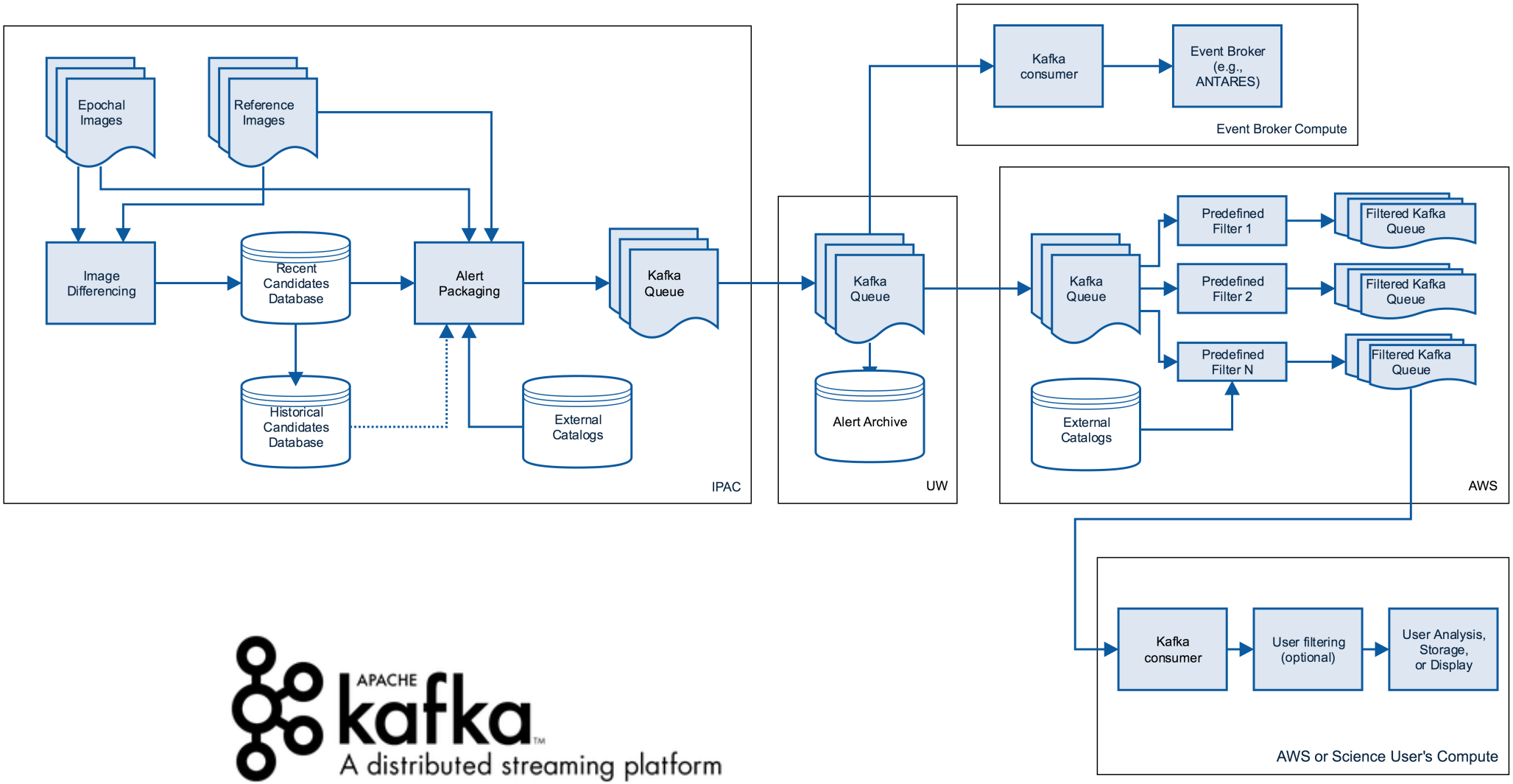
UW LSST group is responsible for producing the actual LSST transient stream (“Level 1”, “Alert Production”).

- Image processing
- Image differencing
- Alert packaging and distribution

⇒ UW interested in prototyping distribution system on real data

Opportunity for community to develop infrastructure in preparation for LSST.

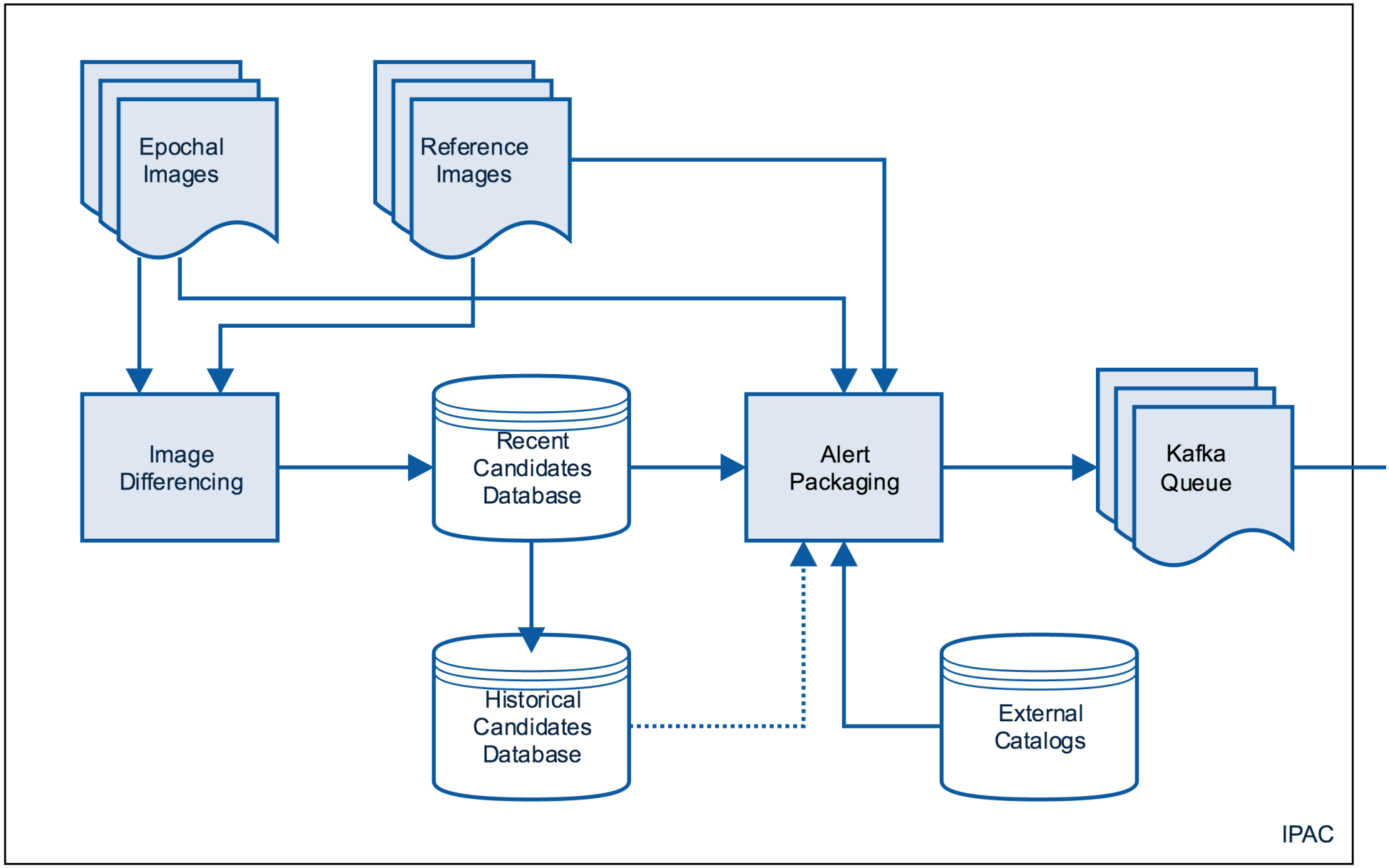
ZADS will use Kafka, an industrial queue system.



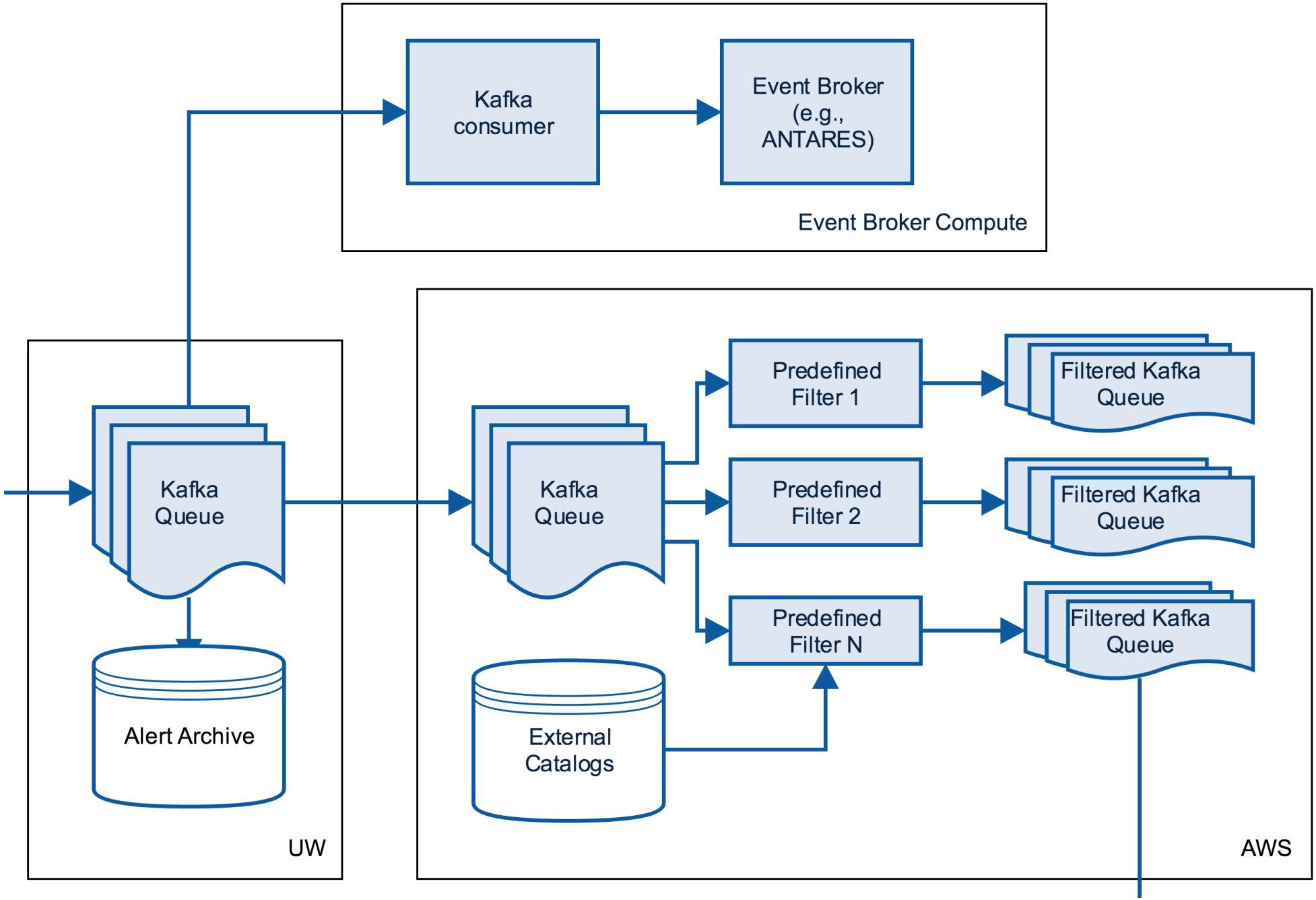
APACHE kafka™
A distributed streaming platform

find events by *filtering* alert stream (stream)

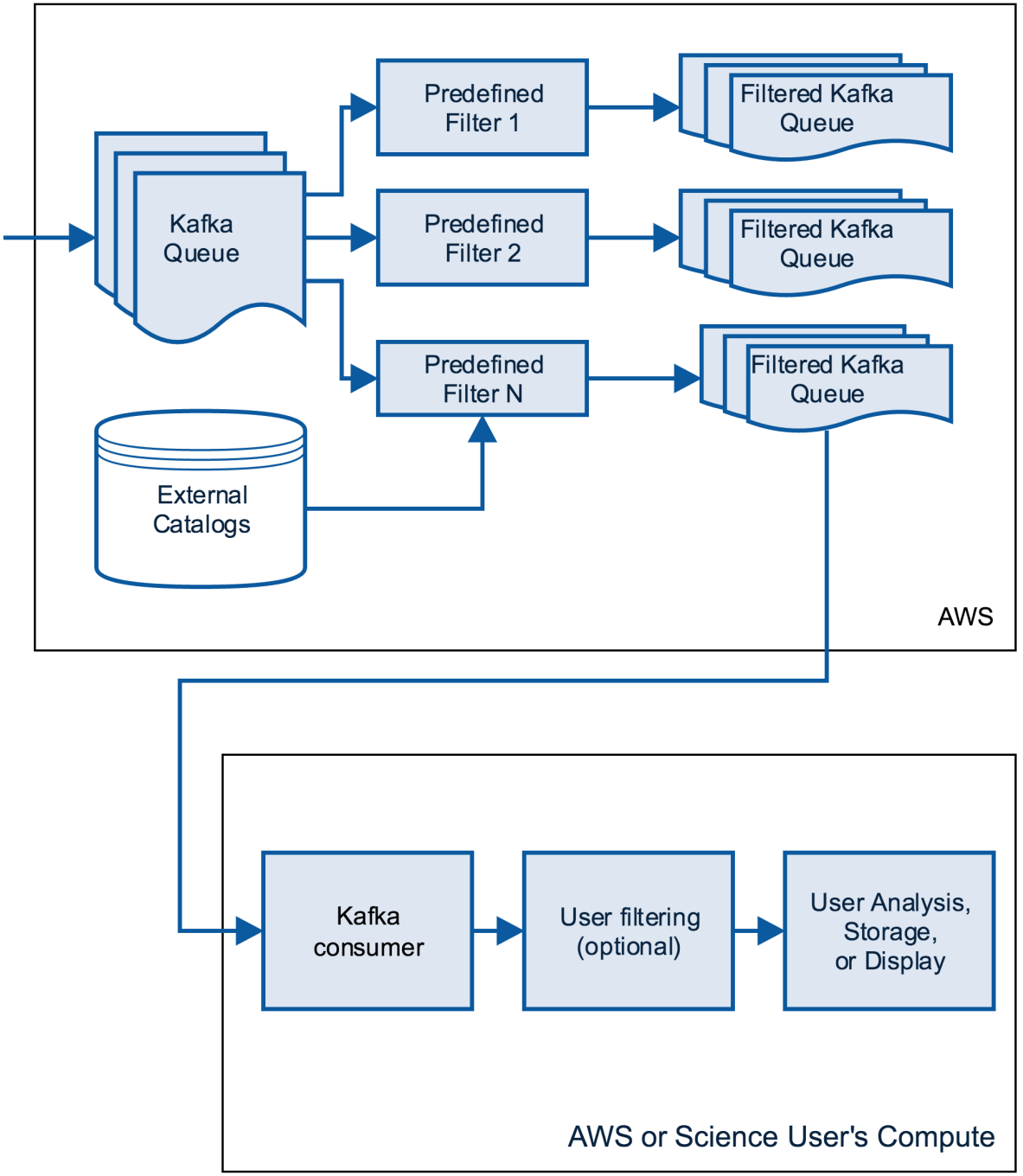
Image processing and alert packaging happens at IPAC.



ZADS feeds event brokers and a filter system.



We expect many users will consume filtered streams.



ZADS will use rich alert packets modeled after LSST's.

ztf.alert https://zwickytransientfacility.github.io/ztf-avro-alert/

The top-level alert contains the following fields:

Field	Type	Contents
`alertId`	long	unique identifier for the alert
`candid`	long	unique identifier for the subtraction candidate
`candidate`	`ztf.alert.candidate`	candidate record
`prv_candidates`	array of `ztf.alert.prv_candidate` or null	candidate records for 30 days' past history
`cutoutScience`	`ztf.alert.cutout` or null	cutout of the science image
`cutoutTemplate`	`ztf.alert.cutout` or null	cutout of the coadded reference image
`cutoutDifference`	`ztf.alert.cutout` or null	cutout of the resulting difference image

candidates record contains:
position, time, filter, magnitudes, Real/Bogus score, distance to nearest reference source, PSF metrics, solar system counterpart (if applicable), star/galaxy score, PS1 crossmatch, number of past detections in the survey, number of past observations

ZADS will provide a filtering service similar to the LSST mini-broker.

In an alert-based architecture, filtering is critical for science productivity: return only the subset of events of interest

ZADS provides a natural *stream->filter->stream* interface: input stream and output stream have same UI

Containerized filter service: downstream users can append further filters (re)using the same code.

We will begin by building a set of ~10 hard-coded filters to get up and running.
E.g., listen to the Young Supernova channel, or potential asteroids channel

Expand to more sophisticated approaches as time and resources allow—no inherent technical limitation.

Single-packet alert filtering covers many use cases.

Description	Examples
Drop columns/alert fields	Remove image cutouts from the alert packet
Filter on a scalar value in the packet	RB cut, star-galaxy cut
Filter on logical combinations of several fields	PS1 color cut AND outburst amplitude cut
Filter on past detection history	Two detections separated by > 20 minutes with no previous
Filter on image cutouts	User-computed RB computation
Filter on a classifying model	Goodness of fit to a SN Ia lightcurve model

Current development status

Initial alert packet format implemented at IPAC
https://github.com/ZwickyTransientFacility/ztf-avro-alert

Sample ZTF packets (from random simulated input) produced

Kafka alert distribution and Spark filtering systems prototyped

UW/AWS hosting being arranged

Initial filter brainstorming in progress

Documentation work beginning; focus on interfaces & sample code