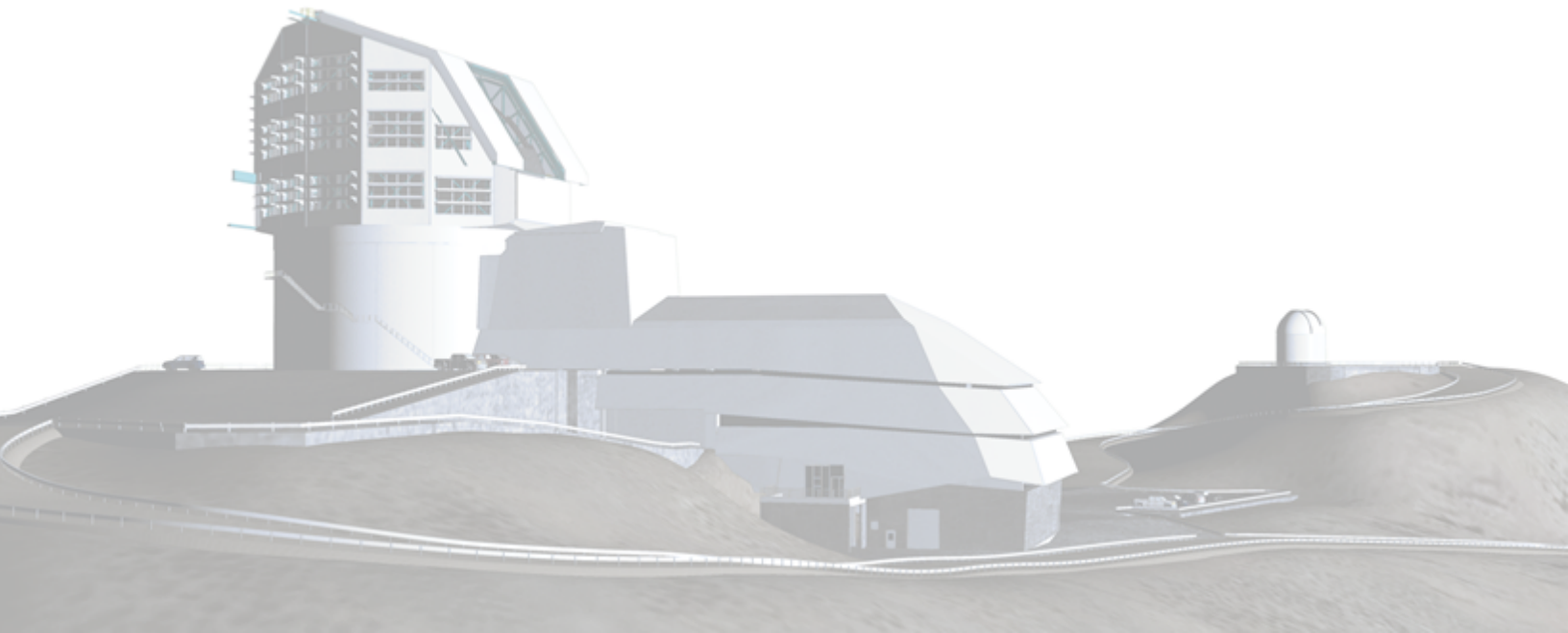

Vera C. Rubin Observatory
Rubin Observatory Operations

Planning for the First Public Release of LSSTCam Alerts

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RTN-061

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Abstract

Real-time science with LSST will begin with the release of the first public alerts from LSSTCam. This document outlines the technical, scientific, and operational prerequisites needed for beginning Alert Production.

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1 Introduction

World-public alerts produced from image differencing and sent to community alert brokers will enable Rubin Observatory's real-time transient, variable, and solar-system science. Accordingly, the commencement of routine Alert Production is a key gateway for early community science [RTN-011]. The Rubin project aims to release high-quality alerts as soon as is feasible. Once Alert Production begins, it is expected to continue without interruption through the ten-year duration of the LSST survey.

Because image differencing relies on coadded template images, multiple prior observations in the same area of the sky are necessary to generate alerts at that position. Throughout commissioning and the first year of the LSST survey we plan to build up templates incrementally as the data quality and availability allow [RTN-011]. The volume of alerts produced each night will thus scale up gradually with template availability. We must balance generating templates and alerts as early as possible (to provide lengthy lightcurves and early followup) with providing larger volumes of higher quality alerts later (by building deeper, better sampled templates with fewer artifacts).

Necessarily, there will be a night on which the very first LSST alerts are released. As this is likely to occur during the fluid period of commissioning and begins a long-term operational campaign, this document aims to specify gateway criteria for beginning Alert Production. Its goal is to aid Project planning and decisionmaking while clarifying expectations for community scientists and our alert broker partners.

2 Technical Prerequisites

We begin by describing at a high level the major technical capabilities required for routine Alert Production.

2.1 Science Pipelines

Alert production begins with pipeline software which differences new science images against coadded templates and associates the resulting DIASources against static DIAObjects as well as Solar System Objects (SSObjects).

2.2 Prompt Processing and the USDF

The Science Pipelines payloads should be executed by the automated real-time Prompt Processing framework at the USDF.

2.3 APDB and PPDB

Realtime association of DIASources to DIAObjects and SSObjects requires a high-performance database, the Alert Production Database (APDB). Records from the APDB must be replicated to a user-facing Prompt Processing Database (PPDB) [DMTN-268].

2.4 Alert Archive

All transmitted alerts should be archived at the USDF [DMTN-183].

2.5 Broker Connectivity

All selected broker teams [LDM-612] should have had the opportunity to test connectivity to the production Alert Distribution system [RTN-010].

2.6 Alert Latency

While Rubin has high-level requirements on alert latency [LPM-17], achieving 60- or 120-second alert latency is *not* a prerequisite to begin routine alert production. Instead, the gating requirement should be that the processing be fast enough that alert production will not saturate the available computational resources in Prompt Processing for the data expected. We expect to continue improving alert latency on an ongoing basis thereafter.

2.7 Catchup Processing and Error Handling

While Alert Production should proceed in an automated fashion throughout the night, the operations team should have the capability both to manually reprocess failed data and to deprecate bad records.

2.8 Data Embargo

While alerts are a world-public data product [RDO-013], other products produced by Prompt Processing are subject to embargo. Full implementation of the measures described in [DMTN-199] is necessary to begin Alert Production.

2.9 Rubin Science Platform

Subject to the embargo restrictions described above, image and catalog products from Prompt Processing should be delivered to users in the Rubin Science Platform [DMTN-105].

3 Scientific Prerequisites

Scientists worldwide will expect Rubin's alerts to be of high quality. In the interest of enabling as much early science as possible, we intend to begin alert production before all performance requirements are formally verified. Nevertheless, some broad analysis of scientific reliability in advance of the first alerts will be necessary to provide appropriate guidance to science users.

It may be that Alert Production may be possible in some sky regions (e.g., the extragalactic Wide-Fast-Deep footprint) but not in others (e.g., in densely crowded fields). We would begin routine Alert Production in the regions deemed sufficiently scientifically useful while continuing to improve pipeline performance elsewhere.

3.1 Systematics and Artifacts

Known systematics and artifacts may be present in the data at the time of the first alert release. These should be documented for science users and updated on an ongoing basis, for

example on `community.lsst.org`. Similarly, users should be encouraged to report artifacts and other problems identified in alerts through the same channels.

3.2 Alert Completeness and Purity

Alerts need not be complete or pure at the required levels in order to begin alert production. However, alerts due to artifacts must not occur in such high volumes as to degrade the performance of alert production and distribution. Filtering operations which reduce the completeness of released alerts but increase purity may be considered.

3.3 Machine-Learned Reliability Scoring

Machine-learned scores for estimating whether a DIASource is astrophysical should be available along with documentation of the estimated performance of the implemented classifier. Again, this classifier need not fully meet requirements at the time of the first alert release.

3.4 Photometric and Astrometric Accuracy

Estimates of photometric and astrometric accuracy should be available for all regions where alert production is underway, even if the resulting difference image products do not yet meet formal requirements.

4 Operational Prerequisites

Finally, before beginning a decade-long continuous data processing campaign we must be prepared organizationally.

4.1 Change Control

A well-defined process must be in place to deploy pipelines and calibration updates affecting the scientific content of alert production.

4.2 Incremental Template Generation Procedures

A procedure for regularly generating, validating, and loading templates for Alert Production should be established prior to the beginning of routine alert production.

4.3 Broker and User Support Channels

Broker operations teams should have access to alert distribution status information as well as communications channels to request support.

Science users should be directed to `community.lsst.org` for support. The Rubin Community Science Team should be prepared to triage support requests as alert production begins.

4.4 Documentation

User-facing documentation describing the Alert Production pipelines, data products, data services, and broker options should be available. A peer-reviewed construction paper need not be published to begin alert production, but a draft should be in Publication Board review.

4.5 Dress Rehearsal

We plan to conduct one or more dress rehearsals for alert distribution to brokers ahead of beginning routine alert production [RTN-010].

4.6 Agency Approval

We expect to seek formal agency approval to begin releasing alerts.

4.7 Communications

The onset of alert production should be marked with a Rubin press release organized by the project office.

5 Expected Timeline

Based on the availability of both data and personnel, we expect that the release of the first alerts and the beginning of routine Alert Production will occur after the System First Light (SFL) milestone [SITCOMTN-061]. We hope to begin around the time of the commissioning Science Validation Surveys, but a later start remains possible.

A References

[SITCOMTN-061], Bechtol, K., Alexov, A., Claver, C., et al., 2023, *System First Light Definition*, SITCOMTN-061, URL https://sitcomtn-061.lsst.io/,
Vera C. Rubin Observatory Commissioning Technical Note

[RTN-010], Bellm, E., 2023, *Pre-operations Alert Distribution Integration Exercises*, RTN-010, URL https://rtn-010.lsst.io/,
Vera C. Rubin Observatory Technical Note

[LDM-612], Bellm, E., Blum, R., Graham, M., et al., 2020, *Plans and Policies for LSST Alert Distribution*, LDM-612, URL https://ldm-612.lsst.io/,
Vera C. Rubin Observatory Data Management Controlled Document

[RDO-013], Blum, R., the Rubin Operations Team, 2020, *Vera C. Rubin Observatory Data Policy*, RDO-013, URL https://ls.st/RDO-013

[DMTN-105], Dubois-Felsmann, G., 2019, *LSP Capabilities for AuxTel, Commissioning, and Early Operations*, DMTN-105, URL https://dmtn-105.lsst.io/,
Vera C. Rubin Observatory Data Management Technical Note

[RTN-011], Guy, L.P., Bechtol, K., Bellm, E., et al., 2023, *Rubin Observatory Plans for an Early Science Program*, RTN-011, URL https://rtn-011.lsst.io/,
Vera C. Rubin Observatory Technical Note

[LPM-17], Ivezić, Ž., The LSST Science Collaboration, 2018, *LSST Science Requirements Document*, LPM-17, URL https://ls.st/LPM-17

[DMTN-183], Nelson, S., 2021, *Alert Database Design*, DMTN-183, URL https://dmtn-183.lsst.io/,
Vera C. Rubin Observatory Data Management Technical Note

[DMTN-199], O'Mullane, W., Allbery, R., AlSayyad, Y., et al., 2023, *Rubin Observatory Data Security Standards Implementation*, DMTN-199, URL https://dmtn-199.lsst.io/,
Vera C. Rubin Observatory Data Management Technical Note

[DMTN-268], Salnikov, A., 2023, *Data replication between APDB and PPDB*, DMTN-268, URL https://dmtn-268.lsst.io/,
Vera C. Rubin Observatory Data Management Technical Note

B Acronyms

Acronym	Description
APDB	Alert Production DataBase
DMTN	DM Technical Note
LSST	Legacy Survey of Space and Time (formerly Large Synoptic Survey Telescope)
OPS	Operations
PPDB	Prompt Products DataBase
RDO	Rubin Directors Office
RTN	Rubin Technical Note
USDF	United States Data Facility