



LARGE SYNOPTIC SURVEY TELESCOPE

# Large Synoptic Survey Telescope (LSST) Policy for Independent Data Access Centers

William O'Mullane, Beth Willman, Melissa Graham

LPM-251

Latest Revision: 2018-03-24

**Draft Revision NOT YET Approved** – This LSST document has been approved as a Content-Controlled Document. Its contents are subject to configuration control and may not be changed, altered, or their provisions waived without prior approval. If this document is changed or superseded, the new document will retain the Handle designation shown above. The control is on the most recent digital document with this Handle in the LSST digital archive and not printed versions. –

**Draft Revision NOT YET Approved**

## Abstract

This note lays out initial ideas for groups independent from the LSST Project and Operating Facility that would like to stand up an independent Data Access Center (iDAC).

Draft

## Change Record

Version	Date	Description	Owner name
	2018-03-24	Initial version.	WOM

*Document source location:* <https://github.com/lsst/LPM-251>

Draft

## 1 Introduction

A few sites or countries have expressed an interest in hosting *the LSST data* while not being to specific on what that means. In this document we lay out some ideas on what being a Data Access Center might mean and what requirements would need to be met.

## 2 What data are we talking about ?

For more Information on Object, Object Extra, Source etc. as used here the reader is referred to [DPDD](#) [LSE-163]

### 2.1 Lite

For many, perhaps most, astronomers thinking of LSST data they will consider first the catalog(s) and more specifically the Object Catalog. This catalog contains one row for each of the observed items in the firmament, hence it is estimated to contain about  $40 \times 10^9$ . This will have close to this size already from DR1. This catalog nominally contains 1840 bytes per row giving a size of  $\approx 7 \times 10^{13}$  bytes (70 Terabytes). One could potential envision smaller version of this (less columns, separate star and galaxy catalogs). This is not something one would handle on a laptop in the next few years but might be put on a small departmental cluster. Of course searching it would require some form of database, many institutes would already have a system which may be capable of loading this data. We might call this LSST lite, potentially a lot of people might be interested. We would only ship files for this with documentation and no support but it could be made widely available to the collaboration. If bandwidth for download could be a problem we could consider setting up some sort of peer to peer network for distributing it.

### 2.2 Catalog Server

The next level would be the full catalogs. This would probably require the specific LSST database server [LDM-135] and specific machines and the deployment of the database system and associated subset of data access services (DAX). If we include Object extra (one row per object with e.g. probability distribution it is  $\approx 20KB$  per row) as well as Object (as above) extra and Source Catalogs this takes the storage to PBs and begins to require a serious commitment

of resources at the proposed DAC. Each object has order 80 observation(sources) per year yielding for the final data release around  $7 \times 10^{12}$  rows and forced sources  $7 \times 10^{12}$  rows. The catalog size for the final release is order 15PB. The evolution of catalog sizes is depicted in Figure 1

## 2.3 Full release(s)

Including the raw image data in a DAC requires roughly 6PB per year of survey this is another serious augmentation on resources (hardware and personnel). The processed data and associated calibrations bring the total to 0.5 Exabytes. One may consider taking a calibrated image per band but it will still take 60PB (this could be compressed to reduce it a little).

In this mode one would assume to deploy the full science platform.

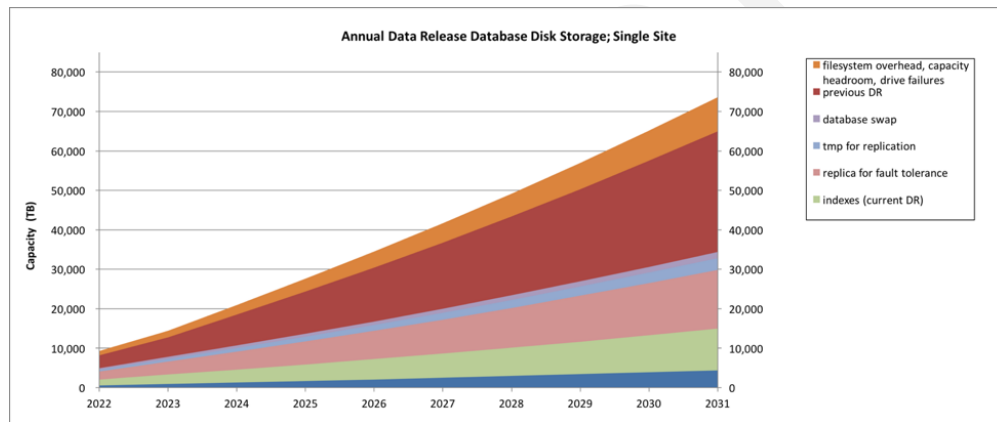


FIGURE 1: Catalog volume over time from LDM-144.

## 3 Requirements on DACs

Any institution considering setting up a DAC will need to show commitment on purchasing sufficient storage and CPU power to hold and serve the data. Sufficient storage here ranges from 100TB minimum to 0.5Exabytes. Even for the *lite* catalog a set of servers would be needed to make access to the 70 TB feasible. For the full catalog it is order 100 nodes to serve it up. To serve images a DAC would need some additional servers, depending on load this may be order 10.

The Science Platform is a term used to describe, a Portal, web services and notebooks which will provide query and analytical tool kits, an open software framework for astronomy and parallel processing, and the associated computational, storage, and communications infrastructure needed to enable science. It is described in LSE-319 and LDM-554

Deploying the science platform would seem logical with the images and catalogs - again depending on assumed load the platform is modest it requires two servers or so to set up, we suggest then 2 CPUs per simultaneous user (hence if you think you have 200 user but on 50 at a time 100 CPUs). The open ended question is next tot he data compute - this can be as large as a data center wishes and may want to connect to some local super computer resources.

Having significant hardware above the normal for most astronomy departments would require dedicated technical personnel to set it up and keep it all running. For the lite Catalogue on existing supported hardware this may not be a significant increase in person power  $\Leftrightarrow$  the service is already order 50-100TB. Still one may assume at least a 0.25 FTE for maintaining this (new releases fixes) and more to get it initially set up. For the full catalog up one could envisage needed 2FTE. Again there will be software updates to install as well as new data to load. The full science platform and all the image data would require 1 or 2 storage engineers to mange the large amount of storage and possible one more FTE to keep the Kubernetes or equivalent system updated and the latest software deploys. Should there be many users local user support will become an specific issue which may not be covered by the usual institutional support requiring further effort. It would seem any potential full DAC without a minimum of 4 FTE should not be considered viable.

### 3.1 Policies

We may require DACs to attach to the LSST authentication system to ensure correct access to the data - this may require some IT work at the hosting site. There is an open point as to whether *any* qualified user could log in to any DAC. This would facilitate collaborations but would require a single authentication system.

Setting up a DAC will require some level of support from LSST. The associated DAC support and infrastructure development costs are being separately considered.

## 4 Cost impacts

There are at least two const impacts of DACs being set up outside USA and Chile. The positive impact is some load may be taken off the existing DACs, the negative is that support will definitely be required to set them up.

We may want to associate specific areas of science to a given iDAC and encourage the associated users to this center. This creates a customer base for the center, brings together like minded experts, and distributes computing load around the network of centers. It may also enhance internal funding arguments for investment resources by arguing for synergies with local science goals and attracting international users and official endorsement.

### 4.1 Data Transfer

Even with good networks the data transfer will not be trivial - LSST is not currently set up to distribute data to multiple sites i.e. there is no form of peer to peer sharing. The bandwidth ti NCSA is adequate for Alerts and for receiving data - one could use some day time bandwidth to transfer data to other DACs. A full release does not have to be transferred on a given day, if the correct agreements are in place this could be transferred as it is produced.

### 4.2 Compute vs Data

A large cost in the DAC is data storage - if this is set up without a large compute capacity the facility may be less useful than augmenting an existing DAC to have more compute. One could consider paid for increased compute quota for a given collaboration or set of PIs. We already have the notion of standard quotas and an allocation committee to adjudicate on bigger proposals.

Another way to approach this would be to have a *Cloud* based DAC where a PI could buy nodes on the provider cloud to access the holdings put there by LSST. In the most radical approach we would move the US DAC to Amazon or Google to achieve this.

## 5 Conclusion

## 6 References

- [1] **[LDM-135]**, Becla, J., Wang, D., Monkewitz, S., et al., 2013, *Database Design*, LDM-135, URL <https://ls.st/LDM-135>
- [2] **[LDM-554]**, Ciardi, D., Dubois-Felsmann, G., 2017, *Science Platform Requirements*, LDM-554, URL <https://ls.st/LDM-554>
- [3] **[LDM-144]**, Freemon, M., Pietrowicz, S., Alt, J., 2016, *Site Specific Infrastructure Estimation Model*, LDM-144, URL <https://ls.st/LDM-144>
- [4] **[LSE-319]**, Jurić, M., Ciardi, D., Dubois-Felsmann, G., 2017, *LSST Science Platform Vision Document*, LSE-319, URL <https://ls.st/LSE-319>
- [5] **[LSE-163]**, Jurić, M., et al., 2017, *LSST Data Products Definition Document*, LSE-163, URL <https://ls.st/LSE-163>

## 7 Acronyms

Acronym	Description
CPU	Central Processing Unit
DAC	Data Access Center
DAX	Data access services
DPDD	Data Product Definition Document
FTE	Full-Time Equivalent
HEP	High-Energy Physics
IT	Integration Test
LDM	Light Data Management
LPM	LSST Project Management (Document Handle)
LSE	LSST Systems Engineering (Document Handle)
LSST	Large Synoptic Survey Telescope
NCSA	National Center for Supercomputing Applications
PI	Principle Investigator
RFC	Request for Comments



TB	TeraByte
US	United States
USA	United States of America
W	Watt; SI unit of power
s	second; SI unit of time

Draft