Rubin Observatory

Vera C. Rubin Observatory
Data Management

Guidelines for Rubin Independent Data Access Centers

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RTN-003

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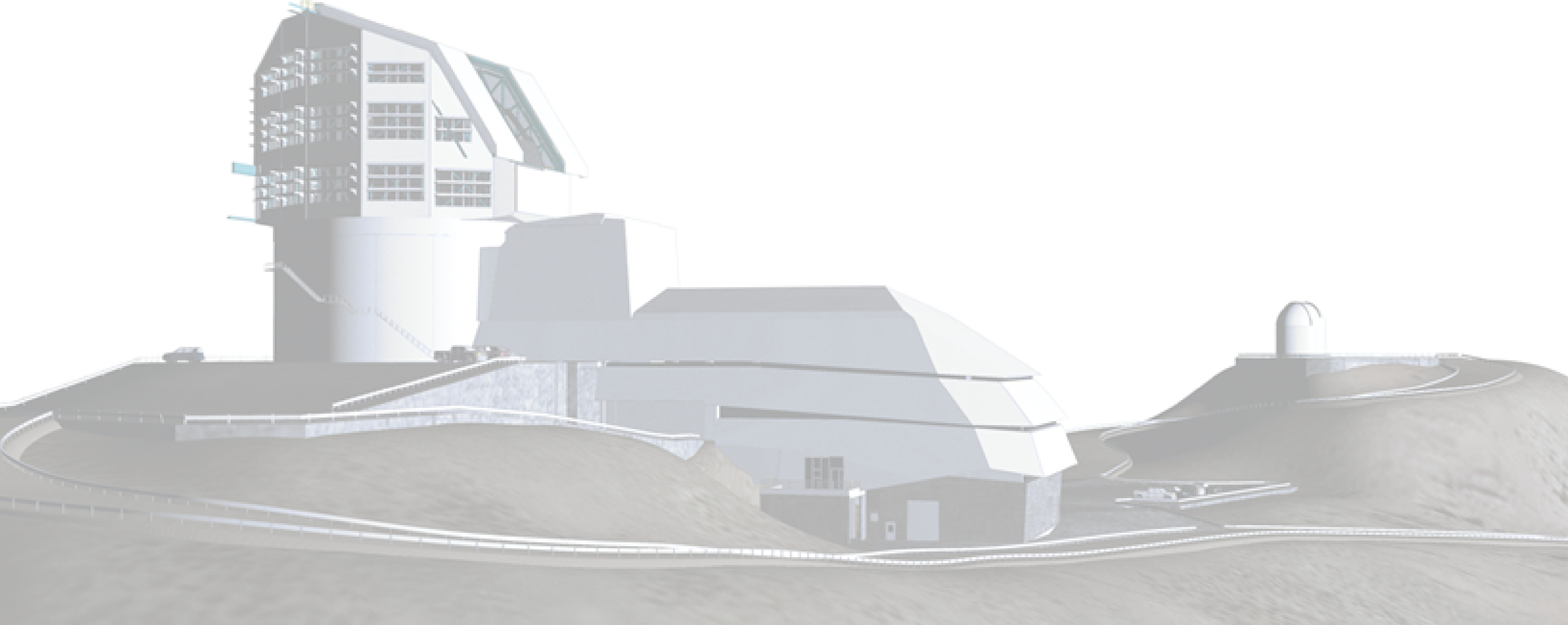

Abstract

This document provides guidelines for groups that are independent from the Rubin Project and Operations (i.e. US Data Facility) and would like to stand up an independent Data Access Center (IDAC; existing data centers that could serve Rubin data products are considered IDACs for purposes of this document). Some IDACs may want to serve only a subset of the data products: this document proposes three portion sizes, from full releases to a ”lite” catalog without posteriors. Guidelines and requirements for IDACs in terms of data storage, computational resources, dedicated personnel, and user authentication are described, as well as a preliminary assessment of the cost impacts. Some institutions, even those inside the US and Chile, may serve LSST data products locally to their research community. Requirements and responsibilities for such institutional bulk data transfers are also described here.

Change Record

Version	Date	Description	Owner name
1	2020-06-22	Migrated document from LPM-251	Leanne Guy
1.1	2020-08-05	Fix some inconsistencies	WOM
1.2	2020-10-20	Fix some more inconsistencies	WOM

Document source location: `https://github.com/rubin-observatory/rtn-003`

Rubin Observatory

Contents

Rubin Observatory

Guidelines for Rubin Independent Data Access Centers

1 Introduction

The current model for Vera C. Rubin Observatoryis that is provides proprietary data to approved users in Chile and the US. The data access model accommodates this restricted data rights policy. This policy requires control over access, publication, and sharing of proprietary data which any (IDAC) would have to comply with just as the US and Chile DACs do.

Access to Rubin Observatorydata products for any users will be possible through a DAC. The United States's DAC , referred to as the US Data Facility, is where registered Rubin Observatoryusers will perform scientific queries. Most users will have access to a default set of resources at the DAC sufficient for basic queries and analysis. Users who require more resources will be able to apply for them, and those granted additional resources will be allowed (for example) to perform analysis on the full data releases using the RSP. The RSP is documented with the vision given in LSE-319, with more formal requirements in LDM-554 and the design in LDM-542. The Chilean DAC will be equivalent in functionality to the US DAC, but scaled-down in terms of the computational resources available for query and analysis given the smaller Chilean community [LDM-572].

The following sections include the types of data products that could be hosted (Section 2), the requirements and responsibilities that would be expected of an IDAC hosting Rubin Observatoryproprietary data products (Section 3), and a description of the main costs *vs.* their science impacts (Section 5).

The contents of this draft document are meant to provide a preliminary resource for partner institutions who may be assessing the feasibility of hosting an IDAC. The specific mechanisms and processes by which future IDACs will negotiate the bulk transfer of data, the installation of software, etc. is considered beyond the scope of this document. A simplified checklist is given in Appendix B.

To better understand the sizes of Rubin Observatorydata products, Table 1 gives an overview of sizes and the estimaed storage needs are in Table 2(from DMTN-135).

Table 1: Inputs used to calculate storage needs during Operations

Parameters	**unit**	**LOY1/ FY23**	**LOY2/ FY24**	**LOY3/ FY25**	**LOY4/ FY26**	**LOY5/ FY27**	**LOY6/ FY28**	**LOY7/ FY29**	**LOY8/ FY30**	**LOY9/ FY31**	**LOY10/ FY32**
Objects	number	2.75E+10	3.25E+10	3.57E+10	3.82E+10	4.03E+10	4.22E+10	4.38E+10	4.53E+10	4.64E+10	4.74E+10
Sources	number	9.01E+11	1.80E+12	2.70E+12	3.60E+12	4.51E+12	5.41E+12	6.31E+12	7.21E+12	8.11E+12	9.01E+12
ForcedSources	number	2.91E+12	6.87E+12	1.13E+13	1.61E+13	2.13E+13	2.67E+13	3.24E+13	3.83E+13	4.41E+13	5.01E+13
Science users	users	5000	6000	7000	7500	7500	7500	7500	7500	7500	7500
Storage per science user	TB	0.4	0.5	0.6	0.7	0.8	0.9	1	1.1	1.2	1.3
LSSTCam image size	TB	0.0152	0.0152	0.0152	0.0152	0.0152	0.0152	0.0152	0.0152	0.0152	0.0152
Raw image compression	factor	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42
Lossy image compression	factor	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250	0.250
Observing nights per year	nights	300	300	300	300	300	300	300	300	300	300
Visits per night	visits	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
Images per visit	images	2	2	2	2	2	2	2	2	2	2
Calibration images per day	images	500	500	500	500	500	500	500	500	500	500
LSSTCam Science images	images	600000	1200000	1800000	2400000	3000000	3600000	4200000	4800000	5400000	6000000
LSSTCam Engineering images	images	6000	12000	18000	24000	30000	36000	42000	48000	54000	60000
LSSTCam Calibration images	images	150000	300000	450000	600000	750000	900000	1050000	1200000	1350000	1500000
Number of coadd data products	number	2	2	2	2	2	2	2	2	2	2
Object table row size	bytes	1896	1953	2012	2073	2136	2201	2268	2337	2408	2481
Object_Extra tables row size	bytes	21005	21636	22286	22955	23644	24354	25085	25838	26614	27413
Source table row size	bytes	467	482	497	512	528	544	561	578	596	614
ForcedSource table row size	bytes	41	41	41	41	41	41	41	41	41	41
Qserv replication factor	factor	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0

Table 2: On floor LDF storage estimates during Operations

LDF Storage (on the floor)	**unit**	**LOY1/ FY23**	**LOY2/ FY24**	**LOY3/ FY25**	**LOY4/ FY26**	**LOY5/ FY27**	**LOY6/ FY28**	**LOY7/ FY29**	**LOY8/ FY30**	**LOY9/ FY31**	**LOY10/ FY32**	
APDB	TB	24	24	24	24	24	24	24	24	24	24	
Qserv Czar/ Object	TB	182	347	562	643	711	774	835	894	951	1006	
Total Fast	**TB**	**206**	**371**	**586**	**667**	**735**	**798**	**859**	**918**	**974**	**1029**	
Normal	TB	38983	67976	99538	131025	162321	193727	225288	256991	288788	320731	
Qserv Storage	TB	4094	9257	17275	24144	31277	38734	46555	54716	63206	72017	
LSSTCam Raw Images	TB	6982	11798	16614	21430	26246	31062	35878	40694	45510	50326	
LSSTCam Output Images	TB	3933	10676	16857	23599	30342	37084	43827	50570	57312	64055	
LSSTCam Output Coadd Images	TB	8636	16364	23182	23182	23182	23182	23182	23182	23182	23182	
LSSTCam Output Parquet	TB	9302	25248	47839	71758	95678	119597	143516	167436	191355	215275	
Object Store	TB	28854	64086	104491	139969	175447	210925	246403	281881	317359	352837	
LSSTCam Raw Images	TB	6982	11798	16614	21430	26246	31062	35878	40694	45510	50326	
All Data Products/ Backup	TB	47626	106967	194226	309242	451681	621564	818915	1043758	1296109	1575992	
All Object Store-Only Products	TB	8636	16364	24091	31818	39545	47273	55000	62727	70455	78182	
Tape	TB	63245	135129	234931	362490	517473	699899	909793	1147179	1412074	1704500	

TABLE 3: Potential/estimated usage of products and images, this table came from the AMCL originally.

Data Product	Cardinality	Volume [PB]	Usage Frequency	Discovery Potential	Replicas
Object_Lite	40M	0.1	95%	20%	0.08
Object_Extra	40M	0.9	4%	24%	0.9
Source	9T	4.0	0.9%	50%	4.0
ForcedSrc	50T	2.0	0.1%	3%	2.0
Image coadds	55K	0.3	0.01%	2%	0.002
Image raw	5.5M	30.0	0.001%	1%	0.002

All access to, and use of the Rubin Observatorydata and data products is subject to the policies described in LDO-13.

In addition to the sizes shown in Table 1 it is interesting to consider how much access and potentially how much science there is per table. This is discussed in detail in PSTN-003. The AURA Management Council for LSST (AMCL) made an interesting table concerning this topic which is reproduced here in Table 3. Feedback on the correctness of this table has been sought from Project Science Team (PST).

2 Types of Data Products for IDACs

The three categories of Rubin Observatorydata products, *Prompt*, *Data Release*, and *User Generated* are defined in the Rubin ObservatoryData Product Categories document LPM-231. Both the *Prompt*, *Data Release* data products are produced by Rubin Observatoryand include images, both raw and processed, and catalogs of both `Objects` and `Sources`. The *User Generated* data products are produced the community using the resources of the Rubin ObservatoryScience Platform LSE-319. These data products are described in detail in the Data Products Definitions Document LSE-163.

Below, three potential realizations of the the Rubin Observatory*Data Release* data products that IDACs might consider hosting are described: the full *Data Release* including images, the *Data Release* catalogs only, and a low-volume ("`lite`") subset of the *Data Release* catalogs.

2.1 Full Data Release(s)

In this case the IDAC would be hosting all of the raw and processed images, and catalogs, as described in [LSE-163]. Hosting the raw image data at an IDAC requires roughly 6 petabytes per year of storage, so this represents a significant augmentation of resources in terms of both hardware and personnel. The processed data and associated calibrations bring the total data volume to 0.5 exabytes for a single data release. Some data volume could be saved by taking only a single calibrated image per band, but the total would still be 60 petabytes (with compression it may be possible to reduce this even further). Any IDAC considering hosting the full *Data Release* should also deploy the full Rubin ObservatoryScience Platform LSE-319 in order to maximize science productivity and their return on investment in hosting an IDAC.

2.2 Catalog Server

Alternatively, an IDAC may find that hosting only the *Data Release* catalogs, and not the images, is sufficient for the scientific needs of its community. This will probably require the specific Rubin Observatorydatabase server [LDM-135] and specific machines, and the deployment of the database system and the associated subset of data access services (Data Access Services (DAX); e.g., web APIs, Qserv, LDM-152). The full `Object` catalog, which contains one row per object with a volume of ≈ 20 kilobytes per row, is estimated to contain about 40×10^9 objects (even in the first full-sky data release). Adding to this the full `Source` and `Forced Source` catalogs, which contain one row per measurement in each of the ~ 80 visit images obtained per year, brings the total storage volume required up into the petabytes range, and will require a serious commitment of resources at the proposed IDAC. The evolution of data sizes over the 10-year Legacy Survey of Space and Time (formerly Large Synoptic Survey Telescope) (LSST) is depicted in Figure 1, the catalog size for the final release is order 15 petabytes. For more details on the row counts see the Key Numbers Page[1].

2.3 An "`Object Lite`" Catalog

Many – perhaps most – astronomers' science goals will be adequately served by a low-volume subset of the `Object` catalog's columns that do not include, for example, the full posteriors for the bulge+disk likelihood parameters. This `Object Lite` catalog would nominally contain 1840 bytes per row for the 40×10^9 objects, giving a size of $\approx 7.4 \times 10^{13}$ bytes (~ 74 terabytes). Even

[1] `https://www.lsst.org/scientists/keynumbers`

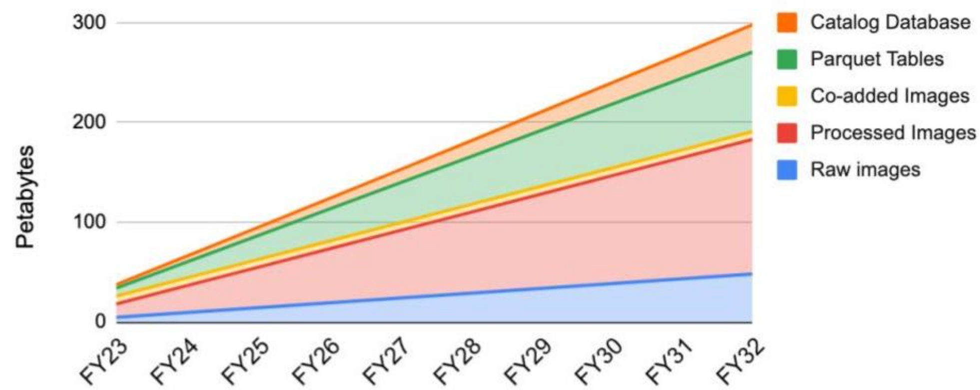

FIGURE 1: Volume of different datatypes over time from DMTN-135 data.

smaller, science-specific versions of `Object Lite` could be envisioned with even less columns and/or separate star and galaxy catalogs. The Solar System community for example will be primarily be interested in the contents of just the `SSObjects` table.

These would not be small enough to handle on a laptop, but might be served by a small departmental cluster. Searching even a small `Object Lite` catalog would require some form of database, but many institutes would already have a system which may be capable of loading this data. In this case, Rubin Observatorymight only ship files with documentation and not provide administrative support for the system, but this would allow the `Object Lite` catalog to be widely available to all partner institution IDACs. Distribution options such as peer-to-peer networking to avoid download bandwidth limitations might be possible to implement in this case.

3 Requirements and Guidelines for IDACs

Since creating, delivering, and supporting the implementation of Rubin Observatorydata products via IDACs creates some cost to the Rubin ObservatoryProject, IDACs will be expected to follow some basic requirements and guidelines, which are described below. The actual costs of IDAC support and infrastructure development are considered separately in Section 5.2.1. We should also consider that there is the possibility of a *lite* DAC or a *full* DAC.

3.1 Rubin Observatorysite topology

Figure 2 shows a topology for a set of interconnected IDACs. US scientists will have direct access to the Rubin ObservatoryUS Data Access Facility. Hosting on the cloud is shown.

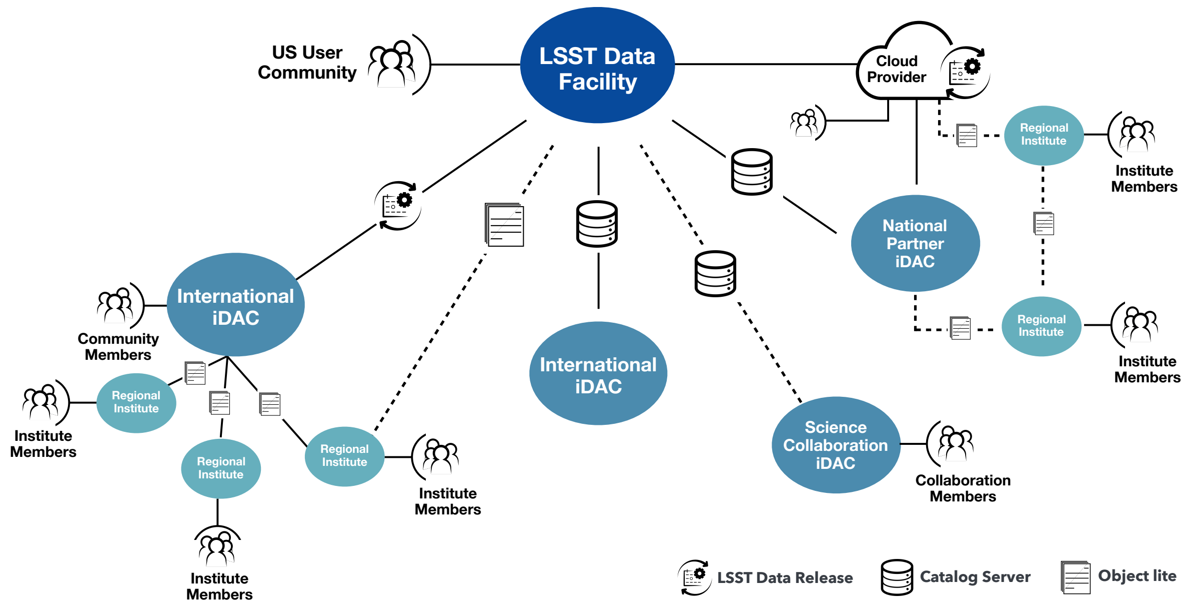

FIGURE 2: US Data Facility and IDAC network topology.

3.2 Authentication and Access

Any DAC will have to support authentication according to Rubin Observatoryaccess rules. This may imply delegating access control to a Rubin Observatoryauthorization service. In addition any user with access rights should be allowed access tot he IDAC.

3.3 Required Resources

Institutions or organizations wishing to set up independent data access centres will be expected to have sufficient resources and commitments before we discuss data transfers and support. See also Section 5.3 for a discussion on compute vs storage. The exact commitment of course depends on the level of IDAC being implemented.

Rubin Observatory

3.3.1 Data Storage

Any institution considering setting up an IDAC will need to show commitment on purchasing sufficient storage and Central Processing Unit (CPU) power to hold and serve the data. Sufficient storage ranges from 0.5 exabytes for the full data release(s) down to 100 terabytes for a catalog server, and potentially further down to 70 terabytes if the `Object Lite` option is offered. For the full catalog , of order 100 nodes are required to serve it up. To serve images, a DAC would need some additional servers; depending on load this may be order 10 additional nodes.

3.3.2 Dedicated Personnel

The significant hardware required by a full IDAC is above the normal level for most astronomy departments, and would require dedicated technical personnel to set it up and keep it running. For an `Object Lite` catalog running on existing hardware, this might not be a significant increase in person power if the hardware is already serving on order 50–100 terabytes. Still, it is recommended to assume $\gtrsim 0.25$ full-time equivalent (Full-Time Equivalent (FTE)) personnel hours for `Object Lite`, and perhaps closer to ~ 2 FTE for the full catalogs, which includes setting up and maintaining the service, and installing new data releases and software updates every year. For IDACs wishing to host the full data releases' images and catalogs and deploy the RSP, it becomes necessary to employ 1–2 storage engineers to mange the large amount of data, and possibly one more FTE to keep the Kubernetes (or equivalent) system updated with the latest software deploys. If the IDAC intends to support the science of many local users, support will become a specific issue which may not be covered by the usual institutional funding, and will require further effort. It is therefore recommended that any partner institution wishing to host a full-release IDAC provide a minimum personnel of 5 FTE to be considered viable.

3.4 Networking and distribution

There is an assumption than any prospective IDAC will have a high bandwidth connection. Any full IDAC should demonstrate sustained $20 Gigabit(Gb)/s$ to enable data transfer and sufficient bandwidth for access by users. In addition all IDACs should be ready to serve the `Object Lite` catalog to any institution worldwide but especially any *local* institutions. This should be thought of as a redistribution mechanism for the catalogs.

Rubin Observatory

3.5 Services for Full IDACs

Full IDACs will be expected to provide services analogous to those provided at the US Data Facility.

3.5.1 The Rubin Science Platform

The *Rubin Science Platform* is a set of integrated web applications and services deployed at Rubin ObservatoryData Access Centers through which the scientific community will access, visualize, subset and perform next-to-the-data analysis of the data collected by the Rubin Observatory; it is envisioned to enable science cases that would greatly benefit from the co-location of user processing and LSST data. It will provide users access to the `Data Products` described in 2, such as, resources for image reprocessing, access to the Rubin Observatoryprocessing framework, and many other services as described in LSE-163. All full IDAC will be expected to run and support the RSP.

The RSP is described in full in LSE-319 and LDM-554. Depending on the assumed load, the RSP is relatively modest as it requires only ~ 2 servers to set up, and it is recommended to have 2 CPUs per simultaneous user (e.g., if the IDAC's desired capability is to serve 200 users, but only expect 50 to be active at a time, then 100 CPUs would be sufficient). From that starting point, the amount of next-to-the-data computational resources can be as large as the data center wishes to provide, and may make use of connecting to e.g., local super computer resources.

3.5.2 User Generated data products

User Generated data products will be created by the community deriving from the *Prompt* and *Data Release* data products, and making full use of the power of the Rubin Observatorydatabase systems and Science Platform for the storage, access, and analysis of their results. The Science Platform will allow for the creation of *User Generated* data products and will enable science cases that greatly benefit from co-location of user processing and/or data within the USDF. Full IDACs will be expected to provide support for the creation of *User Generated* data products and their federation with the LSST Data products.

4 Responsibilities of the US Data Facility

This section describes the services that the USDF will provide in support of all IDACs.

The LSST Data Facility (LDF) will prepare data products for distribution to IDACs along with documentation of hardware and software that will make serving Rubin Observatorydata consistent with the serving of data from the USDF. Rubin Observatorywill provide (modest) technical support consistent with available resources to assist groups setting up IDACs.

LSST, through the USDF will establish a process for potential IDAC groups to interface with and establish data transfers to their IDACs. It is expected that IDAC groups will propose to LSST what their IDAC would support and then LSST will work with them to establish requirements to receive LSST data. One approved, LSST will provide (modest) technical support consistent with available resources to assist groups setting up their IDACs provided they comply with prerequisites discussed in this document and especially in Section 3.3.

4.1 Data Distribution

USDF will have $100Gb/s$ connections on Energy Sciences Network (ESNet) which has interconnects with Internet2 - this should provide a distribution mechanism for getting data to IDACs, it will however be limited by the fact that much of our bandwidth is already allocated for data transmission to Institut National de Physique Nucléaire et de Physique des Particules (IN2P3) and alert distribution.

A tiered model as used by European Organization for Nuclear Research (CERN) for high energy physics would seem a desirable way to achieve big transfers. Hence we would have a small selection of tier 2 centres with all data products from which tier 3 centres could copy the subsets they wish to work with. Other alternatives are discuss in Section 5.2.

In High Energy Physics (HEP) experiments such as BaBar various physics analysis groups (science collaborations in LSST) were assigned to specific international centers as their primary computing and analysis facility, thereby distributing the computing load around the ”network.” Users naturally tend to use the facility with available resources and cycles.

5 Cost Impacts

As previously mentioned, standing up and maintaining multiple IDACs comes at a significant cost impact to both the Rubin ObservatoryProject and the partner institutions. Minimizing these costs – or at least maximizing the amount of science they enable – should be at the forefront of all considerations concerning partner IDACs, such as the following propositions.

5.1 Maximizing Profits with Science-Driven IDACs

There are two main cost impacts of IDACs being set up outside of the US and Chilean DACs: the positive impact is that some computational load may be taken off of these existing DACs, but the negative impact is the level of support required from the Rubin ObservatoryProject in order to get them set up and running. This negative impact could be mitigated by ensuring that science productivity is maximized as a result of this extended effort. One way to do this might be to associate specific areas of science to a given IDAC, and encourage users working in that field to use that IDAC. This could create a customer base for the IDAC, bring together like-minded experts, and effectively distribute the computing load across a network of IDACs. This might also enhance internal funding arguments for investment resources by arguing for synergies with local science goals and attracting international users and official endorsement.

5.2 Data Transfer

Even with good networks the data transfer will not be trivial, and could be quite expensive. Rubin Observatoryis not currently set up to distribute data to multiple sites, i.e., there is no form of peer-to-peer sharing. The bandwidth at National Center for Supercomputing Applications (NCSA) is adequate for receiving data and delivering `Alerts` to brokers during the night; perhaps some day time bandwidth could be used to transfer data to IDACs. A full data release of images and catalogs does not have to transferred within a given day; if the correct agreements are in place with an IDAC, a full release could be transferred slowly as it is produced, and then made available to the IDACs users in whole on the official release day.

5.2.1 Transfer cost use case

If we take the final number from the key numbers page [2] we could consider Data Release 1 (DR1) as about 6 PetaByte (PB) (10% of the final size).

We would have at least two ways to transfer this : via the network, via physical devices.

A network transfer at 10Gbps of 6 PB would take $8 * 6 \times 10^{12}\ 10^{7} = 4.8 \times 10^{6}\ seconds$ or about 55 days[3]. Many institutes have 100 Gbps connections so this should be an upper limit and a transfer should be order one week. If we had a peer to peer network this may go down somewhat and we may be able to support it from the United States Data Facility (USDF).

Alternatively we could host the data on Amazon or Google and let people download it from there - they would have more capacity. Storage on the cloud for public data would be theoretically free - download (egress) would cost. Transfer to another cloud [4] or a Content Delivery Network (Content Delivery Network (CDN))[5] end up costing about a cent a Gigabyte (GB) which for an open science project and at our volume should be negotiable. At one cent a transfer would cost $\sim \$0.01 * 6 \times 10^{12}\ 10^{6} = \$60K$.

For physical devices, today apparently we could get a device like Petarack `https://www.aberdeeninc.com/petarack/` for $300K. Theoretically we could get this cheaper though this is close to the drive price, Tape may also be a possibility especially if Sony/IBM commercialize high density tape with >300TB per cartridge[6]. A current 6TB cartridge is about $30, so enough tapes for 6PB would cost about 30K. If the density increased this could come down significantly. This could be be a partner data center cost as well as shipping it. Transfer of data on to this would be about the same as the network rate above so 7 days. SneakerNet Gray et al. (2002) may still be cost effective in the LSST era, which is predicted in the paper.

5.3 Compute *vs.* Storage Resources

Data storage could be a large cost to IDACs, and could be considered as an overhead relative to the amount of computational resources an IDAC can offer. If a full IDAC is set up without

[2] `https://www.lsst.org/scientists/keynumbers`

[3] day = 86400s

[4] `https://cloud.google.com/storage/pricingi#network-pricing`

[5] `https://cloud.google.com/cdn/pricing`

[6] `https://newatlas.com/sony-ibm-magnetic-tape-density-record/50743/`

a large compute capacity, the facility might be less useful to the science community than e.g., augmenting an existing DAC or IDAC to have more computational resources. It is conceivable that a partner institution may prefer to spend their money increasing the computational quotas available for a given collaboration or set of PIs, and it would be scientifically beneficial if this was possible at all DAC and IDACs. The notion of standard compute quotas and resource allocation committees to adjudicate on large proposals for substantial increases to computational allocations are described in LDO-13. Another way to approach a solution to this issue might be to have a *Cloud*-based IDAC where a user or Principle Investigator (PI) could buy nodes on the provider cloud to access the holdings put there by Rubin Observatory. Such an option may be particularly useful to Science Collaborations with large compute needs.

The full sizing model is in DMTN-135 - any IDAC should have a similar sizing model. They may not need as much compute or as many copies of data as we have but the raw information to make such calls are in the technote. For ball park figures the construction to first year of ops table is copied here as Table 4[7].

Table 4: Operations costs summary table from DMTN-135

Year (all prices Million$)	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**
Compute (2019 pricing)	$2.79	$2.95	$4.87	$6.12	$6.28	$7.10	$6.66	$6.66	$7.10	$6.66
Qserv (2019 pricing)	$1.62	$2.42	$1.86	$2.40	$2.74	$3.60	$2.10	$2.18	$2.78	$3.12
Storage (2019 pricing)	$6.41	$7.46	$8.79	$9.12	$10.72	$15.71	$16.83	$18.17	$18.50	$19.16
Total (2019 pricing)	**$10.82**	**$12.83**	**$15.52**	**$17.64**	**$19.74**	**$26.41**	**$25.59**	**$27.01**	**$28.38**	**$28.94**
Applying price factor (CPU)	$1.83	$1.74	$2.59	$2.93	$2.70	$2.75	$2.32	$2.09	$2.01	$1.69
IN2P3 (50% of compute)	-$0.92	-$0.87	-$1.29	-$1.46	-$1.35	-$1.38	-$1.16	-$1.04	-$1.00	-$0.85
Qserv (applying factor)	$1.19	$1.64	$1.17	$1.39	$1.47	$1.78	$0.96	$0.92	$1.09	$1.13
Applying price factor (Storage)	$5.22	$5.77	$6.46	$6.37	$7.11	$9.90	$10.08	$10.33	$9.99	$9.84
Hosting Overhead NCSA	$0.54	$0.79	$1.01	$1.21	$1.38	$1.61	$1.71	$1.85	$2.01	$2.23
Total budget (using price factors)	**$7.86**	**$9.08**	**$9.93**	**$10.43**	**$11.31**	**$14.67**	**$13.91**	**$14.16**	**$14.10**	**$14.04**
Total Operations hardware to 2032	**$119.48**	**million**								

A References

[LDM-135], Becla, J., Wang, D., Monkewitz, S., et al., 2017, *Data Management Database Design*, LDM-135, URL `https://ls.st/LDM-135`

[LDO-13], Blum, R., et al., 2019, *LSST Data Policy*, LDO-13, URL `https://ls.st/LDO-13`

[7]There is no guarantee of being in sync with DMTN-135 but as an order of magnitude it is good.

Rubin Observatory

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B Glossary

AMCL AURA Management Council for LSST.

Archive The repository for documents required by the NSF to be kept. These include documents related to design and development, construction, integration, test, and operations of the LSST observatory system. The archive is maintained using the enterprise content management system DocuShare, which is accessible through a link on the project website www.project.lsst.org.

AURA Management Council for LSST , group reporting to the AURA Board of Directors that oversees the activities of the LSST Project Office and advocates the mission of the LSST.

CAOM Common Archive Observation Model.

CDN Content Delivery Network.

Center An entity managed by AURA that is responsible for execution of a federally funded project.

CERN European Organization for Nuclear Research.

CPU Central Processing Unit.

DAC Data Access Center.

Data Access Center Part of the LSST Data Management System, the US and Chilean DACs will provide authorized access to the released LSST data products, software such as the Science Platform, and computational resources for data analysis. The US DAC also includes a service for distributing bulk data on daily and annual (Data Release) timescales to partner institutions, collaborations, and LSST Education and Public Outreach (EPO)..

Data Product The LSST survey will produce three categories of Data Products. Prompt, Data Release, User Generated. Previously referred to as Levels 1, 2, and 3.

Data Release The approximately annual reprocessing of all LSST data, and the installation of the resulting data products in the LSST Data Access Centers, which marks the start of the two-year proprietary period.

DAX Data Access Services.

Document Any object (in any application supported by DocuShare or design archives such as PDMWorks or GIT) that supports project management or records milestones and deliverables of the LSST Project.

DR1 Data Release 1.

ESNet Energy Sciences Network.

FTE Full-Time Equivalent.

Full-Time Equivalent A unit equivalent to one person working full time for one year with normal holidays, vacations, and sick time. No paid overtime is assumed.

GB Gigabyte.

Gb Gigabit.

HEP High Energy Physics.

IDAC Independent Data Access Center.

IN2P3 Institut National de Physique Nucléaire et de Physique des Particules.

Independent Data Access Center Externally supported and administered versions of the DAC to serve the full, or a limited subset of, the LSST data products and/or software to authorized users..

IVOA International Virtual-Observatory Alliance.

Rubin Observatory

Kubernetes A system for automating application deployment and management using software containers (e.g. Docker); `https://kubernetes.io`.

LDF LSST Data Facility.

LSST Legacy Survey of Space and Time (formerly Large Synoptic Survey Telescope).

NCSA National Center for Supercomputing Applications.

Object In LSST nomenclature this refers to an astronomical object, such as a star, galaxy, or other physical entity. E.g., comets, asteroids are also Objects but typically called a Moving Object or a Solar System Object (SSObject). One of the DRP data products is a table of Objects detected by LSST which can be static, or change brightness or position with time.

PB PetaByte.

PI Principle Investigator.

Project Science Team an operational unit within LSST that carries out specific scientific performance investigations as prioritized by the Director, the Project Manager, and the Project Scientist. Its membership includes key scientists on the Project who provide specific necessary expertise. The Project Science Team provides required scientific input on critical technical decisions as the project construction proceeds.

PST Project Science Team.

Qserv LSST's distributed parallel database. This database system is used for collecting, storing, and serving LSST Data Release Catalogs and Project metadata, and is part of the Software Stack.

Release Publication of a new version of a document, software, or data product. Depending on context, releases may require approval from Project- or DM-level change control boards, and then form part of the formal project baseline.

RSP Rubin Science Platform.

Science Platform A set of integrated web applications and services deployed at the LSST Data Access Centers (DACs) through which the scientific community will access, visualize, and perform next-to-the-data analysis of the LSST data products.

Source A single detection of an astrophysical object in an image, the characteristics for which are stored in the Source Catalog of the DRP database. The association of Sources that are non-moving lead to Objects; the association of moving Sources leads to Solar System Objects. (Note that in non-LSST usage ”source” is often used for what LSST calls an Object.).

TAP Table Access Protocol.

US United States.

USDF United States Data Facility.

C IDAC Proposal Checklist

There is a spectrum of possibilities for an IDAC's scope, from just hosting the Object lite database, to serving full copies of the current data release and prompt products database. Here an attempt is made to have a set of check lists that can be used to look at an IDAC. Section B.3 covers a full capability IDAC, while Section B.2 gives the criteria for a minimum capability IDAC. There will undoubtedly be proposals in between. There are some criteria that any IDAC must meet, in order to comply with Rubin Observatory data policy. These are given in Section B.1.

C.1 Any DAC

- ☐ Authentication/Authorization system inline with Rubin Observatory Access
- ☐ Agreement to make broadly accessible to all Data Rights holders

C.2 Lite IDAC

All criteria in Section B.1, and then, in addition:

- ☐ Database system capable of handling 4^{10} rows.
- ☐ International Virtual-Observatory Alliance (IVOA) Table Access Protocol (TAP) interface, MyDB and Table Upload, Common Archive Observation Model (CAOM) support.
- ☐ About 500TB of disk for catalogs + MyDBs.
- ☐ Professional support staff (min 0.25 FTE)
- ☐ Sufficient connectivity to support users

C.3 Full DAC

All criteria in Section B.1, and then, in addition:

- ☐ Staff (about 5 FTE) to handle major hardware installation

- ☐ Agreement to stand up standard Science Platform (Puppet/Kubernetes etc.)
- ☐ Database system capable of handling all catalogs (or Qserv) with IVOA interfaces.
- ☐ Understanding of sizing model in DMTN-135 - sizing model and a cost model for the IDAC.
- ☐ "Commitment to fund the IDAC through the LSST operations period, FY22-FY34 (probably $> \$6M/year$ based on hardware cost model and labor plan).".
- ☐ Sufficient connectivity to support data transfer in and user access out at least 20Gbps of free bandwidth.