

Prospectus for the Proposed IDRE Cloud Archival Storage Program

Prepared by the IDRE Research Technology Group
Reviewed and Endorsed by the IDRE Board
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PROGRAM GOAL

The goal of this program is to provide archival and backup of research data at a cost and service level that is better than commercial cloud providers, research groups, and most departmental implementations. We are proposing a professionally run, full service offering at a price that is comparable to or better than external cloud vendors and in almost all cases (except for low-end do it yourself systems) what individual research groups or departments can provide. Additionally we will be able to provide multi-platform accessibility plus a web-based interface for data movement. This archival service will be a major part of the proposed campus rEcosystem infrastructure[1] which will provide a tie-in to campus computing, instruments, visualization capabilities as well as externally to resources such as XSEDE/TeraGrid[2], ESnet[3], and LCRC [4] through Globus Online[5]. This program will also develop a community of researchers who will be able to work together on future research efforts.

BACKGROUND

Over the last 4 years the IDRE Research Technology Group has seen a huge growth in the demand for storage through our Hoffman2 Cluster/HPC storage project. We currently have over 1.5 petabytes of HPC storage spread between two large NAS (Networked Attached Storage) systems from BlueArc and Panasas (vendors for high performance storage used in conjunction with HP compute clusters) that has been purchased by over 80 different research groups and currently supports over 1,200 users. Additionally, IDRE has continued to build its network and grid services, interfaces, collaboration tools, data workflow tools, HP compute and storage facilities into an integrated environment called the UCLA “rEcosystem”. We are defining HPC storage as storage used primarily with the computational capability of the Hoffman2 Shared Cluster that has a higher performance capability as compared to the storage we would be offering for the archival service. Both types of storage are needed for the “rEcosystem.”

THE DEMAND FOR ARCHIVAL STORAGE

During the last four years we have had an increasing number of requests for archival and low cost backup storage from our HPC users who would like to park and backup research data on less expensive storage while maintaining the higher priced HPC storage for staging data for their computational work. We have also been approached by various campus organizations (as well as existing HPC storage users) to support various granting agency data sharing and retention policies with any potential archival storage service offering. This is archival storage that is intrinsically linked, integrated and managed within the IDRE r-ecosystem research program.

The demand for research data storage on campus is growing at a rapid pace with low cost, archival storage showing the largest potential growth volume. Currently individual research groups and campus departments are doing this in a piecemeal fashion on a variety of equipment with mixed results. In particular backup is either not done, done infrequently, not completely or via tape which has very low performance, serial access, questionable reliability, and is difficult and expensive to grow over disk-based solutions. Additionally the properly trained personnel required to run these systems are either not available, marginally available in departments struggling with budget cuts, or funded out of precious research dollars. If this type of service is offered it generally is done on the margin under a “just good enough” scenario with no economies of scale or visibility being realized by the campus.

WHY THIS PROJECT?

- Increasing demand for multiple terabytes of backup/archival research data storage that readily links to our HPC capabilities
- Backup/archival storage that interfaces with multiple network file system protocols allowing researchers to share data readily with internal and external research groups
- To satisfy granting agencies data management plan requirements for retention and sharing of research data.
- HPC storage is expensive and therefore not appropriate for archiving of large amounts of data, and is difficult to make available outside of our cluster environment.
- External Cloud storage providers tend to be quite expensive and in most cases charge significant prices for moving data. There are also privacy issues involved with data living off-campus in a commercial Cloud.
- The archival storage project had a 100% endorsement and the highest ranking in the recent IDRE/I2 Informatics grant process.

DEFINING THE PROGRAM

Given these criteria we have designed a low-cost backup and archival storage program and service for larger, 1TB and up, and longer term, 1 year minimum, requirements.

The archival storage is specifically targeted for users and campus organizations that are looking for storage with the following characteristics and requirements:

- Data is saved in a ‘near-line” state. Not for daily usage.
- Data can be accessed and shared through multiple protocols - file, block, object and web based interfaces to accommodate user requirements. File based access will be first followed by the others over time.
- Users can self-administer their storage through self-service web portal.
- The program is optimized for low cost and redundancy not performance, although performance will be more than adequate for the intended usage
- Storage can be used to fulfill various granting agency data management policies through a web-sharing capability.
- Data can be transferred and staged to HPC storage if desired.
- Data transfer to Hoffman2 will be available but there will not be a mountable file system. Data will need to be transferred to scratch or to a user directory for access during compute runs.
- For the same cost of individual researchers buying low cost storage now, administration and support of the storage facilities relieves researchers from managing and maintaining facilities, focuses researchers on managing the use of the data and ensures better preservation of valuable research data

How The IDRE Cloud Storage Service Differs From The IT Services Storage Offering

Both IT Services and IDRE are pursuing archival and backup solutions. There are key differences in hardware, middleware, and networking that are driven by the differences in the users of these services. These differences are well understood by both organizations:

- The IDRE Cloud Storage project requirements have been defined and driven by campus researchers and their specific needs and funding constraints for research data management. Research data storage program needs are substantially different from Administrative storage program needs
 - ITS architects their systems to emphasize redundancy, failover and management capability. Consequently their systems have a higher cost but are suitable for what is considered an enterprise-class requirement.
 - The IDRE Cloud Storage is designed to emphasize access in a reasonable time, preservation, file system versatility, self-management, linkage to HPC facilities and use within internal/external collaborations including workflows.
- There is greater room with research storage to optimize on absolutely essential services. Hardware and software used within the service have been balanced in order to maximize functionality and ease of use and minimize cost and overhead. ITS is providing very robust disaster recovery and business continuity features, e.g., offsite replication, 24x7 coverage, enterprise-class hardware and storage management software.
- The funding model for the IDRE Cloud Storage Project is optimized for larger, 1TB and above, requirements and longer term, 1 year and longer usage. The ITS offering is managed to allow smaller amounts of storage, in gigabytes, and shorter term requirements starting at one month.
- IDRE Cloud Storage is available for any storage or archival usage. The ITS offering is only available through their VM services environment as storage for use with virtual systems.
- We have plans to extend the IDRE Cloud Storage program to researchers external to UCLA.

PROJECTED COSTS

To arrive at the projected cost for this service, we started with the assumption that the optimum pricing “sweet spot” would be between \$200-300 per replicated terabyte per year. This was based on discussions with a substantial cross section of UCLA faculty researchers and an analysis of external services that include commercial offerings and offerings at other universities including UC campuses. SDSC is the closest to our proposal having settled on a rate of \$390 per-terabyte, per year for their cloud storage offering. For planning purposes we believe we can deploy our service for roughly \$275, replicated, per terabyte per year. We are currently proceeding with a pilot program to substantiate research interest and pricing.

To get to this level of pricing we have had to work an extremely aggressive purchase with a vendor and we need to purchase a very large amount of storage upfront, which would make the sale attractive enough for a vendor to meet our target costs. To that end we are looking at

following equipment and prices:

- Approximately 2.1 petabytes of usable storage at a cost of \$673.9K
- In addition to the storage hardware there are additional infrastructure costs to complete the full system
 - Storage access, load balancer and proxy nodes = \$92.2K
 - Maintenance and software licenses - \$102.4K
 - Network, cabling, racks = \$149.3K
 - MSA electrical upgrades and fiber lease costs - \$21.0K
 - Taxes and interest - \$167.5K
- Total project cost of \$1, 206.3K[3]
- Marketing/promotion, financial/administrative and systems administration costs are based on a per transaction basis of \$55.

ADDITIONAL CONSIDERATIONS

Our current thinking is to place the two data replicas in separate data centers, MSA and the POD, for geographic separation. Additional replicas can be added for additional redundancy, disaster recovery and business continuity scenarios. Given these objectives, there are additional considerations for a system of this magnitude for which we believe there are satisfactory solutions:

- Floor loading – The storage systems proposed under this project are extremely dense and heavy (roughly 2,700lbs. per rack) and extra precautions will need to be taken to safely place them in the POD and MSA datacenters. MSA will be able to accommodate this weight with some under floor bracing. The POD can handle this weight but there is a need to distribute the storage nodes over more racks in the bottom area, because of the narrowness of the cold aisle for installing the equipment. The upper part of the racks will be used for compute nodes.
- Power – The total power requirement for storage and infrastructure equipment is 210kVA split between the POD (70kVA, 240V) and the MSA datacenter (140kVA, 208V. Half from dirty power, half from UPS/motor generator-backed power). There is currently power available in the POD but the MSA datacenter will require power to be pulled to the new racks from existing power feeds.
- Space – The storage hardware, support nodes, and networking equipment require 6 racks, which equates to roughly 300SQFT. The required space is currently available in the MSA datacenter and the POD.

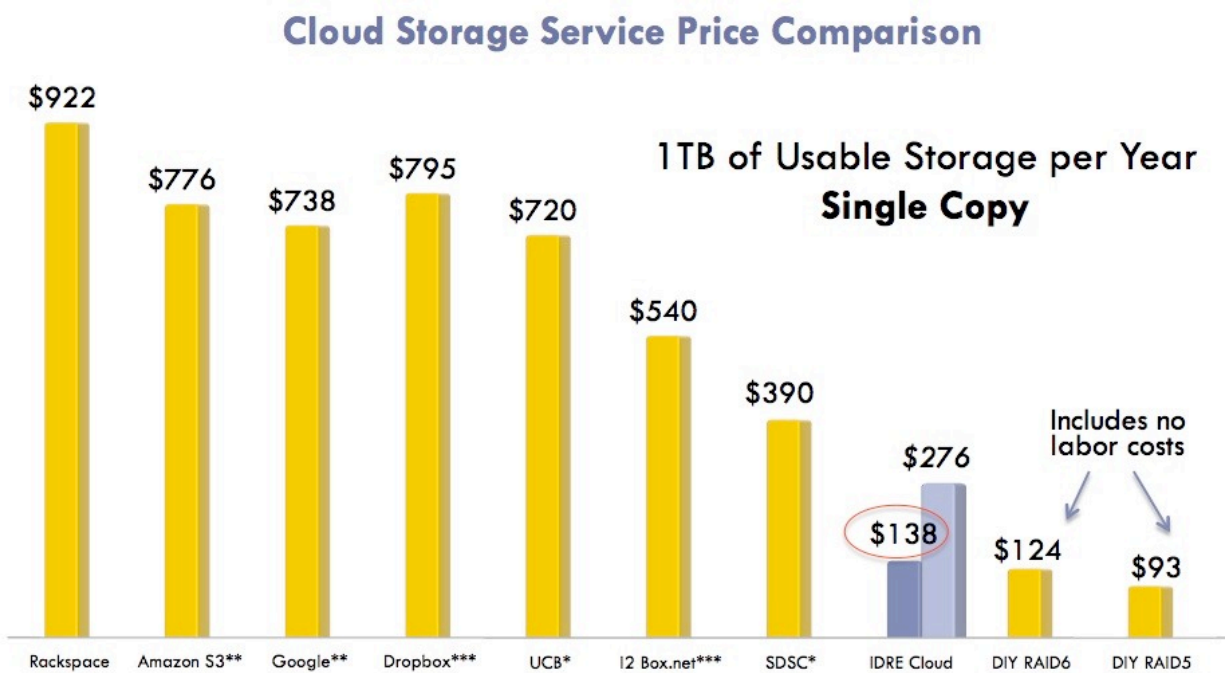
PRICING and POTENTIAL DEMAND

For a program like this to be successful in a campus environment, the price must be as low as reasonably possible. Our current hardware and software estimates show that we can create a service that should be very affordable to our research users.

- Demand is dominated by the relative cost of the service.
- As mentioned above, \$200-300 per replicated terabyte per year is considered the “sweet spot” for this service based on informal surveys, discussion with various facility and departmental IT personnel and review with the IDRE Board.
- This is the maximum viable cost at the proposed storage quantity for this service based on the \$276 per terabyte replicated, per year target rate.

- We are planning a pilot to substantiate services, costs and interest. We have 5-7 groups across the campus that have indicated they will work with us on our pilot testing. There are several other groups who want this service “as soon as possible”.
- We also did a survey of various Cloud storage vendors, both within the UC system as well as commercial offerings:
 - Using Google’s Cloud Storage pricing, their current storage price is estimated at roughly \$738 a terabyte per year[6] and does not include their Network and Request charges which vary by the amount of usage.
 - Using Amazon’s S3 pricing at the 5,000TB level the cost for storage only is \$776 a terabyte a year and also does not include Requests and Data transfer charges which vary by the amount of usage{7}.

A larger cross-section of Cloud storage providers is below:



* No single replica option. ** Without read traffic charges. ***Replica on user's desktop

The service we are proposing will provide approximately two petabytes of usable archival storage to start with. We believe the largest demand will be for backup and true archival services. As an example the IDRE Shared Cluster HPC storage currently has a capacity of 1.5 petabytes. Right now we are only backing up roughly 400 terabytes of data to a tape system, which we are struggling to accomplish in a 24-hour backup window. We will need to transition to a disk-based backup solution to grow any further. If all current users requiring back up transition to the new backup service this would immediately account for approximately 20% of the total proposed system capacity.

PROPOSED PLAN OF ACTION

- Establish Pilot to substantiate demand, services, technologies and costs with a wide variety of campus groups who have indicated their willingness to test the system with us.
 - In parallel, proceed with seeking financial model and pricing approvals from POSSSE.
 - Seek a loan based on a five-year payback period.
 - If the pilot proves successful both technically and financially, officially roll the service out to the campus.
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[1] NSF Strategic Technologies for Cyberinfrastructure, Funding Opportunity Number: PD-11-7684

[2] <https://www.xsede.org/>

[3] <http://www.es.net/>

[4] <http://www.lcrc.anl.gov/>

[5] <https://www.globusonline.org/>

[6] See: <https://developers.google.com/storage/docs/pricingandterms> \$480 a year was based on an estimated cost of \$40/month for one terabyte. Actual pricing was not available for volumes greater than 400TB, shown at \$1,020/year per terabyte.

[7] <http://aws.amazon.com/s3/pricing/>