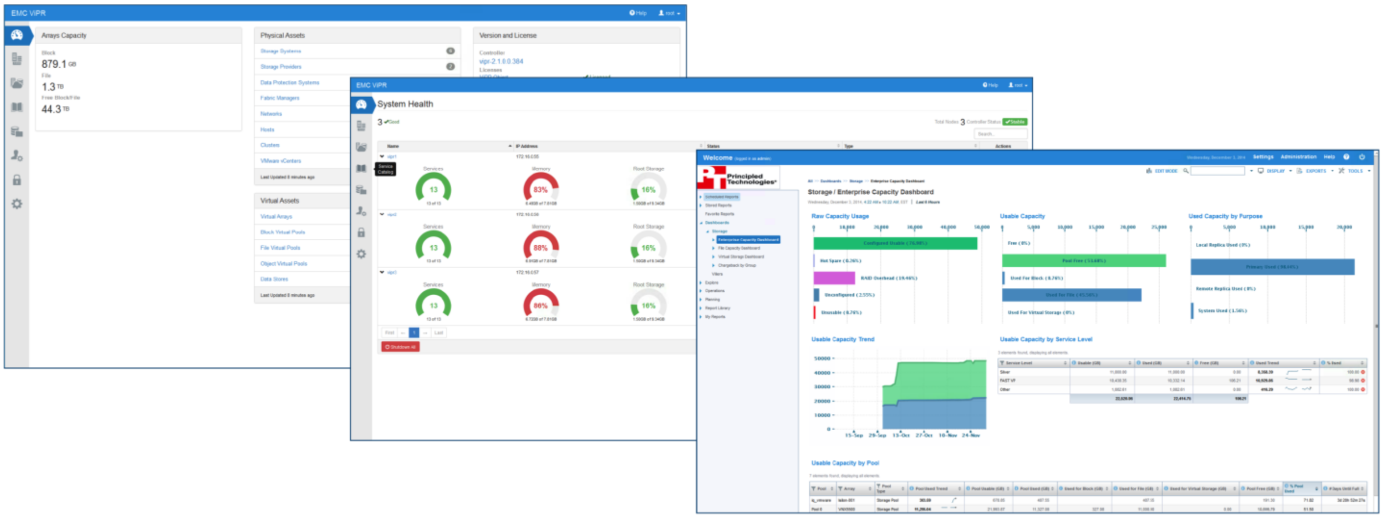
Reducing Operating Expense with EMC ViPR Controller and ViPR SRM



Data growth and increased virtualization within the data center has changed how some businesses provide services to their customers. In a similar fashion, cloud computing, with on-demand provisioning models and customers' desire to self-service many of their IT needs, is driving organizations to better integrate their existing back-end platforms with software-defined service technologies. Cloud-based automation technologies allow enterprises to retain legacy capabilities while remaining nimble enough to compete in a changing technology ecosystem that emphasizes rapid delivery of services with less regard for specified physical hardware. In addition, these new automation technologies create the possibility for organizations to realize operating expense (OPEX) savings from reductions in administrative time and effort. The new technologies can shift the Information Technology Service Management (ITSM) burden from change management to the release management phases and can reduce costs associated with human error.

In previous hands-on testing at Principled Technologies, we explored how EMC ViPR Controller 1.0 automates storage provisioning, consolidates monitoring and reporting, integrates with VMware®, and provides cloud-compatible object stores that

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allow cloud applications to run in your data center.[1] Leveraging this previous work in conjunction with additional hands-on testing with EMC ViPR Controller 2.0 and ViPR SRM 3.5 storage-resource management software, we analyzed potential OPEX savings by comparing administrative tasks, change management workflows, data collection and reporting, and ticket handling processes in a representative environment with and without ViPR Controller and ViPR SRM. Our analysis shows that an organization similar to the one in our scenario could realize $1,942,901.60 (USD) in OPEX savings per year by integrating EMC ViPR Controller into its data center. Adding ViPR SRM, which integrates with ViPR Controller, could bump this savings up by $2,028,323.22 for a net $3,971,224.82 of OPEX reduction annually.

DETAILED TEST CASES

About our approach

To analyze potential OPEX savings from deploying ViPR Controller and ViPR SRM, we researched salary information from publically available sources for a variety of IT functions, including analysts, administrators, specialists, and director- and C-level roles.[2] We used this data as we created our example ITSM change management process, which defines how an organization would manage customer requests to ensure minimal risk to the operating environment. In addition to ticket handling and transfers, we evaluated the OPEX costs associated with the Change Advisory Board (CAB). The CAB is a service management layer that reviews each requested change for its impact and risk, and approves and schedules changes for implementation.

We conducted customer interviews that provided us with real-world experiences for our framing scenario and supporting data that validated our calculations. In addition, we leveraged the hands-on testing from our previous EMC ViPR Controller work where applicable.

Framing scenario

We considered how a large enterprise, with multiple data centers each containing storage platforms of various ages and from different vendors, would operate. In our example, this large enterprise has thousands of internal and external customers who require IT provisioning, data protection, and management services. Our organization has six different regional data centers geographically dispersed over a wide

[1] See the Principled Technologies report for EMC, www.principledtechnologies.com/EMC/ViPR_Software-Defined_Storage_0414.pdf.
[2] www.salary.com/category/salary/

expanse, each with a variety of active storage platforms. Each data center has three shifts of employees with at least one storage, network, server, and virtualization administrator on shift at all times.

This organization would necessarily leverage both Fibre Channel and iSCSI for block storage and file-based NAS storage systems to accommodate the wide range of requests for its customers. We anticipated an organization of this size would deal with thousands of requests for additions, changes, and reductions in services yearly.

Our example enterprise has implemented ITSM to help manage their environment, and has a mature change management process that approves changes to customer environments. This includes a CAB at each facility,[3] which comprises selected senior management, middle management, and senior engineers who convene daily using a software-based management system for prioritizing, approving, and scheduling changes. For more details on the CAB, see Appendix A. To manage costs associated with their physical infrastructure assets, the organization relies on robust capacity planning and management that ensures fulfillment of customer needs and requests while maintaining sufficient stand-by capacity.

To calculate OPEX savings for our enterprise, we researched the salaries of storage, network, and server administrators; help-desk staff; IT and executive management; and other supporting full-time employee costs using publically available sources. See Appendix B for a complete list of salaries and employee roles we used in our analysis.

Test environment

Our test environment, in our labs at Principled Technologies, simulated various storage platforms a large organization might encounter. To show how EMC ViPR Controller or ViPR SRM can manage these various platforms, we used an EMC VNX5500, an HP EVA 4000 physical array, NetApp® and EMC Isilon simulators running as virtual appliances on a dedicated infrastructure virtualization host, and a non-supported Dell™ EqualLogic™ 6110 physical array.

To manage the HP EVA 4000, we set up a Windows Server® 2008 R2 x64 server with HP P6000 CommandView 10.1 and physically connected the server to the SAN environment. As they were otherwise unutilized during testing, we configured the EMC SMI-S provider, which allowed us to discover and manage our EMC VNX5500, and the HP SMI-S provider, which allowed us to access the EVA 4000 using non-HP tools such as ViPR SRM, on alternate ports.

With the exception of our Command View EVA server, all infrastructure components, such as our cloud orchestration software; EMC ViPR Controller virtual

[3] itsm.certification.info/cab.html

appliances; Active Directory; DNS; DHCP; and other network services, ran on this dedicated infrastructure host while our testing targeted a different cluster. We connected all virtualization hosts to both the data network shown in Figure 1 and a Storage Area Network (SAN) shown in Figure 2. We used a Cisco UCS® 5108 blade chassis with two B250 M2 blades and two B200 M2 blades for our infrastructure and servers under test.

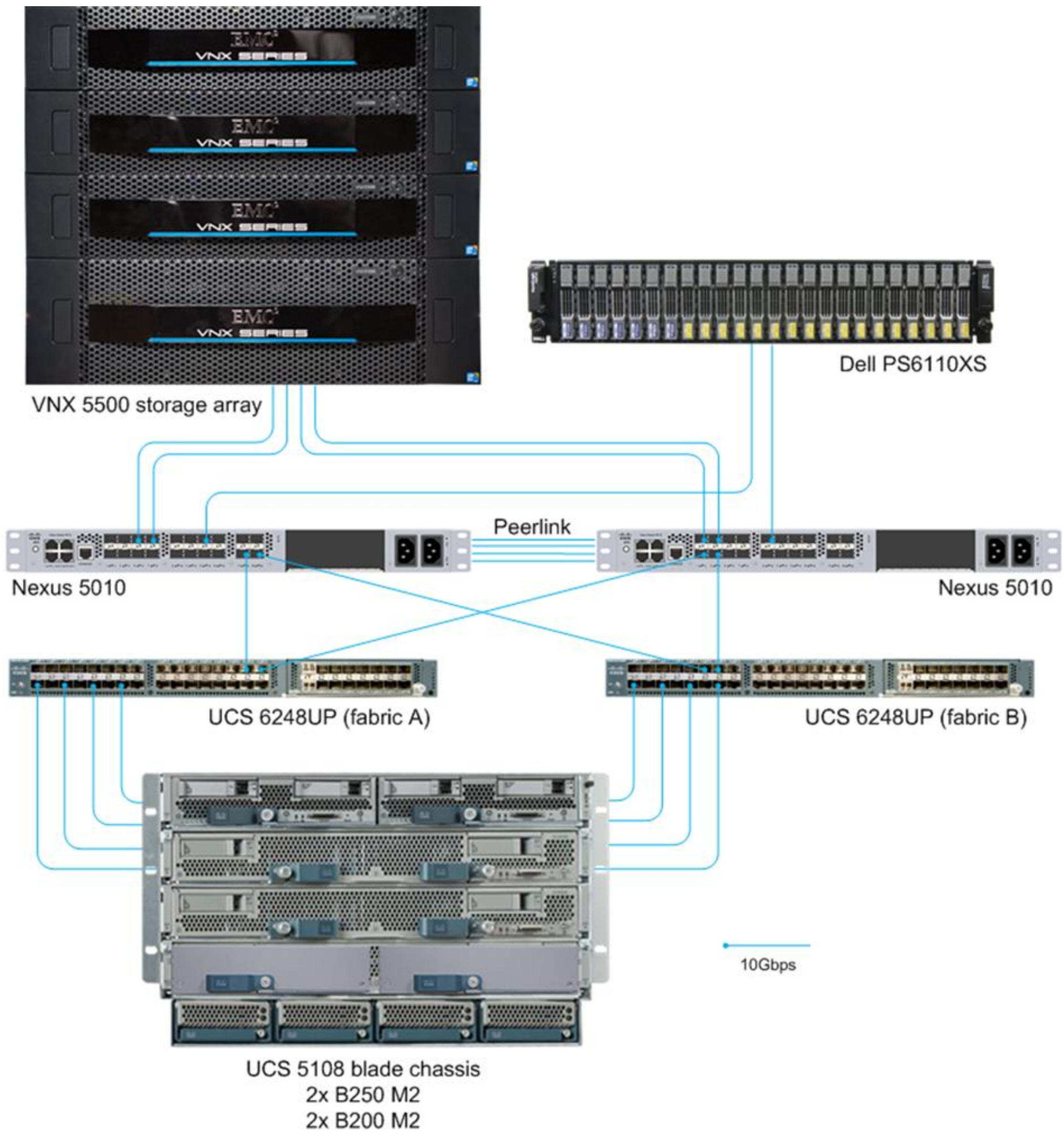

Figure 1: Our physical lab environment with data network connections.

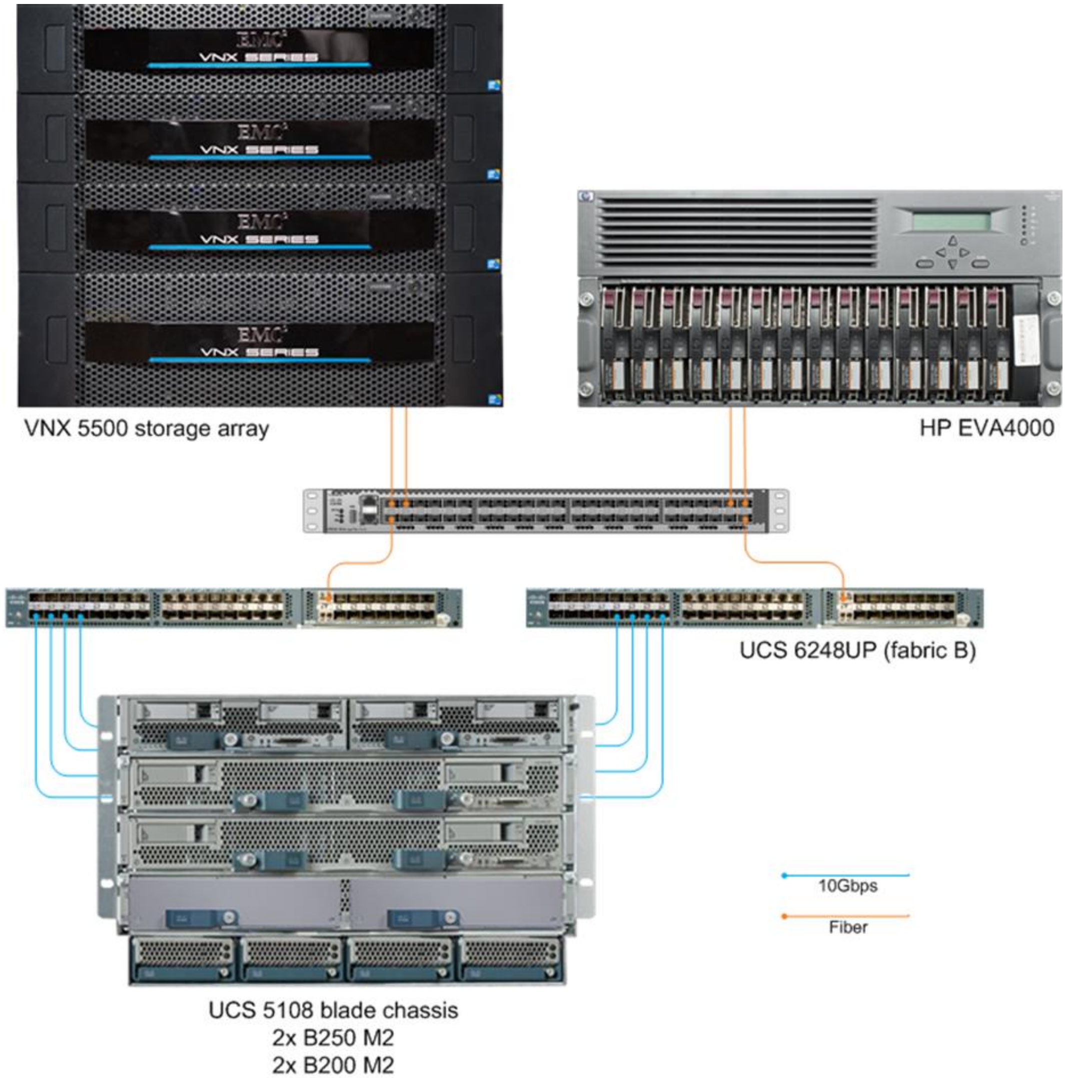

Figure 2: Our physical lab environment with SAN connections.

Within this environment, we executed hands-on testing that supplemented our previous findings and validated those findings with the latest versions of ViPR Controller and ViPR SRM.

Storage automation

Provisioning automation

In our previous testing of ViPR Controller, we showed how IT staff could discover and register storage components such as block and file arrays and fabric managers. We found the current version of ViPR Controller to be similar in function but with an improved, more responsive interface compared to the prior ViPR Controller release that we tested. Operational functions moved to a left-hand sliding menu, which enables an operator to explore various available options without leaving the current view. As shown in Figure 3, we looked at the options within the service catalog section without leaving the dashboard.

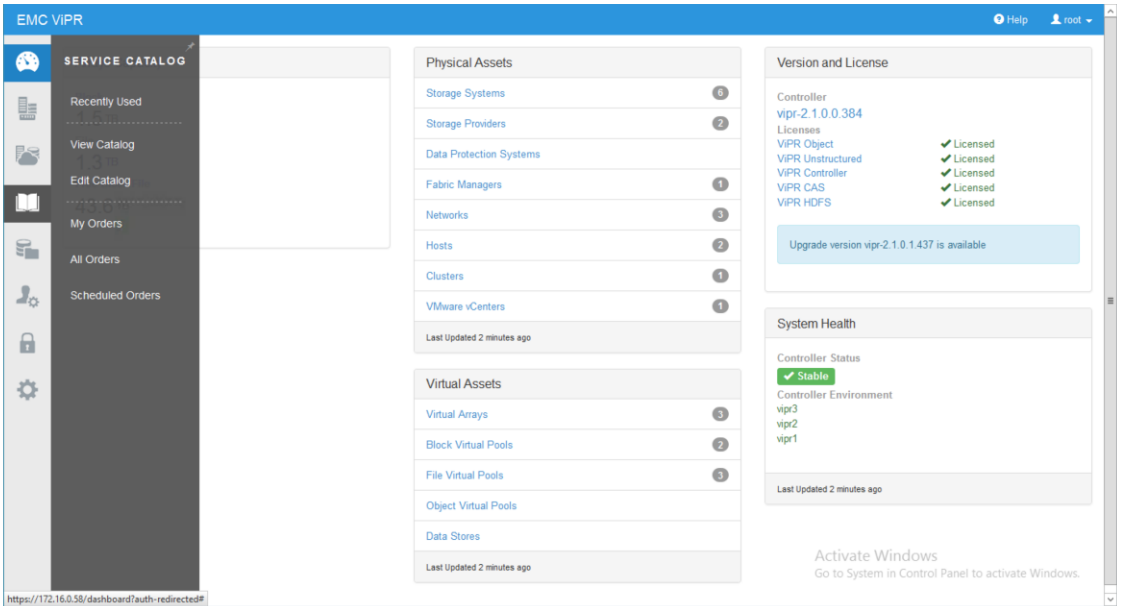

Figure 3: The EMC ViPR Controller user interface with interactive menus.

Discovering assets was simple—we provided connection information and credentials, as shown in Figure 4, and saved the connection. We could then add ViPR Controller-supported elements to virtual networks, pools, and arrays. These elements enable ViPR Controller storage provisioning from the physical assets without logging in to each individual element manager to execute component-specific provisioning tasks.

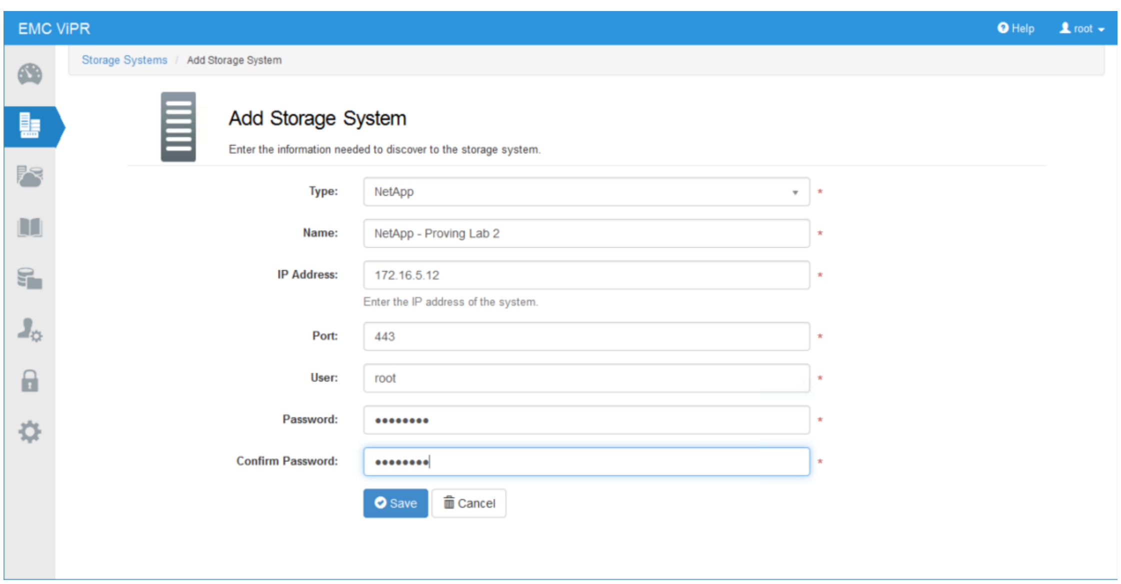

Figure 4: Discovering assets with EMC ViPR Controller.

In previous testing with ViPR Controller, we explored how ViPR Controller automated provisioning saved administrative effort and time.[4] In each of our test cases, we found ViPR Controller handled provisioning faster than an administrator executing manual methods did. These time and effort savings can translate to OPEX savings. Figure 5 shows our calculated OPEX cost savings an organization can realize using ViPR Controller automation for routine provisioning tasks based on our time and effort. We based the following calculations on the salary of a Storage Management Specialist executing these tasks (see Appendix B).

Provisioning storage	Number of admin steps	Reduction in steps with ViPR Controller	Admin time (mm:ss)	Reduction in time with ViPR Controller	Time reduction per instance (s)	OPEX savings per instance (USD)
ViPR Controller (Block)	11		0:44			
Manual - VMAX	46	76.1%	5:27	86.5%	283	$5.14
Manual - VNX	37	70.3%	2:49	74.0%	125	$2.27
ViPR Controller (File)	11		0:49			
Manual - VNX	12	8.3%	1:35	48.4%	46	$0.84
Manual - Isilon	20	45.0%	2:04	60.5%	95	$1.73
Manual - NetApp	15	26.7%	1:30	45.6%	41	$0.74

Figure 5: Calculated OPEX savings for single instances of storage provisioning tasks performed by a Storage Management Specialist.

ViPR Controller provides a single common interface, driven by pull-down menus, for selection of the attributes your users need for their storage profile and provisioning with a few clicks.

One advantage of ViPR Controller is the uniformity it brings to storage provisioning, which helps eliminate delays due to human error. Regardless of the vendor or model of storage from which your administrators provision, ViPR Controller provides a single common interface, driven by pull-down menus, for selection of the attributes your users need for their storage profile and provisioning with a few clicks. As shown in Figure 6, provisioning block storage did not require multiple windows as all selections were contained on a single page.

[4] See Figures 5 and 7 from the Principled Technologies report for EMC, www.principledtechnologies.com/EMC/ViPR_Software-Defined_Storage_0414.pdf.

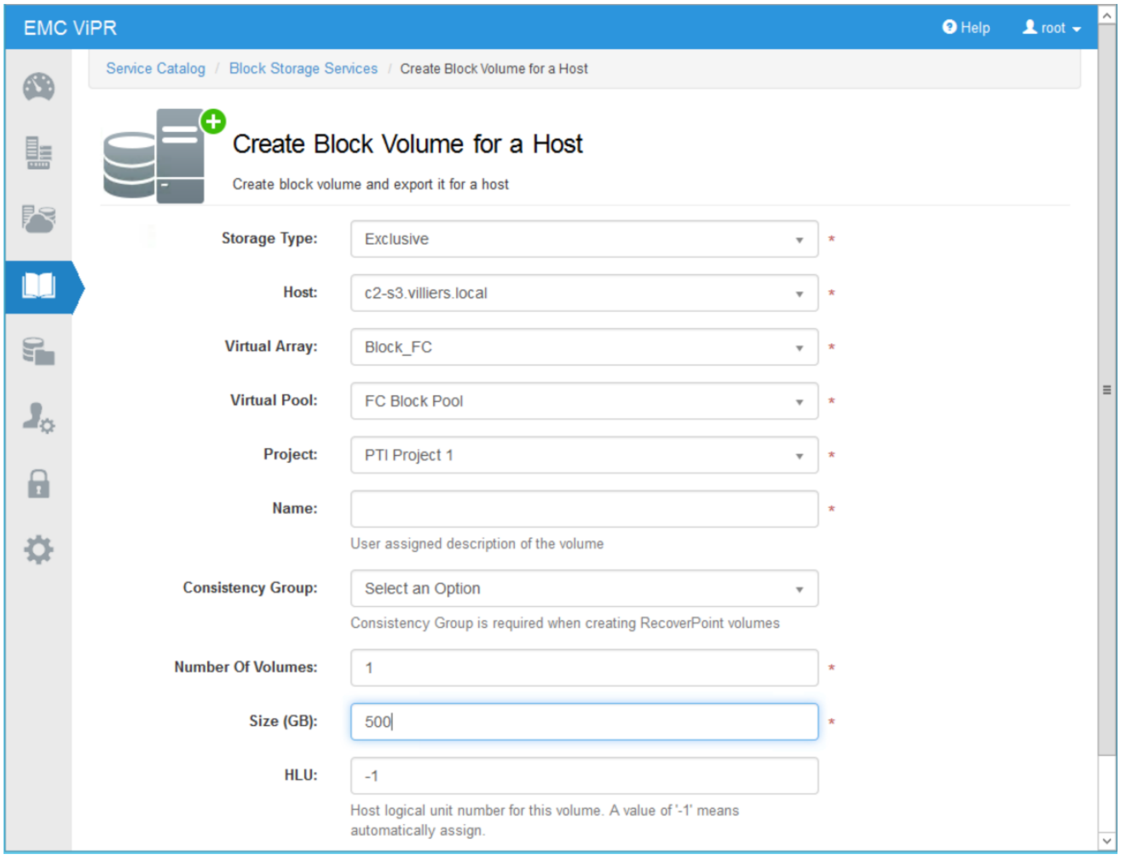

Figure 6: Provisioning block storage in EMC ViPR Controller.

As demonstrated in Figure 7, ViPR Controller offered the ability to create either UNIX® NFS or Windows® CIFS shares without the need to manage another server for file storage.

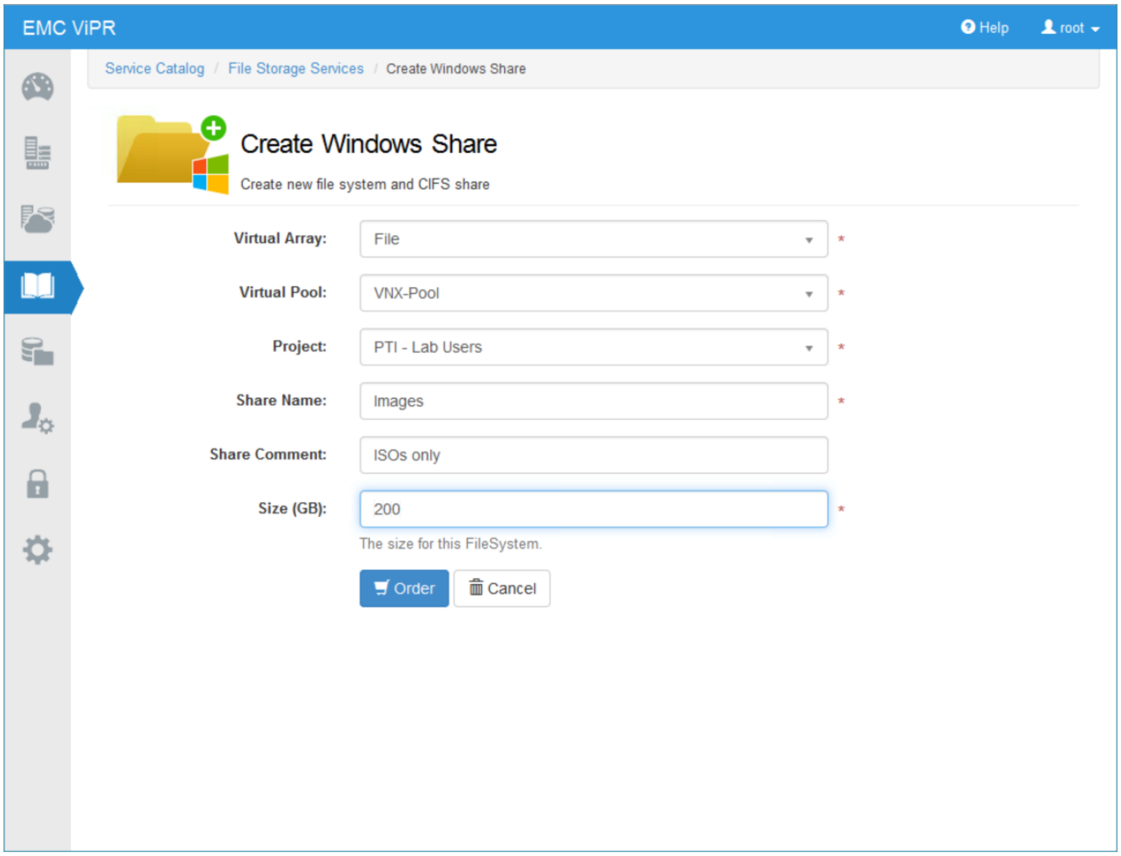

Figure 7: Provisioning a CIFS share in EMC ViPR Controller.

The organization in our example could save up to $64,320 per year in administrative costs, which means up to a 73 percent reduction in storage provisioning costs with ViPR Controller.

ViPR Controller can eliminate the need for error-prone SAN zoning changes and the associated operating expense.

For organizations similar to our example enterprise, administrators would typically handle a large number of requests each day. If each of the provisioning tasks from Figure 5 occurred only 1,000 times per year at each data center, the organization in our example could save up to $64,320 per year in administrative costs for those tasks,[5] which means up to a 73 percent reduction in storage provisioning costs with ViPR Controller. See Appendix F for more details on our cost calculations.

EMC ViPR Controller can eliminate the need for storage administrators to perform any SAN zoning tasks. In our previous paper, we found that the manual method for zoning a host to an array required 24 steps and 7 minutes and 17 seconds in an ideal lab setting with no data entry errors. The manual SAN zoning tests were one of the most error-prone storage management tasks we performed—SAN zoning tasks must be performed for hosts to access the storage when adding new hosts to the environment or when integrating a new array into the environment.

ViPR Controller can eliminate fabric-zoning tasks for both Brocade® and Cisco® SAN infrastructure. We discovered and registered the fabric management switches (see

[5] Calculation

Figure 8), compute hosts, and storage arrays within ViPR Controller, and ViPR Controller created these logical connections automatically when storage was provisioned and exported to a host. Discovery of these components was a one-time effort. ViPR Controller can eliminate the need for error-prone SAN zoning changes and the associated operating expense.

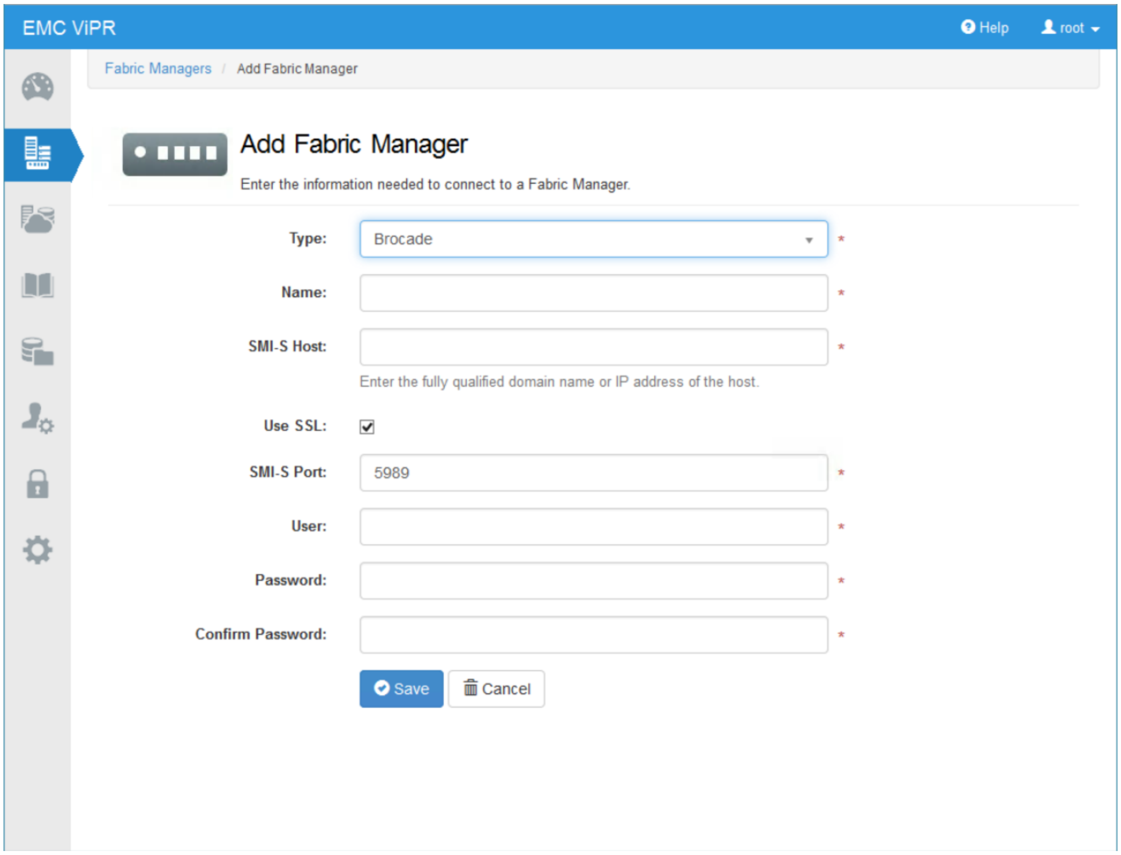

Figure 8: Discovering and registering a Fabric Manager in EMC ViPR Controller.

As it was one of the most time consuming and error-prone tasks in our previous testing, eliminating SAN zoning with ViPR Controller could have a dramatic effect on OPEX savings, with each perfect occurrence costing nearly $8 in administrative costs based on the salary guidance we found (see Figure 9).

Setting up SAN zoning	Number of admin steps	Reduction in steps with ViPR Controller	Admin time (mm:ss)	Reduction in time with ViPR Controller	Time reduction per instance (s)	OPEX savings per instance
ViPR Controller	0		0:00			
Manually	24	100%	7:17	100%	437	$7.94

Figure 9: Calculated costs for each instance of SAN zoning performed by a Storage Management Specialist.

ViPR Controller can save up to 100 percent of the OPEX costs for SAN zoning tasks.

ViPR Controller can save up to 100 percent of the OPEX costs for SAN zoning tasks. For organizations similar to our example enterprise, if only five of these activities occurred daily in each data center, EMC ViPR Controller could save up to 100 percent, or $86,943, per year in administrative costs for SAN zoning alone.[6]

Training costs

We considered the ongoing training costs associated with managing storage platforms. Each storage administrator must have sufficient familiarity with every managed storage platform. In organizations with infrastructure and personnel gained through merger or acquisition, this can mean a significant investment in training.

ViPR Controller can reduce training expense by allowing administrators to provision storage without becoming familiar with any particular storage vendor's proprietary method.

We examined the costs of vendor-specific courses designed to train storage administrators for platform-specific management. The courses we reviewed for NetApp,[7] HP,[8] Hitachi®,[9] and EMC[10] averaged $4,237.50 per class. We used this average as the cost of a generic course for any storage platform, and assumed that each employee attends at least one professional training course per year. At that rate, training a single storage administrator at each data center on only a single storage platform would cost $25,425. If a busy organization staffed each shift with two administrators to fulfill requests and then trained each administrator on all four storage platforms that we cited previously, training costs could skyrocket. Without ViPR Controller, training lower level storage administrators could cost a large enterprise organization over $610,200 (USD) per year.[11]

ViPR Controller can reduce training expense by allowing administrators to provision storage without becoming familiar with any particular storage vendor's proprietary method. ViPR Controller executed tasks based on repeatable, best practices, and intelligent processes. This means an administrator could provision storage from EMC VNX or VMAX block storage using the same procedure used to provision block storage from Hitachi, NetApp, or the other third-party block storage providers we will discuss later in the paper.

In addition, ViPR Controller can create file systems, so the nuances of how each file-based storage system provisions storage could be irrelevant for ViPR Controller users. If ViPR Controller supports the storage system, administrators need to use only

[6] Calculation

[7] www.fastlaneus.com/course/na-d7adm

[8] www.exitcertified.com/training/hp/storage-administration/p6000-eva-enterprise-virtual-arrays/p6000-administration-management-28533-detail.html

[9] www.exitcertified.com/training/hitachi-hds/storage-foundations/data-systems-19857-detail.html

[10] www.globalknowledge.com/training/course.asp?pageid=9&courseid=16388&catid=517&country=United+States

[11] Calculations

For our example organization, this could mean a 75 percent reduction in training costs, because each administrator would specialize in only one platform instead of four.

the ViPR Controller procedures, and those procedures are uniform for all supported arrays.

Rather than train all administrators on every storage platform, organizations could provide in-depth training on a single platform to each administrator—creating experts who can configure, setup, and maintain each platform—and use ViPR Controller for storage provisioning tasks for all platforms. For our example organization, this could mean a 75 percent reduction in training costs, because each administrator would specialize in only one platform instead of four. That is equivalent to $457,650 in savings.

Additional OPEX savings

Beyond storage provisioning and administration, ViPR Controller offers other opportunities to reduce operating expenses. Many organizations with complex infrastructures, large customer bases, and contractual obligations to provide designated levels of service have turned to ITSM to provide a framework for enhancing the quality of management of their services. Service providers must carefully consider the risk and possible effect to other services before implementing changes. Change management's purpose is to minimize risk by carefully reviewing possible points for human error and to prevent outages by thoroughly understanding the effect a change will have on the rest of the environment and by taking any recommended mitigating steps.

One of the more expensive aspects of change management is the CAB. The expense is purely a function of the amount of time required to review and approve changes and the staff necessary to make those decisions, as illustrated in Figure 10. Customer requests or trouble incidents may prompt Requests for Change (RFC). These transitions flow from one category to the next via an electronic ticketing system.

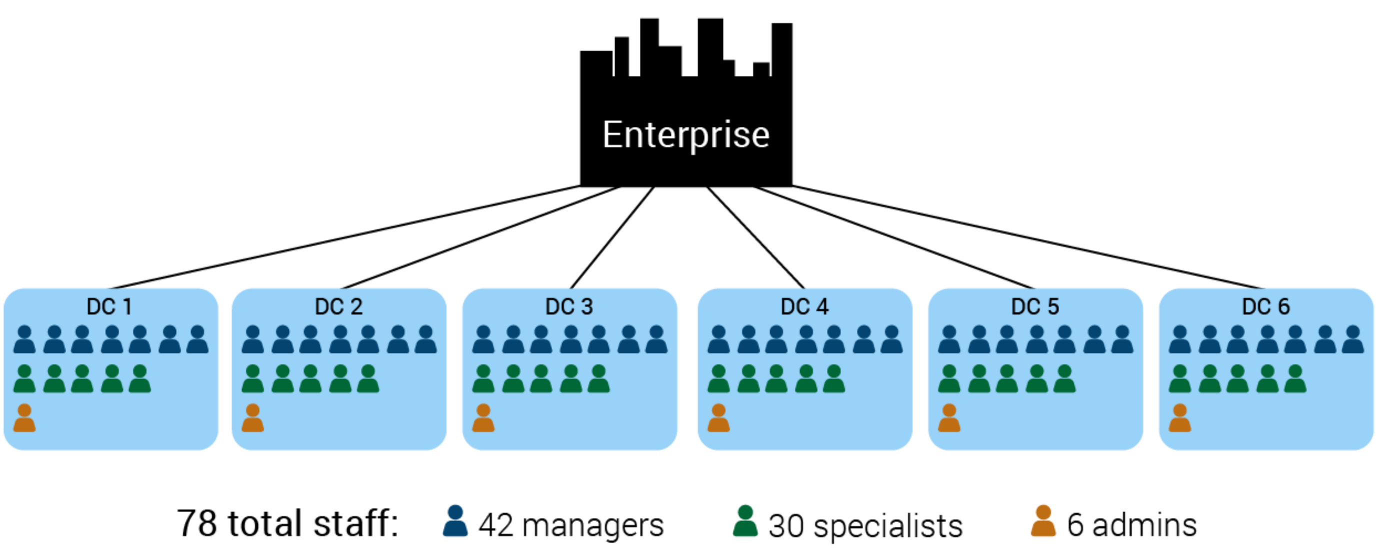

Figure 10: Necessary staffing requirements to operate a CAB.

ViPR Controller can relieve the costs associated with a Change Advisory Board (CAB) by removing the work of a significant number of staff from the change phase.

Removing 1,350 changes from the change management process could lead to an 18 percent reduction in OPEX costs related to the CAB with ViPR Controller.

For example, when the Help Desk receives requests or trouble reports, the technician assigns the issue to an administrator for research and troubleshooting. If the administrator determines the problem is outside the scope of his authority, he will transfer the issue, via the ticket, to the administrator he believes has the ability and authority to correct the issue. When the correct administrator receives the ticket, she may discover an infrastructure change is necessary to fulfill the need. She creates an RFC and the approval process begins. This process generally introduces additional costs and delays into fulfillment of the request or mitigation of an incident.

ViPR Controller can relieve the costs associated with a Change Advisory Board (CAB) by removing the work of a significant number of staff from the change phase. The purpose of change management is to mitigate the risk of humans introducing errors into the environment. By pre-allocating storage infrastructure, devices, disk pools, and other resources to ViPR Controller, organizations can avoid frequent infrastructure changes. Administrators, or possibly the users, fulfill requests in a timely manner without the introduction of management overhead, which can create a flexible organization with fewer human resources required for fulfilling requests.

Appendix C shows a systematic example of the costs associated with request, incident, and change management. Very little of the expense has to do with the actual task itself; rather, it is the approval process with multiple points of potentially error-prone data entry, management-intensive labor costs, and quality control checks that drive up the costs. Based on our calculations, a single change in our organization can cost up to $162.93.

Of the 7,500 changes that can be handled per year by this example CAB, we assumed only 30 percent of them are storage or fabric related, and 60 percent of the storage-related tasks could be handled by ViPR Controller, either by provisioning new storage or by performing automated SAN zoning. Removing those 1,350 changes from the change management process could save $219,955.50 in OPEX costs in a single year,[12] an 18 percent reduction in OPEX related to the CAB with ViPR Controller.

Finally, considering that we have six geographically distributed data centers, each with its own infrastructure to manage, that cost applies to each data center. EMC ViPR Controller could save an organization like the one in our example up to $1,319,733 in a single year in CAB-related costs.

ViPR SolutionPack

EMC ViPR Controller is bundled with the ViPR SolutionPack for monitoring and reporting the environment. The ViPR SolutionPack provides administrators with a single

[12] Calculations

composite view of the health, capacity, and usage trends of the storage managed by ViPR Controller. When both the ViPR Controller and ViPR SRM are installed in the environment, the ViPR SolutionPack appears in the ViPR SRM Report Library and feeds into the ViPR SRM global reports. Figure 11 shows the top-level report of the ViPR SolutionPack, presented within ViPR SRM.

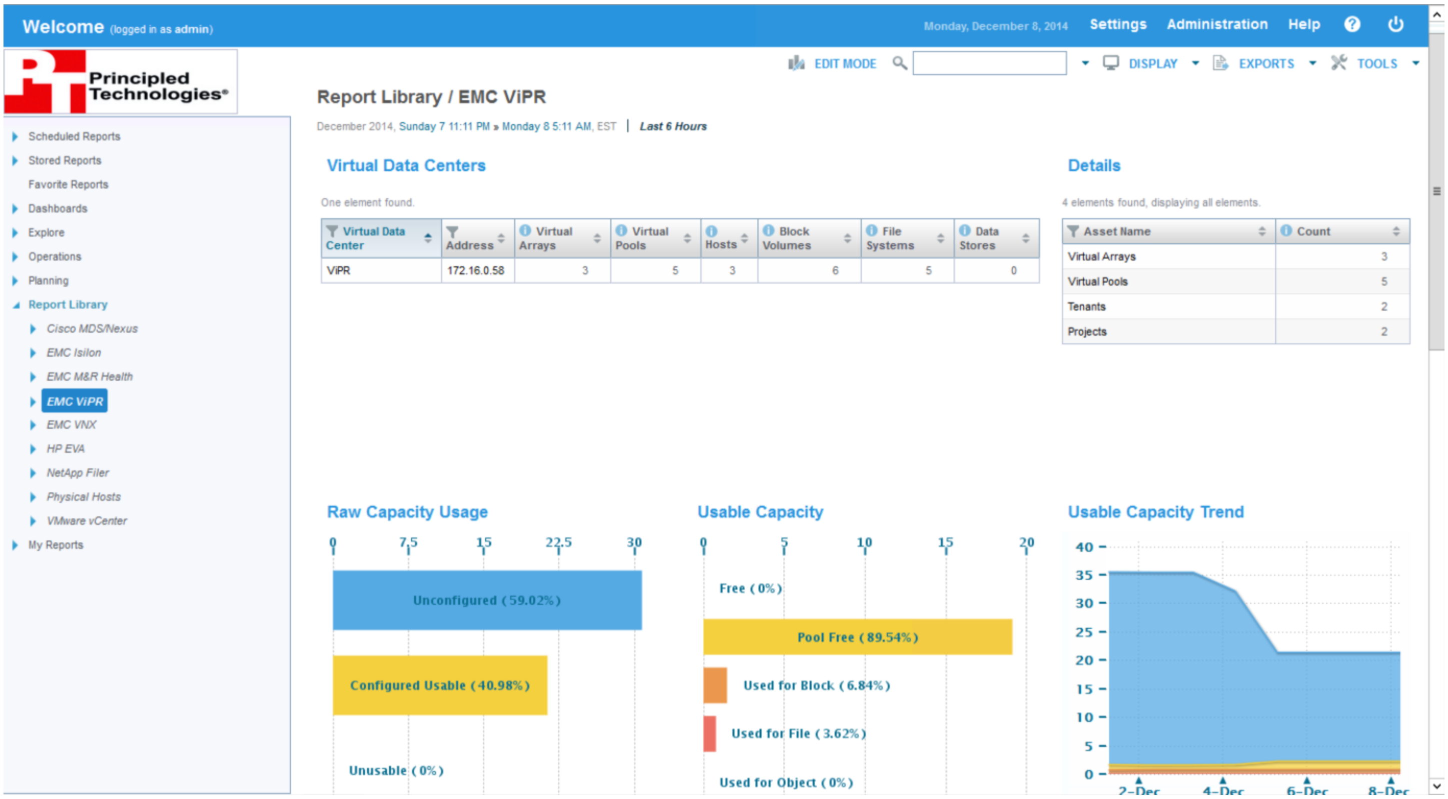

Figure 11: ViPR SolutionPack.

Drilling down into the ViPR SolutionPack, administrators can find a wealth of information on the virtual storage pools and arrays within ViPR Controller. From a single common interface, administrators can view and export information on availability, capacity, and utilization of the virtual components within ViPR Controller. Figure 12 shows a view of our iSCSI virtual array that contained physical devices presented by the third-party block storage provider. It is important to note that the physical devices were outside the scope of this view—the ViPR SolutionPack provided insight only into the virtual assets discovered in ViPR Controller.

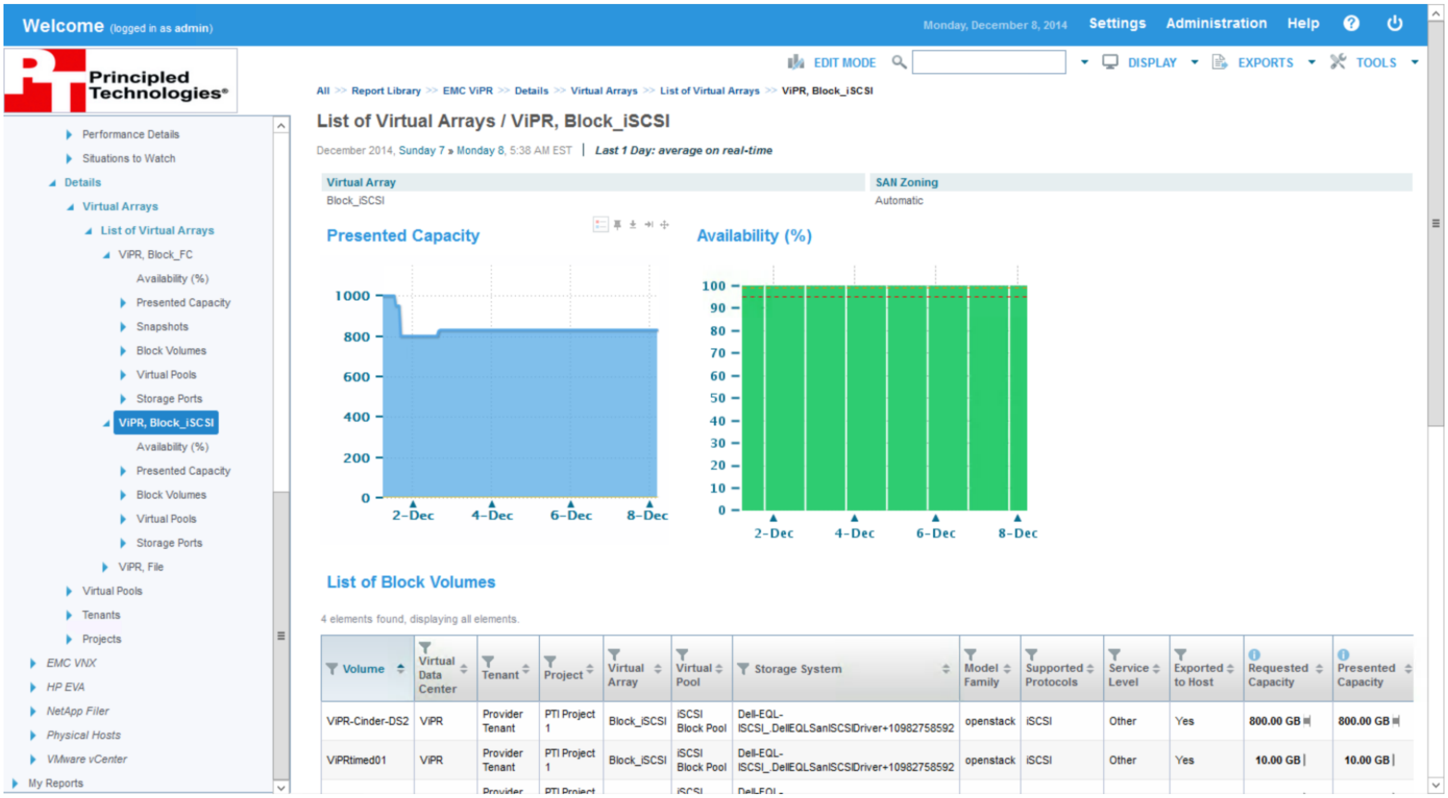

Figure 12: Detailed reporting on virtual assets with the Monitoring and Reporting SolutionPack.

The ViPR SolutionPack enabled us to generate reports per tenant or per project. This is important for determining which customers have the highest demands. Figure 13 shows a sample view of a single project with details about which storage pools the customer uses.

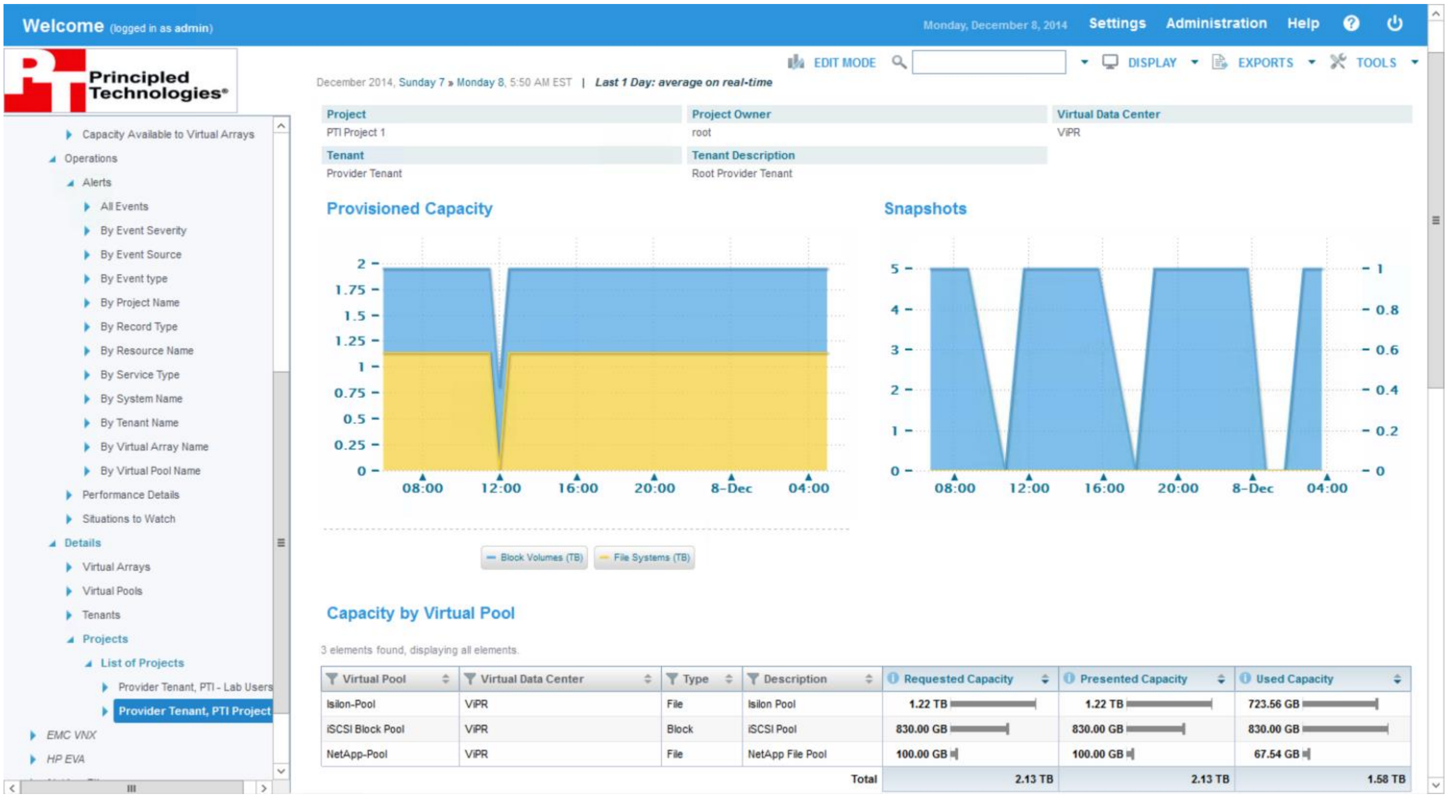

Figure 13: Users can generate reports based on each tenant or on a per project basis.

One advantage of centralized monitoring and reporting for ViPR Controller is the potential elimination of having to log into each physical component to gather all of the information related to the virtual arrays configured in ViPR Controller. The information contained within each physical array management application, with different provisioning methods and vendor-specific labeling, can be difficult to manually export, consolidate, and manipulate into a useable dataset for reporting purposes. The ViPR SolutionPack offers users the ability to collect relevant data, customize the views based on needs, and provide consistent quality reporting. Because the ViPR SolutionPack leverages the ViPR SRM framework, storage administrators can move easily back and forth between the two to get a true enterprise-wide picture of virtual and physical storage. ViPR SRM obtains capacity usage information from the ViPR SolutionPack to provide showback or chargeback reports to consumers for all storage utilization.

ViPR SRM

In addition to views of virtualized storage in the ViPR SolutionPack, ViPR SRM generates management reporting for the physical infrastructure in your storage environment through the installation and configuration of vendor-specific SolutionPacks. Once the SolutionPacks are enabled, ViPR SRM can collect the data and perform automatic collation and analysis, and generate custom reports that can be used for a variety of purposes. As shown in Figure 14, dashboards such as the Enterprise

Capacity Dashboard can give administrators a high-level view of their environments and provide the ability to drill down for more details.

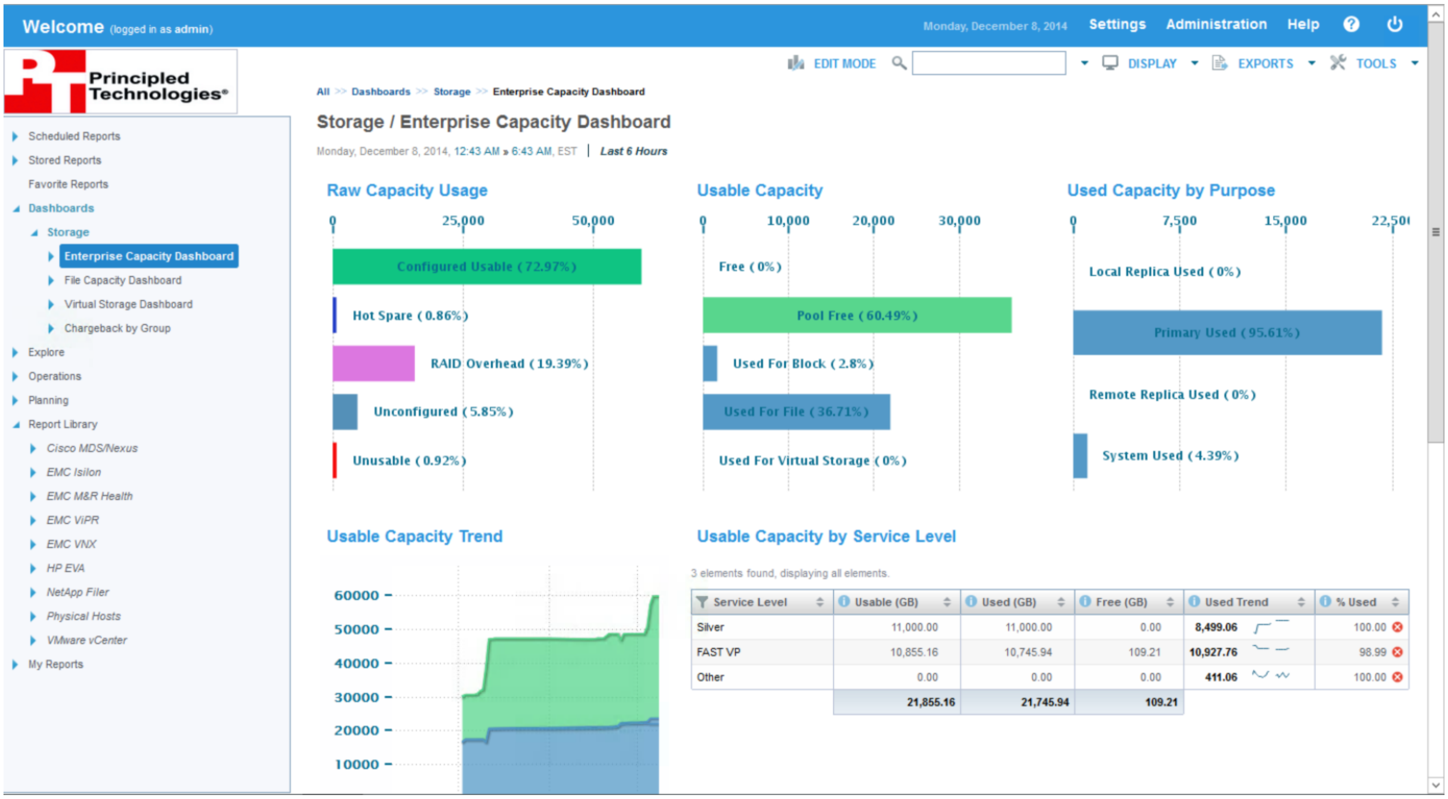

Figure 14: ViPR SRM dashboards provide a quick way to access frequently used data.

For purposes of capacity planning and reporting, ViPR SRM can bring significant savings in data center OPEX.

For the purposes of capacity planning and reporting, ViPR SRM can bring significant savings to data center OPEX. We considered the effort required for collecting the data from each physical array, aligning the data under common headings for calculations, and manipulation. First, we logged in to ViPR SRM and sent the data from the Enterprise Capacity Dashboard directly to our inbox via its email delivery function. In five steps spanning 18 seconds, we viewed the report in PDF format (see Appendix D).

We then identified the data elements we would attempt to extract manually from our storage arrays. We determined that total capacity, used capacity, and percent used were the fields we would collect from our arrays. For almost 30 minutes, we researched the data fields used by each type of array and built a spreadsheet that would automatically calculate totals based on the data we input. Our final output appears in Appendix E.

For this simple report, our total time including report creation and data entry required 37 minutes and 12 seconds—7 minutes and 35 seconds of this was data collection and entry. For each time we executed the report in our test environment, the manual method required 7 minutes and 25 seconds more than ViPR SRM did.

Our lab environment consisted of only a few storage targets. Large enterprises will have many storage targets, each with their own management interfaces and data labels. We identified the amount of time to access the information in each of the individual arrays we used for our storage capacity report (see Figure 15). We used this data to extrapolate OPEX savings in a larger environment. For this study, we eliminated data entry and other human errors—our extrapolation was a perfect scenario, which is typically not the case due to human error.

Array	Per login (s)	Per pool (s)
Isilon	22	20
NetApp	25	20
VNX Block	48	21
VNX File	9	19

Figure 15: Storage management times by array.

An increase in the number of arrays in a data center and an increase in the number of pools defined on each array can significantly affect the required time to perform manual data collection. If our example organization had 20 of each type of array in each data center, and if each array had a minimum of five pools, the administrator would have to spend time logging in and then additional time addressing each pool—for a total of 80 separate logins and 400 pools to check. A single data collection run for our simple report would require 2 hours and 48 minutes from IT staff at each data center. Across the organization, that equals more than two business days' worth of person-hours from the array managers—all Storage Management Specialists—to generate a subset of data that ViPR SRM can provide in a matter of seconds. In 18 seconds, we were able to obtain a roll-up of all the capacity in the enterprise, with the ability to drill down as needed.

Generating management reports could reduce capacity-reporting costs by up to 99 percent when using ViPR SRM.

If we instead assume the employees at the Help Desk Support level (see Appendix B) collect this data using ViPR SRM, then generating a similar report could save $400,658 in OPEX per report each year,[13] a 99 percent reduction in capacity-reporting costs using ViPR SRM. By using ViPR SRM for five small reports involving the infrastructure components and manual data collection methods described here, organizations could realize $2,003,290 in OPEX cost savings each year.

EMC ViPR SRM can schedule automatic report generation. Users can customize the frequency and recipients of those reports and specify formats for data delivery. In Figure 16, we specified multiple targets and chose to deliver a daily, up-to-date report at 10:00 AM. ViPR SRM delivered the output in PDF and XLS formats, which means ViPR

[13] Calculations

SRM can simultaneously provide a static report and a data set for manipulation. This is particularly useful because report delivery schedules can coincide with daily status meetings and provide the most recent data at just the right time.

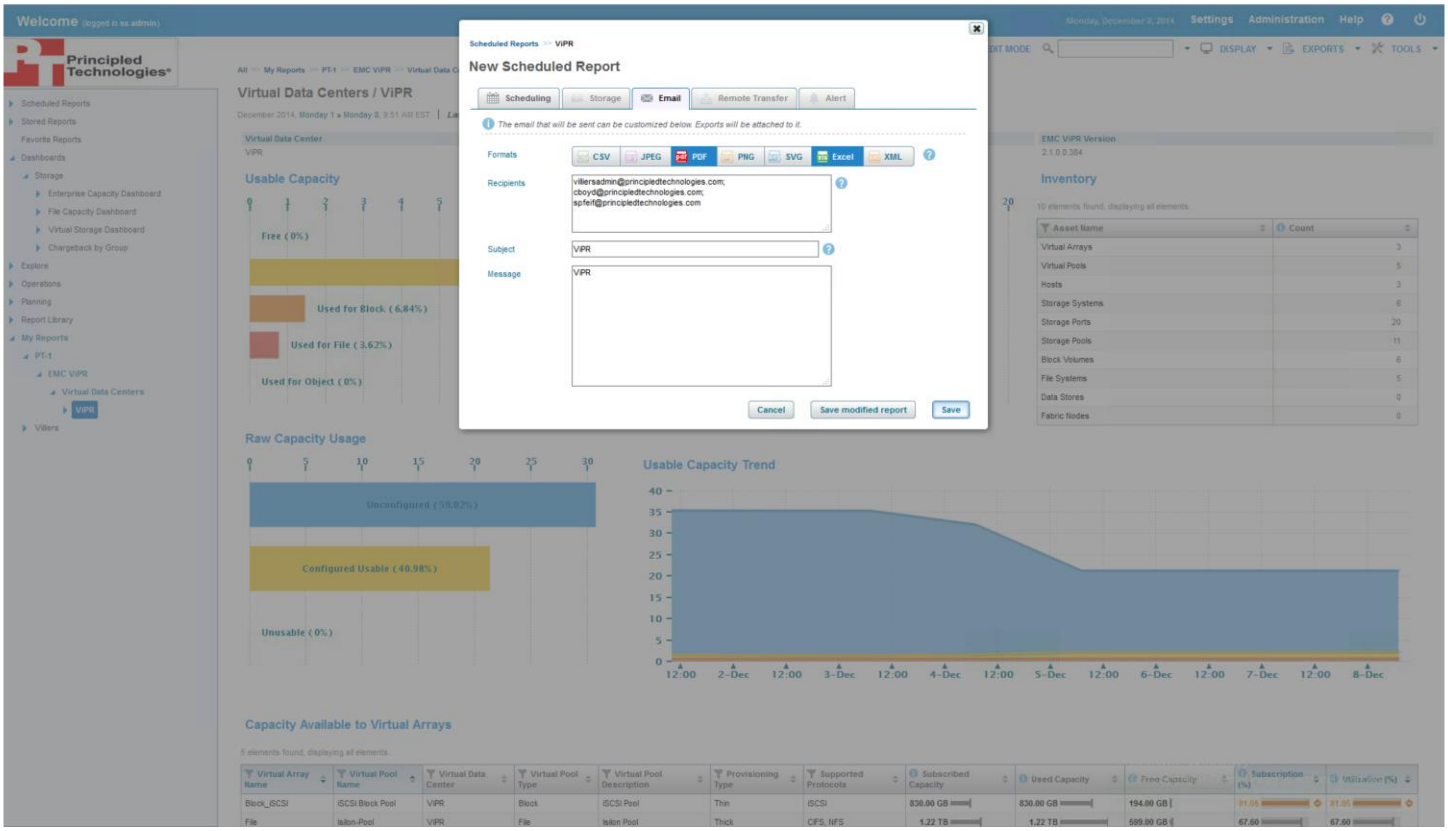

Figure 16: Scheduling automatic report generation and delivery with ViPR SRM.

Performance monitoring and troubleshooting

ViPR SRM can streamline troubleshooting performance issues. Often when a customer reports an issue, they report only a few seemingly disjointed symptoms or something such as, “Our system is slow.” How can the Help Desk technician properly route the ticket to the correct group for resolution?

For many large organizations, administrators organize their staff into specialized, functional groups such as server management, network support, storage management, and application development. Each group’s primary responsibility aligns with their specific skillset, so if a customer reports an issue with an unknown cause, administrators must transfer the problem ticket among the functional groups so that the correlating group handles each component requiring investigation. Figure 17 demonstrates this manual flow.

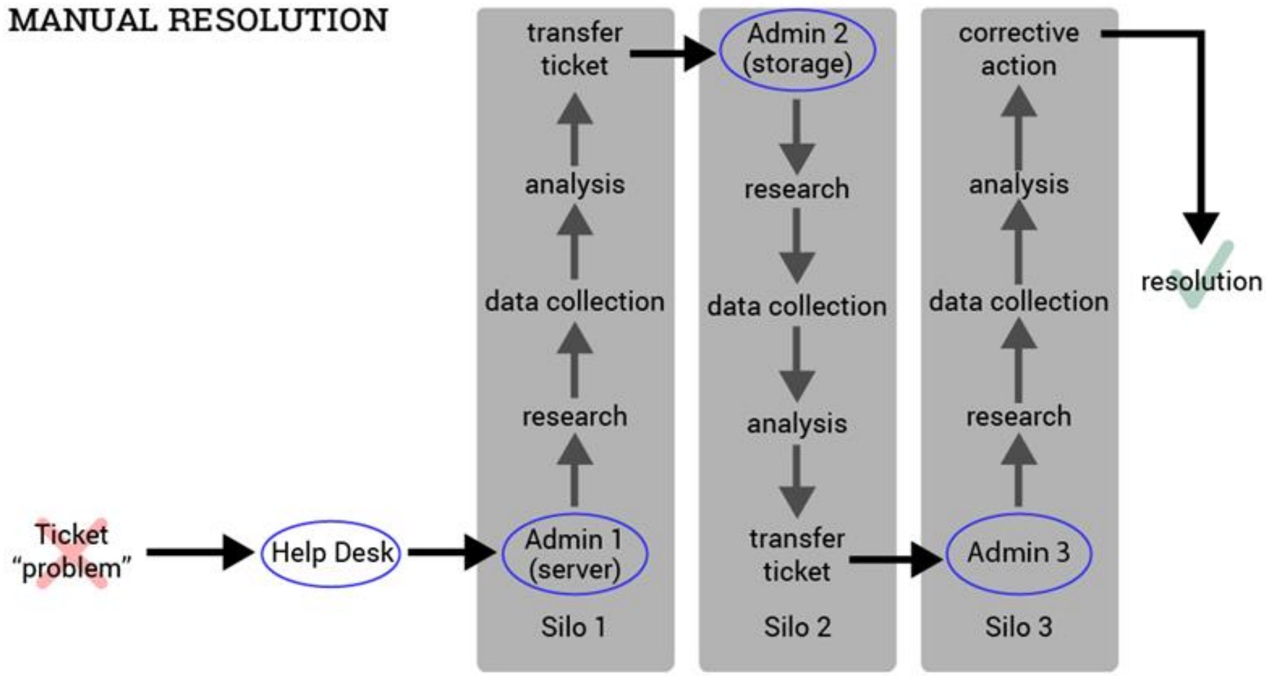

Figure 17: Manual data collection for troubleshooting a ticket can involve multiple hand-offs.

As an example, a Help Desk technician receives a problem report and creates a ticket. It is not clear to the Help Desk person which group should receive the ticket because the customer has an application running on hosted servers using a public-facing data network and FC block storage. The Help Desk technician forwards the ticket to the server administrator.

The server administrator has visibility of the infrastructure as presented to only the server. After verifying that the local system components, such as CPU and RAM, are well within normal operations, the administrator discovers a LUN that is not responding normally. The server administrator documents his findings and forwards the ticket to the SAN management group to make sure the SAN fiber network is functioning normally.

The fiber network administrator logs into the fabric switches under her control and verifies the switches are performing normally, that all connections are active, and that data is flowing properly. Then the ticket goes to the SAN switch manager who documents her findings. She transfers the ticket to the storage-array management group for further investigation.

The storage-array administrator receives all of the previous information and checks on the problematic LUN. He discovers an issue and takes corrective action, invoking emergency change control in the resolution. The storage-array admin documents the problem, verifies normal operations, and resolves the ticket.

This example has multiple possible points for human error. Each pass from silo to silo creates an opportunity for a typographical error, which means the next administrator may research the wrong issue. In addition, each data capture is a possible transcription problem. Our example is a simplified ticket handling workflow. When administrators in each silo cannot identify an issue properly, tickets can bounce back through the system multiple times before arriving at a solution.

Figure 18 presents the same solution with ViPR SRM leveraged by first-level analysts who can use the data to gather cross-silo information and pass the problem ticket to the correct administrator for resolution.

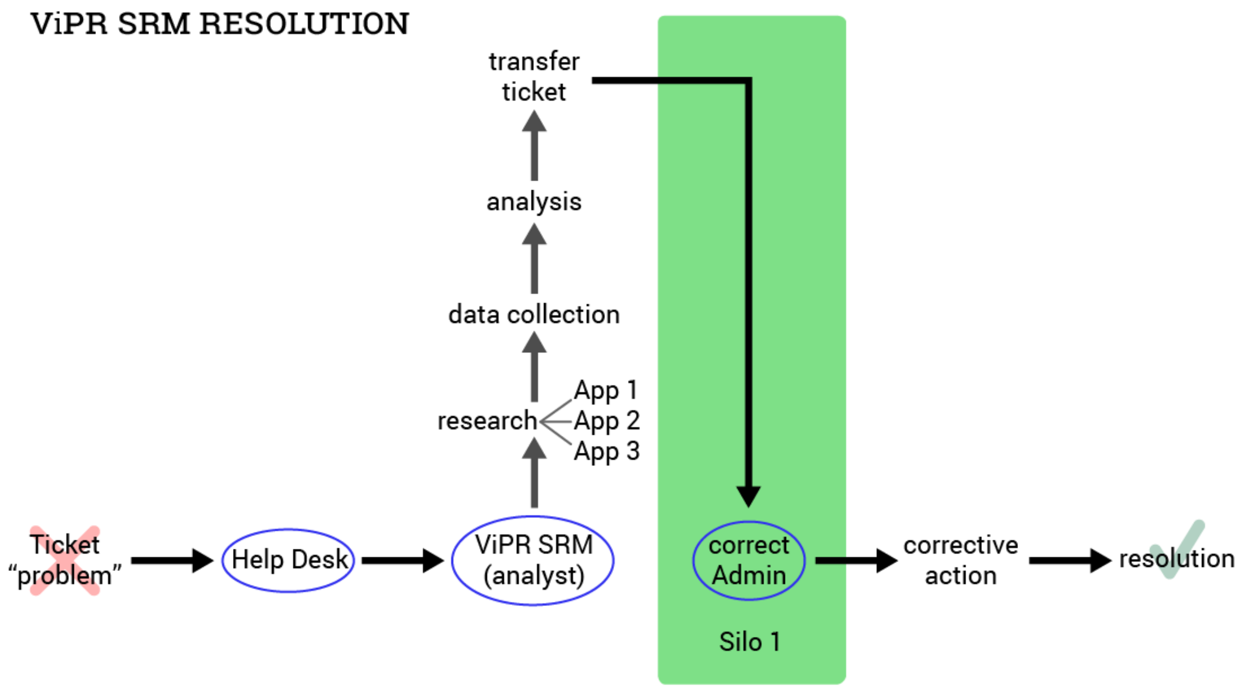

Figure 18: The troubleshooting process with ViPR SRM.

By eliminating multiple ticket recipients, and performing the bulk of data collection with automated reporting tools, ViPR SRM can provide a reduction in issue resolution time and OPEX associated with ticket management.

In this example using ViPR SRM, the Help Desk technician transfers the ticket to an analyst dedicated to triage. The analyst can use ViPR SRM to view the entire end-to-end infrastructure, and can drill down into each component to discover abnormalities or events that affect performance. We compared the manual process for logging in to each element—host, fabric switch, and storage array—with obtaining the same data with ViPR SRM. Our testing showed the manual process required 4 minutes and 28 seconds to log in to all the elements (80 seconds for compute, 80 seconds for fabric management, and 108 seconds for storage management), give a cursory review of each, and export the data for later review. It took 31 seconds to view and export the data from ViPR SRM. In an organization like the one in our example, if ViPR SRM assisted in troubleshooting only 1,000 times per data center, the manual OPEX cost to gather this data is $26,811.62 when performed by silo admins.[14] Compared to $1,778.40 for the ViPR SRM automated data collection, performed by Help Desk Support,[15] that is a savings of up to $25,033.22 in OPEX—a 93 percent reduction over the manual cost.[16]

In assigning times to each administrative silo, our manual process time of 4 minutes and 28 seconds came from a single administrator with access to all components. We did not have to transform and interpret the data from each element, document the findings, or transfer a ticket from one operational group to another. We estimate an administrator would spend at least 15 minutes with ticket management, investigation, analysis, and documentation. By eliminating multiple ticket recipients, and performing the bulk of data collection with automated reporting tools, ViPR SRM can provide a significant reduction in issue resolution time and on OPEX costs associated with ticket management.

OPEX savings for storage automation

Based on our calculations for storage provisioning ($64,320.00), SAN Zoning ($86,943.00), Training ($457,650.00), CAB savings ($1,319,733.00), reporting ($2,003,290.00), and troubleshooting ($25,033.22), an organization like the one in our example could save $3,956,969.22 in OPEX by implementing ViPR Controller and ViPR SRM in their environments.

EMC VPLEX, EMC RecoverPoint, and EMC SRDF

ViPR Controller also includes VPLEX and RecoverPoint-related enhancements, such as RecoverPoint failover in VPLEX environments to local or remote targets, VPLEX local volume mirrors for volume protection across arrays, and VPLEX Snapshots for full life cycle management of snaps and clones on arrays behind VPLEX. Using EMC Symmetrix Remote Data Facility (SRDF) synchronous and asynchronous replication as well as failover and failback, ViPR Controller can automate disaster recovery protection. Organizations that leverage these technologies in conjunction with ViPR Controller and ViPR SRM could save even more on OPEX costs due to automating manual provisioning, recovery, failback, and reporting processes.

For more information on VPLEX and RecoverPoint, see www.emc.com/collateral/solution-overview/h12240-vipr-vplex-so.pdf. For more information on SRDF, see www.emc.com/storage/symmetrix-vmax/srdf.htm.

[14] Calculation

[15] Calculation

[16] Calculation

Storage-as-a-Service

Self-Service provisioning

Allowing internal customers, such as application developers, lab users, and internal IT staff to provision storage for themselves, rather than have to utilize the request process, can reduce the lag time and costs associated with ticket management.

One of the advantages of the ViPR Controller interface is the ability to integrate with an Active Directory, and allow designated users to provision storage for the tenants and projects with which they are associated. Allowing internal customers, such as application developers, lab users, and internal IT staff to provision storage for themselves, rather than have to utilize the request process, can reduce the lag time and costs associated with ticket management.

ViPR Controller can limit the ability of users to perform tenant activities based on group membership or by other limiting attributes, such as the department listed in their Active Directory user account properties, as shown in Figure 19. Additionally, when used with ViPR Controller, ViPR SRM can automate the creation and delivery of multitenant chargeback reports for ViPR Controller tenants and projects to provide the cost transparency frequently required when delivering storage-as-a-service.

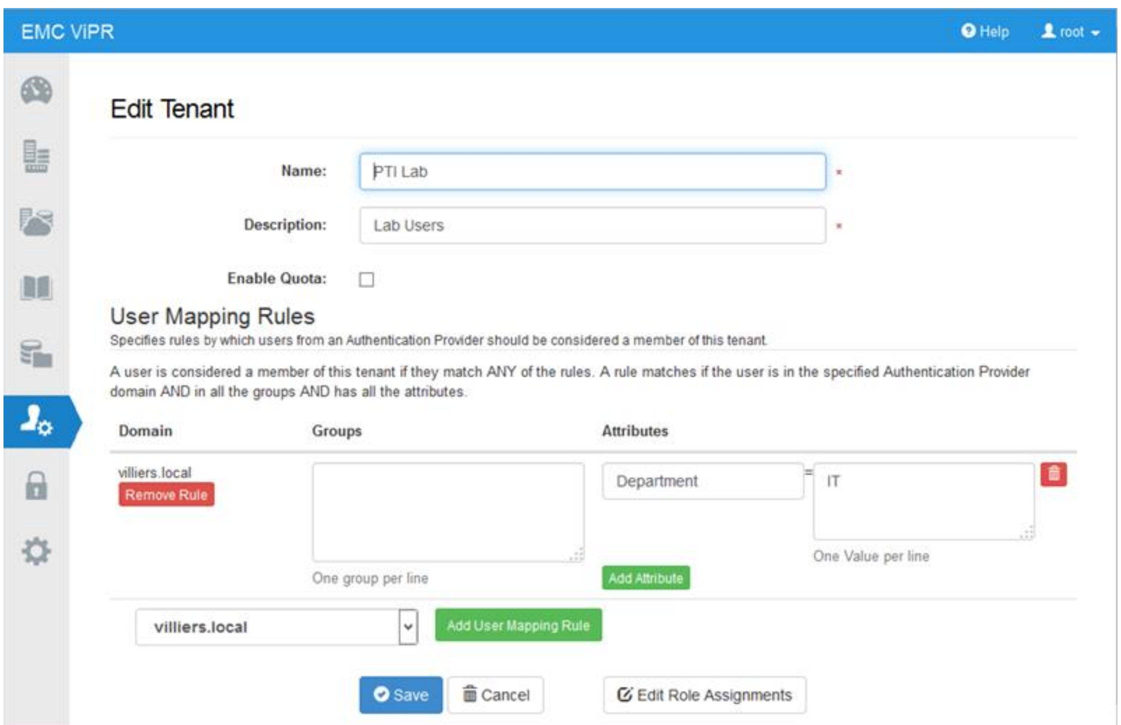

Figure 19: User Mapping Rules provides Active Directory members privileges for self-service within a tenant.

Orchestration integrations

ViPR Controller plug-ins and REST APIs can enable cloud orchestration applications to leverage the power of automated storage provisioning to speed storage availability and lower operating expense.

ViPR Controller plug-ins and REST APIs can enable cloud orchestration applications to leverage the power of automated storage provisioning to speed storage availability and lower operating expense. In our previous study, we showed how ViPR Controller integrated with VMware orchestration tools and how it provided administrators with the ability to add storage-provisioning automation to newly provisioned VMs in their cloud tenants. ViPR Controller offers the same level of integration with the latest versions of vCloud Automation Center (vCAC), now known as vRealize Automation (vRA), and vCenter Orchestrator (vCO), now known as vRealize Orchestrator (vRO). We set up both products and tested the difference between automated provisioning and manually performing the same provisioning tasks.

After configuration, provisioning multiple VMs at the same time required just a click from the vCAC service catalog, a few selections in the order page (see Figure 20), and one click to order as many VMs as desired. Provisioning five VMs, each with additional RDM storage volumes attached, required only 6 steps and 33 seconds of administrative time.

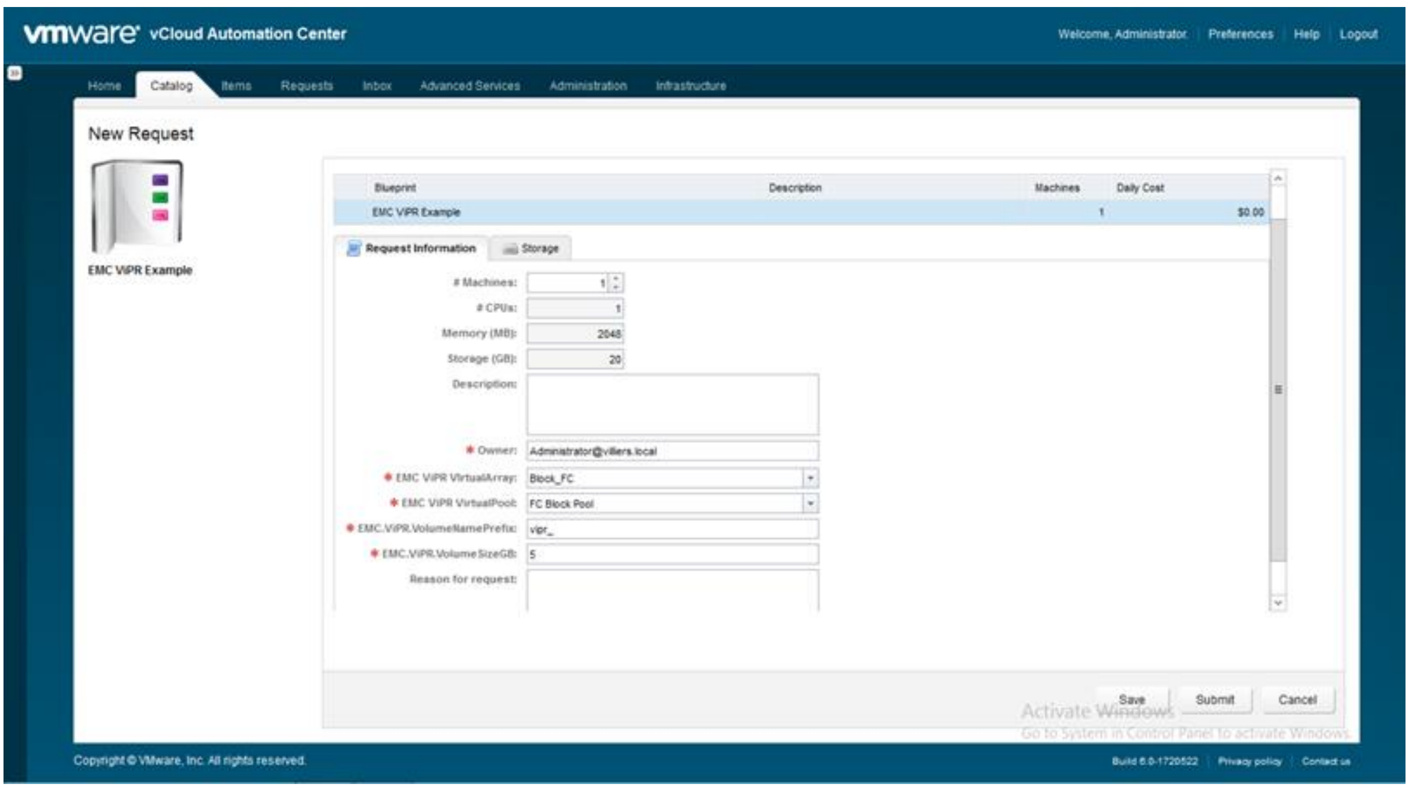

Figure 20: Provisioning virtual machines with additional storage in vCloud Automation Center – now known as vRealize Automation.

Our manual provisioning tasks required more time and effort. Creating a single VM with the same parameters as the automatically provisioned system required 4 minutes and 18 seconds and took 50 steps to complete the process, of which 64 percent involved volume creation and attaching a volume to a VM. The manual provisioning of five virtual machines with additional RDM storage required 21 minutes and 30 seconds of administrative time and took 250 steps because of the serialized tasks.

Handoffs within our ticket-driven silo organization can inflate the time required to fulfill provisioning requests. First, the server team must create the virtual servers with the configuration parameters requested by the customer. Once the VMs exist, the server admins transfer the ticket to the storage administrators where they provision the volumes and export them to the correct virtual host cluster.

The storage administrators document the volume information, and transfer the request back to the server administration team for completion. The server administrator rescans the Host Bus Adapters (HBAs) on the cluster, selects a newly provisioned virtual machine, and changes the properties—creating a new RDM using one of the volumes just provisioned and exported to the host cluster. Figure 21 shows the workflow required to fulfill a request for a single virtual machine with additional RDM storage.

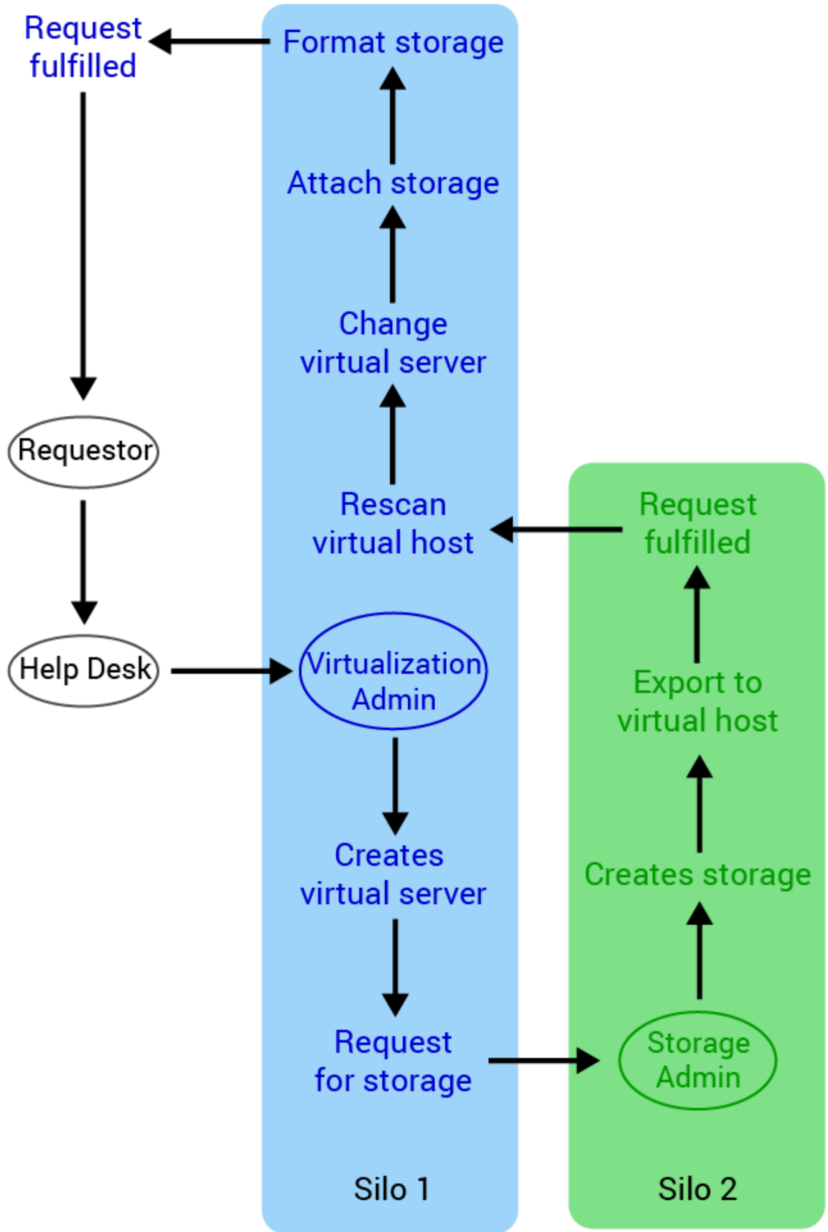

Figure 21: The manual process for provisioning a new VM with RDM disk.

This complicated workflow still occurs in the automation process, but vCO handles it all behind the scenes, as shown in Figure 22.

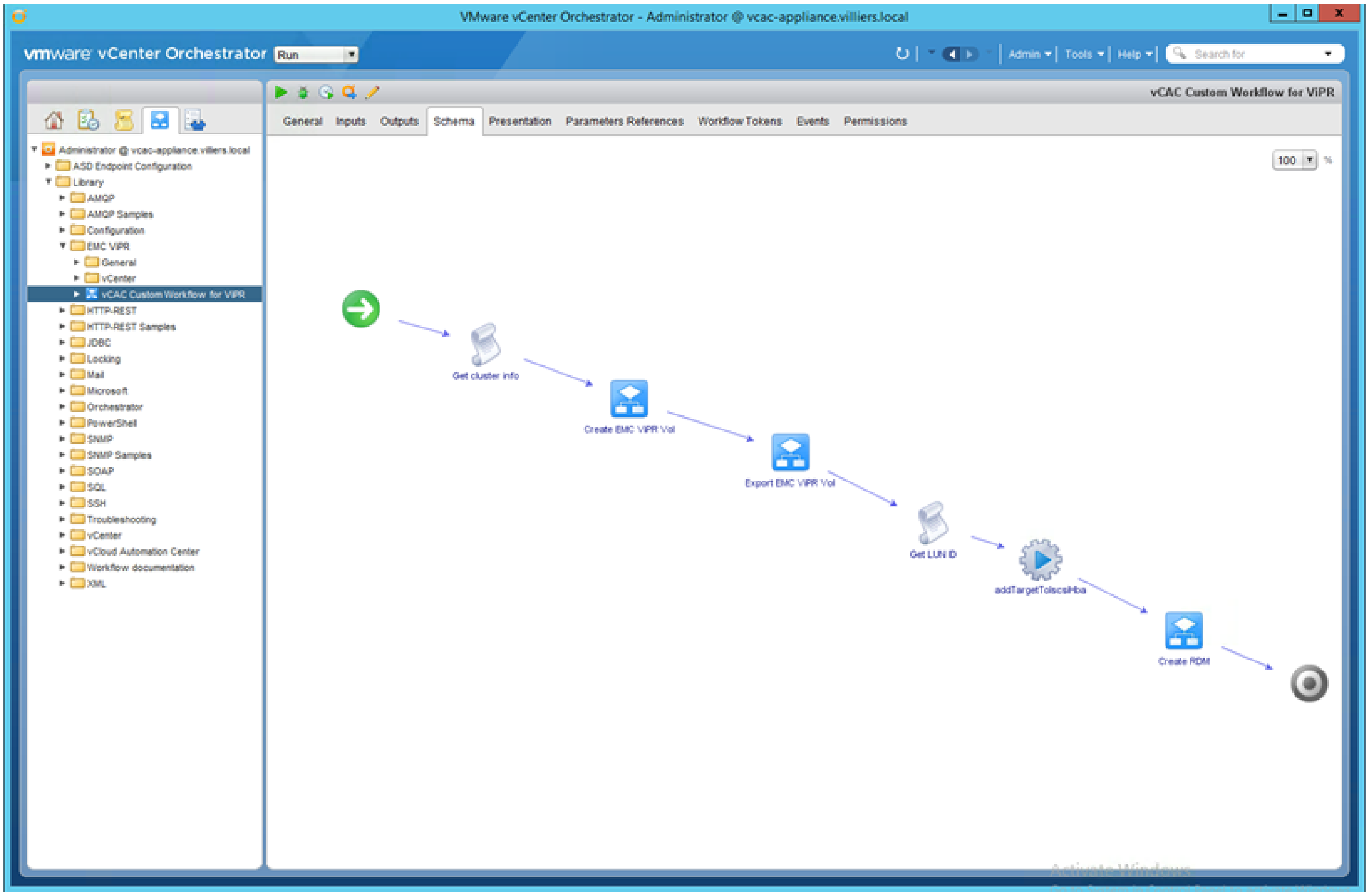

Figure 22: Behind the scenes, vCloud Orchestrator (now known as vRealize Orchestrator) uses ViPR Controller to provision and mount RDM storage to newly provisioned VMs.

In these situations, the VMware orchestration with ViPR integrations could save an organization up to $14,255.60 USD in OPEX costs, or up to 63 percent, because a level-one systems administrator can now perform these tasks.

In an organization like the one in our scenario with thousands of customers, to process requests for only 5,000 VMs in a year, in increments of five VMs per request, and to fulfill those requests using manual provisioning methods, excluding ticket handling, could take 14 days, 22 hours, and 20 minutes. Using the VMware orchestration with ViPR Controller integrations could take 8 hours and 20 minutes for the same workload, saving up to 350 hours of administrative time, and shifting the cost of provisioning to lower-cost administrators.

In our testing, storage provisioning and attaching the storage to a VM accounted for 64 percent of the time, which in this example is equivalent to 224 labor hours. In these situations, the VMware orchestration with ViPR Controller integrations could save an organization up to $14,255.60 USD in OPEX costs,[17] or up to 63 percent, because a level-one systems administrator can now perform these tasks.[18]

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[17] Calculation

[18] Calculations

Software-defined data center

OpenStack integration

ViPR Controller can use OpenStack Cinder as its intermediary, passing the ViPR provisioning parameters through OpenStack to its backend arrays.

ViPR Controller detected and provisioned storage 50 percent faster than performing the same task manually in an OpenStack Cinder deployment.

With our ViPR Controller testing, we had the opportunity to integrate ViPR Controller and OpenStack® Cinder to take advantage of the third-party block storage provider within ViPR Controller. While ViPR Controller already natively supports several non-EMC array platforms such as NetApp and Hitachi, some organizations have unsupported storage arrays that ViPR Controller does not currently support natively. However, if your storage array has a Cinder driver for provisioning block storage, ViPR Controller can use OpenStack Cinder as its intermediary, passing the ViPR Controller provisioning parameters through OpenStack to its backend arrays.

In our testing, we configured OpenStack Cinder to provision block storage volumes on a Dell EqualLogic 6110 array. We then connected ViPR Controller to the Cinder node via the third-party block storage provider, as shown in Figure 23. Using the third-party block storage provider allowed us to order volumes from the Dell EqualLogic 6110 in ViPR Controller, as if we were managing the array directly. ViPR Controller detected and provisioned storage 50 percent faster than performing the same task manually in an OpenStack Cinder deployment. It took 79 seconds with ViPR Controller while it took 159 seconds to perform the same task manually.

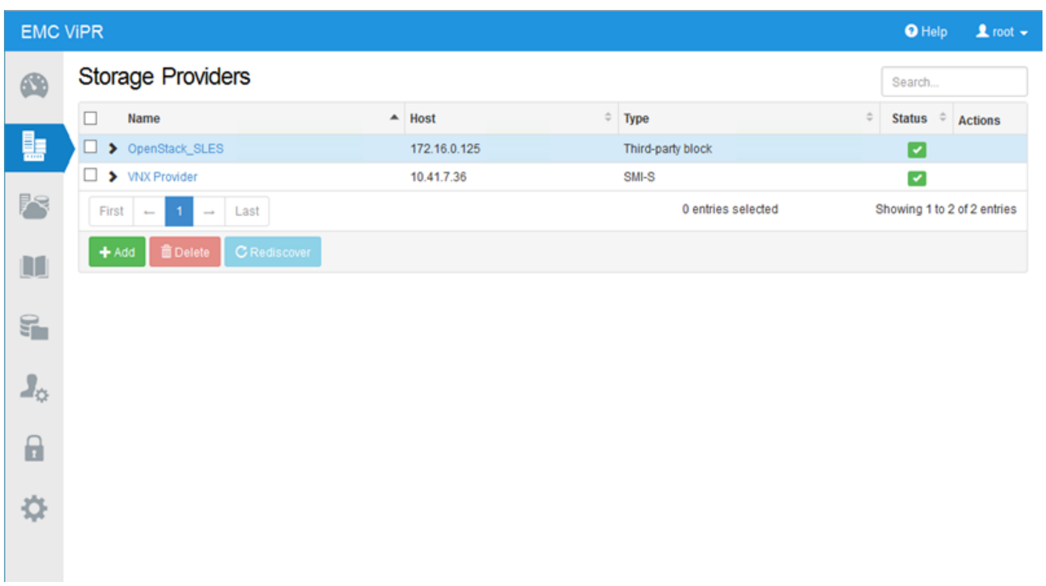

Figure 23: EMC ViPR Controller can use OpenStack as a storage provider, enabling provisioning in otherwise unsupported storage.

OpenStack Cinder can support multiple backend storage systems for provisioning block storage. ViPR Controller displays each backend storage system as defined in the Cinder configuration file, along with other identifying information (see

Figure 24). Some additional configuration within ViPR Controller may be necessary for Fibre Channel back-end storage.[19]

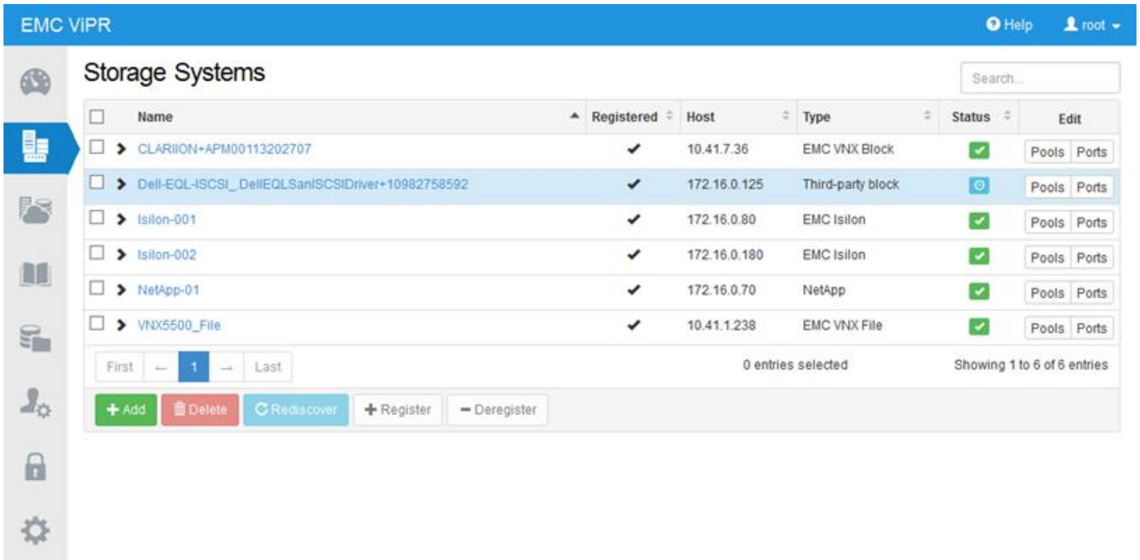

Figure 24: ViPR Controller can integrate unsupported block storage devices leveraging OpenStack drivers.

Our manual process for provisioning storage for our VMware cluster was not overly difficult, but did require some switching back and forth between screens to copy and paste information. To access an iSCSI LUN on our array, we created a CHAP user, and we limited access to the LUNs by iSCSI initiator name, as shown in Figure 25. We had to enable multiple simultaneous connections for use in a vSphere® cluster, and we had to create an access policy for each cluster member, with the iSCSI initiator name of a cluster member in each separate policy. This manual process could become unwieldy for larger clusters, or for servicing multiple clusters, as the access policies must be created for each host that will access an iSCSI LUN on this array, and the potential for misconfiguration or confusion would be higher. ViPR Controller, through the third-party block provider, is a much better manager than the manual process because it eliminates possible missteps from human error.

[19] www.emc.com/techpubs/vipr/ui_add_storage_third_party_block-2.htm

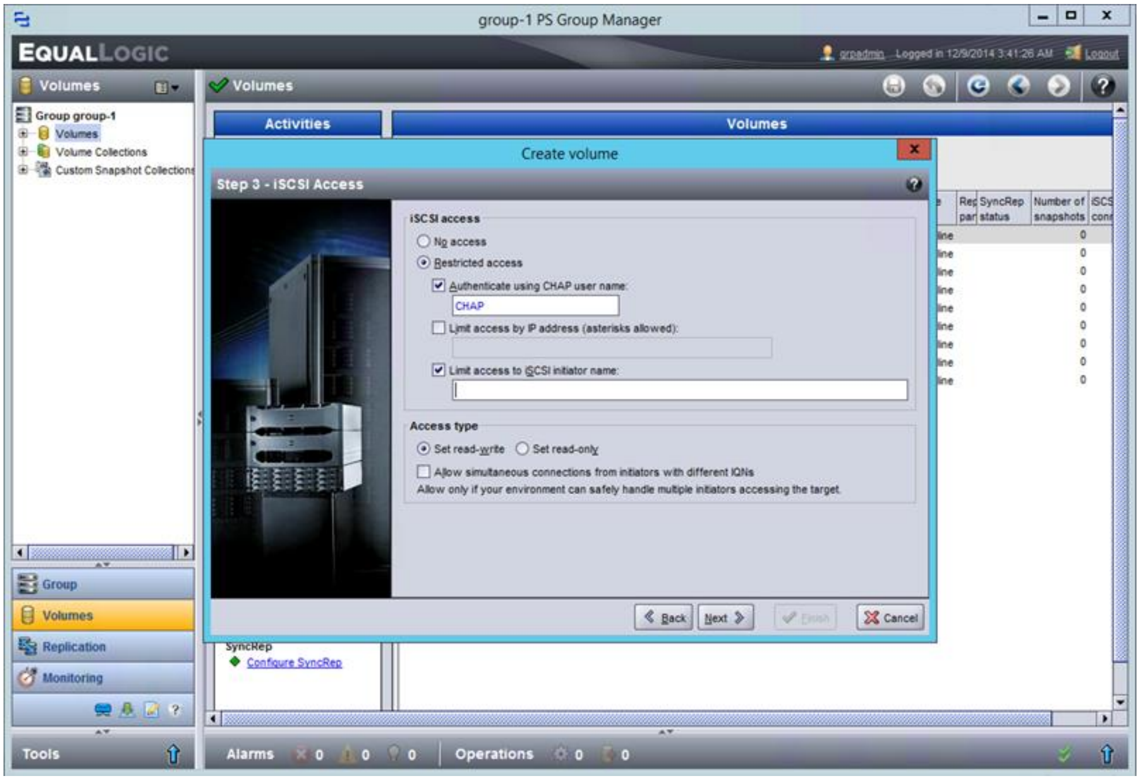

Figure 25: Manually provisioning the third-party storage.

Integration with VMware cloud stack

Managing a VM's storage in vSphere can be cumbersome when dealing with multiple datastores provisioned from a variety of storage systems. To help ease the administrative burden, EMC ViPR Controller contains a built-in VASA provider. The VASA provider allows virtualization administrators to build VM storage policies around the virtual storage pools defined in ViPR Controller (see Figure 26). These profiles make choosing the right datastore to house your VM simple and efficient. At VM creation, simply select the storage policy containing the storage characteristics you need. The vSphere New Virtual Machine wizard sorts all of the datastores as compatible or incompatible based on whether they meet your requested storage needs, which is particularly useful if your datastores have generic names.

Once you assign a storage profile to a VM, it will monitor the VM to make sure that its storage is always in compliance. When it is time to expand your company's storage needs, you will not have to add another VASA provider to incorporate those changes—simply add the new storage to ViPR Controller, and add the new storage to your already defined ViPR Controller storage pools.

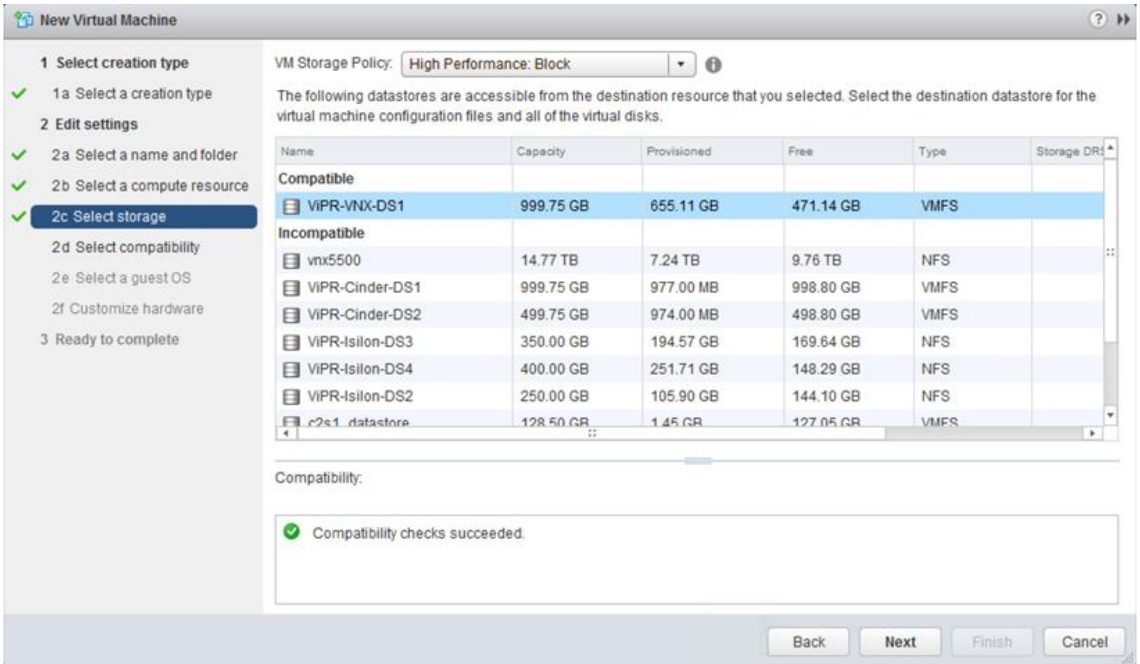

Figure 26: The EMC ViPR Controller VASA provider gives vSphere visibility into the ViPR Controller storage pools.

In our previous ViPR Controller paper, we discussed ViPR Controller integration with vCenter Operations Manager suite (vCOM) using the EMC ViPR Analytics Pack. This add-in gives virtualization administrators the ability to monitor capacity, availability, and performance of virtual storage pools. Monitoring the health of the virtual storage pools helps administrators ensure they always have sufficient resources available to meet the demands placed on their service.

The VMware cloud stack integrations with EMC ViPR Controller help administrators leverage additional behind-the-scenes automation. One blogger created an automation workflow in vCO that would execute whenever vCOM tripped an alarm because of storage capacity.[20] The vCO workflow had ViPR Controller automatically provision new datastores and export them to the affected vCenter. These kinds of innovative solutions demonstrate the power and flexibility of ViPR Controller, and can dramatically reduce the human intervention necessary in managing data center infrastructure, which in turn beneficially affects OPEX.

RESTful APIs

Your organization can further integrate ViPR Controller into its environment using RESTful APIs. The ViPR Controller REST API provides details on the HTTP methods you can use to perform storage management, provisioning, and configuration within the

[20] v-ran.com/2014/03/30/future-datacenter-vcops-vco-emc-vipr/

data center.[21] Embedding RESTful APIs in your higher-level management applications can give your apps the ability to leverage ViPR Controller automation, without exposing the ViPR Controller management consoles to consumers.

CONCLUSION

In our tests, ViPR Controller and ViPR SRM saved administrative time and effort. Based on our analysis, these savings can translate into significant OPEX savings, as shown in Figure 27.

	OPEX savings	ViPR Controller	ViPR SRM
Provisioning	$64,320.00	$64,320.00	
SAN zoning	$86,943.00	$86,943.00	
Training	$457,650.00	$457,650.00	
CAB savings	$1,319,733.00	$1,319,733.00	
Reporting	$2,003,290.00		$2,003,290.00
Troubleshooting	$25,033.22		$25,033.22
Orchestration	$14,255.60	$14,255.60	
Total	**$3,971,224.82**	**$1,942,901.60**	**$2,028,323.22**

Figure 27: Results derived from our hands-on testing

Furthermore, the ability to integrate with orchestration applications and cloud stacks and to leverage officially unsupported storage via a third-party block provider means that ViPR Controller can benefit your organization across your service portfolio. When coupled with the additional OPEX savings found through reductions in change control and improved site management, ViPR Controller and ViPR SRM can improve your organization's bottom line, providing millions of dollars in OPEX savings.

For more information about ViPR Controller and ViPR SRM, including access to a no-charge, fully functional ViPR Controller software download, see the following links:

- EMC ViPR Community
- EMC ViPR Download

[21] https://community.emc.com/docs/DOC-35333

APPENDIX A – CHANGE ADVISORY BOARD

Figure 28 shows CAB membership and corresponding costs that we used for our analysis.[22] We assumed the number of CAB members would be 14.

	CAB meeting costs		Pre-meeting review costs	
	Salary & benefits	Staff level	Reviewer	Salary & benefits
Chief Information Technology Officer	$388,692.00	C-level	None	
Client/Server Operations Manager	$152,636.00	Manager	Systems Administrator II	$105,542.00
Computer Operations Manager	$150,779.00	Manager	Systems Administrator II	$105,542.00
Data Center Director	$206,696.00	Manager	Systems Administrator II	$105,542.00
Systems Engineering Director	$238,306.00	Manager	Systems Administrator II	$105,542.00
IT Capacity Planning Manager	$173,753.00	Manager	Systems Administrator II	$105,542.00
Disaster Recovery Manager	$167,016.00	Manager	Systems Administrator II	$105,542.00
Database Administration Manager	$168,274.00	Manager	Systems Administrator II	$105,542.00
Database Analyst III	$133,189.00	Analyst/ Specialist	N/A	$133,189.00
Applications System Analyst III	$125,023.00	Analyst/ Specialist	N/A	$125,023.00
Data Security Analyst III	$132,836.00	Analyst/ Specialist	N/A	$132,836.00
Network Planning Analyst III	$120,207.00	Analyst/ Specialist	N/A	$120,207.00
Storage Management Specialist	$136,037.00	Analyst/ Specialist	N/A	$136,037.00
Administrative Assistant II	$64,910.00	Meeting assistant	N/A	
Total salary	**$2,358,354.00**			**$1,386,086.00**

[22] Source: salary.com

Cost per hour (based on 52 40-hour weeks)	**$1,133.82**			**$666.39**
Cost per minute	**$18.90**			**$11.11**

Per-meeting overhead					
Task	**Participant**	**Salary & benefits**	**Cost per minute**	**Number of minutes**	**Cost per meeting**
Preparation of change list and updating change database with results	Database Analyst III	$133,189.00	$1.07	60	$64.20

Cost of CAB meetings	
CAB cost per hour	$1,133.82
Length of meeting (hours)	1.00
Per-meeting overhead	$64.20
Cost per meeting	$1,198.02
Cost per minute	$19.97

Figure 28: Cost analysis for a 14-member CAB meeting, including pre-meeting costs.

APPENDIX B – SALARY INFORMATION FOR VARIOUS ROLES IN OUR ORGANIZATION

Figure 29 shows the salaries and benefits in USD for positions cited in this study.[23]

	Salary & benefits
Administrative Assistant II	$64,910
Applications System Analyst III	$125,023
CEO	$1,366,130
Chief Information Security Officer	$257,943
Chief Information Technology Officer	$388,692
Chief Technology Officer	$297,525
Client/Server Operations Manager	$152,636
Client/Server Operations Supervisor	$121,324
Computer Operations Manager	$150,779
Computer Operations Supervisor	$102,402
Data Center Director	$206,696
Data Security Analyst III	$132,836
Database Administration Manager	$168,274
Database Analyst III	$133,189
Disaster Recovery Manager	$167,016
Help Desk Support	$71,397
Help Desk Support, Sr.	$82,809
IT Capacity Planning Manager	$173,753
Network Planning Analyst III	$120,207
Storage Management Specialist	$136,037
Systems Administrator I	$81,854
Systems Administrator II	$105,542
Systems Administrator III	$129,118
Systems Engineer I	$89,016
Systems Engineer II	$109,550
Systems Engineer III	$133,990
Systems Engineering Director	$238,306
Systems Engineering Technician III	$101,010
Systems/Applications Security Analyst	$118,224

Figure 29: Salary information as reported by salary.com.

[23] Source: salary.com

APPENDIX C – CHANGE CONTROL

Figure 30 shows the change control process used in our example, including CAB activities.

Step	Participants	Cost per minute	Number of minutes per change	Total cost per change
Receive problem report	Help Desk support	$0.57	5	$2.85
Document and forward change to System Administrator	Help Desk support	$0.57	5	$2.85
Triage	Server Administrator (Systems Administrator II)	$0.85	10	$8.50
Request for Change (RFC)	Storage Management Specialist	$1.09	20	$21.80
Pre-meeting review (see Appendix A)	CAB members or their designated staff spend time reviewing changes prior to meetings (members themselves for Admins/Specialists, Systems Administrator III-equivalent for managers)	$11.11	5	$55.55
Approval	Change Advisory Board (CAB)	$19.97	2	$39.93
Storage change	Storage Management Specialist	$1.09	10	$10.90
Test/validate change	Storage Administrator (Systems Administrator I)	$1.09	5	$5.45
Make storage usable to customer	Server Administrator (Systems Administrator II)	$0.85	10	$8.50
Test/validate change	Server Administrator (Systems Administrator I)	$0.66	5	$3.30
Close approved change	Server Administrator (Systems Administrator I)	$0.66	5	$3.30
Total cost per change				**$162.93**
Total elapsed time for change	A change with a CAB process can take multiple days just for CAB approval, because the CAB does not necessarily address all changes in the queue every day. The lag time for other tasks depends on staff availability. Because it depends on four different staff members' schedules (Help Desk, two server administrators, and a storage management specialist), lag could be another day or more. If committee approval takes a day and each other task takes an hour from entering a workers queue to completion, total time for a change could average close to two days.			

Number meetings per week	**Annual number changes at 30 changes per meeting (50 weeks)**	**Cost at $162.93 per change**	**Number changes per day**
5	7,500	$1,222,005.00	30

Figure 30: Change management introduces additional OPEX costs that ViPR Controller can help alleviate.

APPENDIX D – EXAMPLE ENTERPRISE CAPACITY DASHBOARD REPORT DELIVERED VIA EMAIL

Figure 31 shows an example Enterprise Capacity Dashboard report.

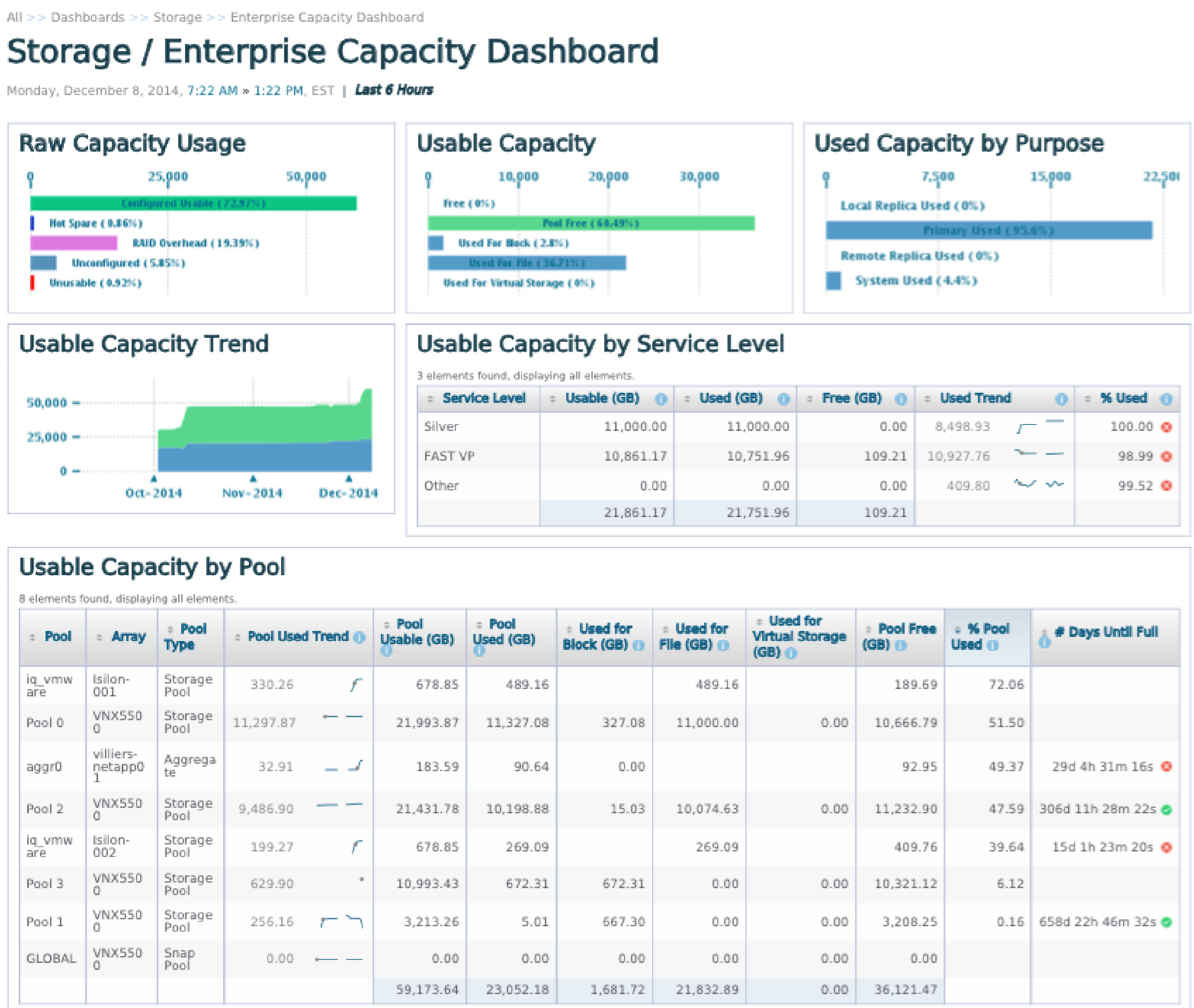

Figure 31: An example Enterprise Capacity Dashboard report in ViPR SRM.

APPENDIX E – SAMPLE CAPACITY DATA FROM MANUAL DATA COLLECTION

Figure 32 shows sample capacity data from the manual data collection.

Pool	Capacity Usable (GB)	Pool Used (GB)	Pool Used %	Total Capacity (GB)
Isilon-001	190	489	72.06	679
Isilon-002	148	252	62.93	400
NetApp-001	92.95	72.28	44	165.23
pool0	10666.793	11327.08	0.51	21993.873
pool1	3208.254	5.01	0	3213.264
pool2	11232.896	10198.881	0.47	21431.777
pool3	10321.119	672.311	0.06	10993.43
Total	**35860.012**	**23016.562**	**39.09290306**	**58876.574**
Pool 0	600	10100	0.94	10700
Pool 2	4100	15900	0.79	20000

Figure 32: Sample capacity data from manual data collection.

APPENDIX F – FORMULAS AND CALCULATIONS USED IN THIS REPORT

We used the following formulas and calculations to derive the cost savings for the example organization used in our scenario.

Provisioning

(Sum of ViPR Controller OPEX Savings in Figure 5) × (number of instances per data center) × (number of data centers) = OPEX savings per year

Calculation

$10.72 × 1,000 × 6 = $64,320.00

Total time for the manual tasks = 13.4166666667 minutes; per-minute cost of the storage admin = $1.09; total cost for the manual tasks = $14.62; total OPEX savings for all instances = $10.72

(Total cost for manual tasks – Total OPEX savings for all instances) ÷ Total cost for manual tasks = ViPR OPEX cost

Calculation

($14.62 – $10.72) ÷ $14.62 = .27

1.00 – ViPR OPEX Cost = percent reduction of OPEX costs

Calculation

.27 – 1.00 = –0.73 = 73% reduction

SAN zoning

(OPEX savings per instance) × (number of daily instances) × (number of data centers) × (number of days) = OPEX savings per year

Calculation

$7.94 × 5 × 6 × 365 = $86,943.00

Training

(Average cost per course) × (number of admins per shift) × (number of shifts) × (number of data centers × number of platforms) = training costs for storage administrators.

Calculations

$4,237.50 × 1 × 3 × 6 × 1 = $76,275.00 (for one admin each shift, six data centers, and one platform)

$4,237.50 × 2 × 3 × 6 × 4 = $610,200.00 (for two admins each shift, six data centers, and four platforms)

$4,237.50 × 2 × 3 × 6 × 1 = $152,550.00 (for two admins each shift, six data centers, and one platform)

Cost for all admins trained for 4 platforms – Cost for all admins trained for 1 platform = Training cost savings; Training cost savings ÷ Cost for all admins trained for 4 platforms = percent reduction

Calculations

$610,200 – $152,550 = $457,650

$457,650 ÷ $610,200 = .75 = 75% reduction in training costs

CAB savings

(Total number of CAB changes) × (percentage of total that are storage changes) × (percentage of storage changes ViPR Controller can eliminate) × (CAB cost per change) × (number of data centers) = OPEX cost savings

Calculations

7,500 × 0.30 × 0.60 × $162.93 × 1 = $219,955.50

7,500 × 0.30 × 0.60 × $162.93 × 6 = $1,319,733.00 (one CAB per data center)

Because we already calculated the cost per change ($162.93), we only have to calculate how many changes were removed from the CAB, and use this to calculate a percent reduction.

(Total number of changes) × (percentage of total changes that are storage changes) × (percentage of storage changes ViPR Controller can eliminate) = number of changes removed from the CAB

Calculation

(7,500 × 0.30 × 0.60) = 1,350

(Total number of changes – number of changes removed from the CAB) ÷ Total number of changes = percent of changes remaining

Calculation

(7,500 – 1,350) ÷ 7,500 = .82

1.00 – percent of changes remaining = percent reduction

Calculation

1.00 – 0.82 = 0.18 = 18% reduction

Reporting

(Cost per minute of Storage Management Specialist) × (number of minutes required to perform tasks once) × (number of times tasks must be performed) × (number of data centers) × (number of days) = OPEX cost to manually create report

Calculation

$1.09 × 168 × 1 × 6 × 365 = $401,032.80 = OPEX cost to manually create report.

(Cost per minute of Help Desk Analyst) × (number of minutes required to perform task) × (number of times task must be performed) × (number of data centers) × (number of days) = OPEX cost to use ViPR SRM

Calculation

$0.57 × .3 × 1 × 6 × 365 = $374.49 = OPEX cost to use ViPR SRM

(OPEX cost to manually create report) – (OPEX cost to use ViPR SRM) = OPEX savings per report

Calculations

$401,032.80 – $374.49 = $400,658.31 = OPEX savings per report

$2,003,290.00 = OPEX savings for five reports

(OPEX Savings per report) ÷ OPEX Costs for manual report = percent reduction in costs.

Calculation

$400,658.31 ÷ $401,032.80 = .9990 = 99.9% reduction in costs

Troubleshooting

[{(Cost per minute of Systems Administrator II) × (number of minutes required to perform tasks once)} + {(Cost per minute of Systems Administrator III) × (number of minutes required to perform tasks once)} + {(Cost per minute of Storage Management Specialist) × (number of minutes required to perform tasks once)}] × (number of times tasks must be performed) × (number of data centers) = OPEX cost to manually perform data collection

Calculation

$[{0.85 × 1.3333} + {1.03 × 1.3333} + {1.09 × 1.8}] × 1,000 × 6 = $26,811.62 = OPEX Cost to manually perform data collection for troubleshooting.

(Cost per minute of Help Desk Analyst) × (number of minutes required to perform task) × (number of times task must be performed) × (number of data centers) × (number of days) = OPEX cost to use ViPR SRM

Calculation

$(0.57 × .52) × 1,000 × 6 = $1,778.40 = OPEX cost to use ViPR SRM to collect data for troubleshooting

(OPEX cost to manually perform data collection for troubleshooting) – (OPEX cost to use ViPR SRM to collect data for troubleshooting) = OPEX savings

Calculation

$26,811.62 – $1,778.40 = $25033.22= OPEX savings

(OPEX Savings) ÷ OPEX cost to manually perform data collection for troubleshooting = percent reduction in costs.

Calculation

25033.22 ÷ 26,811.62= .9336 = 93% of costs

Orchestration

(Average [Systems Administrator III cost per minute + Storage Management Specialist cost per minute]) × (number of minutes required for tasks over one year) = OPEX cost without orchestration

Calculations

(Average [$1.02 + $1.09]) × 21,500 = OPEX cost without orchestration

$1.06 × 21,500 = OPEX cost without orchestration

$22,790.00 = OPEX cost without orchestration

(Sys Ad I cost per minute) × (number of minutes required for tasks over one year) = Orchestration OPEX Cost

Calculation

$0.66 × 500 = Orchestration OPEX cost

$330 = Orchestration OPEX cost

(OPEX cost without orchestration × percent time for storage tasks) – Orchestration OPEX Cost = OPEX savings

Calculation

($22,790.00 × .64) – $330.00 = $14,255.60 = OPEX Savings

APPENDIX G: TEST METHODOLOGIES

TROUBLESHOOTING AND PERFORMANCE TESTING

Using ViPR SRM to identify performance issues

Gathering performance metrics for troubleshooting

1. Log into SRM.
2. Select My Reports.
3. Select Villiers→Storage Performance.
4. In the upper right-hand corner, select Tools→Email me this report.

Identifying performance issues without ViPR SRM

Gathering server performance metrics

1. Log into vCenter Client.
2. Select the correct ESXi host.
3. Select the Performance tab.
4. Click the Advanced button.
5. Use the Switch to: pull-down menu and select Disk.
6. Use Real-time chart view to watch for any performance spikes.
7. Click Chart Options.
8. Under Chart Options, select the category Disk.
9. Deselect the check box labeled Always load these settings at startup.
10. In the Objects section, deselect all objects except for the problematic disk (We selected DGC Fibre Channel Disk).
11. In the Counters section, select read latency, write latency, read rate, and write rate.
12. Click OK to apply the changes.
13. Click the floppy disk icon to export the graph to a file on your computer.
14. Provide a name for the chart and click Save.

Gathering SAN fabric switch performance metrics

1. Log into the SAN MDS device.
2. Select the Summary tab.
3. Verify device port configuration for each device.
4. Select the Logs tab.
5. Select Summary of Statistics.
6. Save the data as a .txt file.
7. Open a blank workbook in Excel®.
8. Select the Data tab.
9. Click From Text to import the .txt file using the Text Import Wizard.
10. Select Delimited and click Next.
11. Select the Tab delimiter and click Next.
12. Click Finish.
13. Select the desired initial cell for import and click OK.

Gathering storage array performance metrics

1. Log into EMC Unisphere.

2. Select vnx5500-cs0 listed under Systems by Severity.
3. Select Storage→LUNs.
4. Sort by Host Information.
5. Right-click the LUN (ViPR-VNX-DS1)→Analyzer→Select Performance Summary.
6. Select Utilization.
7. Select the graph data and copy it to clipboard.
8. Paste the clipboard data into a text editor.
9. Select Response Time (ms).
10. Select the graph data and copy it to clipboard.
11. Paste the clipboard data into a text editor.
12. Select Service Time (ms).
13. Select the graph data and copy it to clipboard.
14. Paste the clipboard data into a text editor.
15. Save the data as a .csv file.

ORCHESTRATION

Creating VMs manually and provisioning storage

Building a VM in VMware vSphere

1. Using administrator credentials, log into the vSphere Web Client.
2. Select the cluster or host that will house the VM.
3. Click Create a new virtual machine.
4. Select Create a new virtual machine, and click Next.
5. Enter a name for the VM, select a location to create it, and click Next.
6. Select a cluster, host, vApp, or resource pool to run the VM, and click Next.
7. Select a destination datastore for VM configuration files and virtual disks, and click Next.
8. Select a compatibility for the VM, and click Next.
9. Select a guest OS, and click Next.
10. Select the desired number of CPUs. We selected 1.
11. Select the desired amount of memory. We selected 2 GB.
12. Select the desired amount of hard disk space. We chose 20 GB.
13. Select the proper SCSI controller.
14. Select the correct network adapter, and click Next.
15. Review the VM configuration, and click Finish.

Provisioning Storage

1. Using administrator credentials, log into EMC Unisphere.
2. Select the target system.
3. Select Storage.
4. Select Storage Configuration.
5. Select Storage Pools.
6. Right-click the target storage pool→Create LUN.
7. Check Thin.
8. Change the User Capacity. We selected 5 GB.
9. Click Apply.
10. Click Yes to confirm.
11. To close the create LUN window, click Cancel.

Exporting newly created storage

1. Select the newly created LUN.
2. Click Add to Storage Group.
3. From the Available Storage Groups, select the target storage. To move the target storage to the Selected Storage Groups, click the right arrow.
4. Click OK.
5. Click Yes to confirm.
6. Click OK.
7. Select the newly assigned LUN, and click Properties.
8. Select the Hosts tab, and click Update host information.
9. Click Yes.
10. To close the window, click OK.

Attaching the storage to the VM

1. In the vSphere Web Client, select the host in the cluster that houses the VM.
2. Click the Storage tab.
3. Select Storage Adapters.
4. Rescan the storage adapters. The new storage should now be available for the VM to use.
5. Select the VM, and click Edit virtual machine settings.
6. In the New device dropdown menu, select RDM Disk, and click Add.
7. By matching UIDs, find the correct target LUN, and click OK.
8. To close the VM edit settings window, click OK.

Automating VM creation and provisioning storage with vCAC

1. Using administrator credentials, log into VMware vCloud Automation Center.
2. Select Catalog.
3. In the box of the desired service, click Request.
4. Select the desired number of VMs. We chose five.
5. Click Submit.
6. To close the request, click OK.

OPENSTACK

Provisioning OpenStack Cinder third-party block storage with ViPR Controller for Dell EqualLogic PS6100

Before undertaking the following steps, ensure that cluster members are logged into the array.

1. Log into ViPR Controller.
2. Select Service Catalog→View Catalog.
3. Click Block storage services for VMware vCenter/ESX environments.
4. Click Create a New Block Volume for VMware.
5. From the pull-down menus, select the following items:
    a. Datacenter
    b. ESX Host/Cluster
    c. Virtual Array (we selected Block_iSCSI)
    d. Virtual Pool (we selected iSCSI Block Pool)
    e. Project
6. Enter the name of the volume and the size of the volume to provision. We selected 10 GB.

7. Click Order.
8. Log into the vSphere Client. Select a cluster member, and click the configuration tab. Under Hardware, click Storage, and rescan the storage adapters. The newly provisioned storage will be available for use.

Provisioning third-party block storage manually for Dell EqualLogic PS6100

Before undertaking the following steps, ensure that cluster members are logged into the array.

1. Log into the Dell EqualLogic PS Series Group Manager.
2. In the right-pane menu, click Volumes.
3. In the right-pane menu, click create volume.
4. Provide a name (and optional description) for the volume. Click Next.
5. Enter the size of the volume to create, and check thin provisioned volume. We selected 10 GB. Click Next.
6. Select Restricted access. Check Authenticate using CHAP user name.
7. Enter the (preconfigured) CHAP user you wish to use for authentication. We used CHAP.
8. Check Limit access to iSCSI initiator name.
9. Log into the vSphere Client.
10. Select the first host in the cluster that will have access to the new storage. Click the Configuration Tab.
11. Under Hardware, click Storage Adapters.
12. Under iSCSI Software Adapter, locate and select vmhba32.
13. In the Detail section, select and right-click the iSCSI name, and choose Copy.
14. Switch back to the EqualLogic PS Series Group Manager.
15. Select and right-click the field for Limit access to iSCSI initiator name, and choose Paste.
16. Under Access type, check Allow simultaneous connections from initiators with different IQNs. Click Next.
17. Click Finish.
18. In the left panel under Volumes, the new volume will appear highlighted. In the left pane Activities menu and under Access, click Create access policy.
19. Check Authenticate using CHAP user name.
20. Enter the (preconfigured) CHAP user you wish to use for authentication. We used CHAP.
21. Check Limit access to iSCSI initiator name.
22. Switch to the vSphere Client.
23. Select the next host in the cluster that will have access to the new storage. Click the Configuration Tab.
24. Under Hardware, click Storage Adapters.
25. Under iSCSI Software Adapter, locate and select vmhba32.
26. In the Detail section, select and right-click the iSCSI Name, and choose Copy.
27. Switch back to the EqualLogic PS Series Group Manager.
28. Select and right-click the field Limit access to iSCSI initiator name, and choose Paste.
29. Click OK.
30. Switch to the vSphere Client. The last cluster member added should still be selected. Under Hardware, click Storage, and rescan the storage adapters. The new storage will be available for use.

APPENDIX H – HARDWARE DETAILS

Figure 33 shows the configuration details for our test servers.

System	Cisco UCS B250 M2	Cisco UCS B200 M2
General		
Number of processor packages	2	2
Number of cores per processor	6	4
Number of hardware threads per core	2	2
CPU		
Vendor	Intel®	Intel
Name	Xeon®	Xeon
Model number	X5670	X5570
Socket type	FCLGA1366	FCLGA1366
Stepping	B1	D0
Core frequency (GHz)	2.93	2.93
Bus frequency	6.4 GT/s	6.4 GT/s
L1 cache	32 + 32 KB (per core)	32 + 32 KB (per core)
L2 cache	256 KB (per core)	256 KB (per core)
L3 cache	12 MB	8 MB
Platform		
Vendor and model number	Cisco UCS B250 M2	Cisco UCS B200 M2
BIOS name and version	S5500.2.1.1.0.100720122118	S5500.2.1.3.0.081620131102
BIOS settings	Defaults	Defaults
Memory module(s)		
Total RAM in system (GB)	192	96
Speed (MHz)	1,333	1,333
Size (GB)	4	8
Number of RAM module(s)	48	12
Chip organization	Double-sided	Double-sided
Rank	Dual	Dual
Operating system		
Name	VMware ESXi™ 5.5.0	Ubuntu® 14.04.1.LTS
Build number	1746018	
Language	English	English

System	Cisco UCS B250 M2	Cisco UCS B200 M2
RAID controller		
Vendor and model number	LSI Logic® LSISAS1064E	LSI Logic LSISAS1064E
Ethernet adapters		
Vendor and model number	Intel 82598EB 10GB controller	Intel 82598EB 10GB controller
Type	PCIe® v2.0	PCIe v2.0

Figure 33: Configuration details for our test servers.

Figure 34 shows detailed configuration information for the Dell EqualLogic PS6100 array.

Storage array	Dell EqualLogic PS6100
Number of storage arrays	1
Number of storage controllers per array	2
RAID level	6
Firmware version	6.0.6
Number of drives	24
Model number	ST9146852SS
Drive size (GB)	146
Drive buffer size (MB)	16
Drive RPM	15,000
Drive type	6Gb/s SAS 2.5”

Figure 34: Detailed configuration information for the Dell EqualLogic PS6100 array.

Figure 35 shows detailed configuration information for the HP EVA 4000 array.

Storage array	HP EVA 4000
Number of storage arrays	2
Number of storage controllers per array	1
RAID level	vRAID5
Firmware version	04180000
Number of drives	14
Model number	BF14658244
Drive size (GB)	147
Drive buffer size (MB)	8
Drive RPM	15,000
Drive type	2Gb/s FC 40 Pin 3.5”

Figure 35: Detailed configuration information for the HP EVA 4000 array.

Figure 36 shows detailed configuration information for the EMC VNX5500 array.

Storage array	EMC VNX5500
Number of storage arrays	1
Number of storage controllers per array	1
RAID level	5
Firmware version (Block)	05.32.000.5.215
Firmware version (File)	7.1.76-4
Number of drives	18
Model number	ST9300603SS
Drive size (GB)	300
Drive buffer size (MB)	16
Drive RPM	10,000
Drive type	6Gb/s SAS 2.5”

Figure 36: Detailed configuration information for the EMC VNX5500 array.

ABOUT PRINCIPLED TECHNOLOGIES

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