



IT service transformation with hybrid cloud: Buy or build?

Save time and money with Dell EMC Enterprise Hybrid Cloud compared to building your own

Cloud computing continues to gain momentum across organizations of all sizes as awareness of the technology's compelling business agility and cost containment advantages grows. Initially, end-users and developers spearheaded the use of public cloud services and unknowingly sparked a major IT transformation. Frustrated by slow IT service delivery, these users used their credit cards to instantly purchase storage capacity, servers, and other IT resources from public cloud providers. While satisfying short-term requirements, the rise of "shadow IT" raised serious concerns among CIOs about IT security, privacy, and reliability while alerting them that user expectations of IT service delivery were changing rapidly. These changes led to growing popularity of the hybrid cloud consumption model, which enables IT to rapidly deliver services, applications, and workloads on- or off-premises. In fact, according to IDC, more than 80 percent of enterprise IT organizations will commit to hybrid cloud architectures by the end of 2017.¹

¹ <http://www.idc.com/research/viewtoc.jsp?containerId=259840>

80%

moving to hybrid cloud by the end of



This paper explores the cost savings and business benefits a consumption model based on hybrid cloud delivers while providing readers with a framework to evaluate the potential impact on their enterprises. We also present the economic impact of a theoretical organization transforming from a traditional IT service model to a hybrid cloud self-service consumption model, with the understanding that your results may vary.

Once committing to a hybrid cloud, organizations must decide to buy or build a hybrid cloud platform. While the build-your-own (BYO) path may appear to offer limitless customization options, it is a journey that presents significant challenges for already overextended IT staff resources. Many businesses have found building their own hybrid cloud was far more expensive and time-consuming than expected. The build-your-own approach also runs counter to the unfolding IT transformation as IT organizations move away from integrating components and delivering services manually and focus more on providing high-value services aligned with business objectives.

To help provide a solid understanding of the time, resources, and costs associated with a buy approach vs. a BYO approach, this paper compares the two strategies, with Dell™ EMC® and Principled Technologies® (PT) each implementing a hybrid-ready platform—Dell EMC utilizing the “buy” approach and PT utilizing the “build-your-own” option. PT also observed Dell EMC delivering the Enterprise

Hybrid Cloud platform for basic infrastructure-as-a-service, which combines hardware and software from Dell EMC, VMware, and Pivotal Software®. Our findings show that the Enterprise Hybrid Cloud platform can be delivered 15.2 months or 92 percent faster² than a BYO approach. The hands-on experience and analysis in this paper provide the reader with a comprehensive framework for evaluating both options.

What does a hybrid cloud do for your business?

Many IT organizations are hitting roadblocks when limited IT budgets fall short of meeting growing business demand for a greater array of technologically advanced services and more agile, flexible delivery options. The adage of “doing more with less” has never been truer in IT than today. A hybrid cloud is a viable way to help solve this vexing problem.

A hybrid cloud enables IT to become a broker of IT services between private and public clouds. The hybrid cloud encompasses both on- and off-premises resources and can seamlessly access, manage, and deliver those resources to users exactly when and where they need them. Considering performance, cost, accessibility, and security requirements, IT staff and other decision makers determine whether applications and workloads reside on- or off-premises.

92%

faster deployment
than build-your-own

Public cloud

offers general-purpose IT resources to an unlimited group of paying users inside and outside of a business

Private cloud

offers business-defined and -controlled IT resources only to users within the business

Hybrid cloud

is a framework to offer IT resources from both kinds of clouds to users within a business³



2 See [Appendix E](#) for these calculations.

3 <https://www.vmware.com/files/pdf/idc-hybrid-cloud-defined-white-paper.pdf>



Figure 1: The capabilities of the hybrid cloud can produce a number of potential cost savings and benefits.⁴

Figure 1 highlights how each of the hybrid cloud’s key capabilities affect business operations, end-users, developers, and IT staff, as well as revenue and spending. The sections following Figure 1 examine these capabilities and outcomes in more detail. By analyzing hybrid cloud’s cost-saving advantages, we created a scenario to demonstrate possible savings for a hypothetical enterprise of 29,550 employees and a virtualized infrastructure of 5,000 virtual machines (VMs). Our calculations indicate that this hypothetical business could realize over \$41.1 million in savings and benefits over a three-year period.

We based our estimates on publicly available information referenced throughout this report. Your results may vary based on your user count, number of VMs and applications in your hybrid cloud, staffing, infrastructure size, software and hardware discounts, and other factors.

⁴ See [Appendix A](#) for details.

Hybrid cloud benefits: Self-service portal and catalog

Self-service catalogs, on-demand resources, and automated provisioning—essential IT as a service (ITaaS) capabilities enabled by hybrid cloud—provide users with enormous agility while improving the efficiencies and productivity of IT staff. As an example, Figure 2 shows a possible procurement process for a multi-tiered application in both a hybrid cloud and traditional IT service model. You will notice that automation delivered by the hybrid cloud eliminates most of the steps in a traditional service delivery model. Users simply select their desired infrastructure, platform, or applications with service levels that align with their workload requirements.

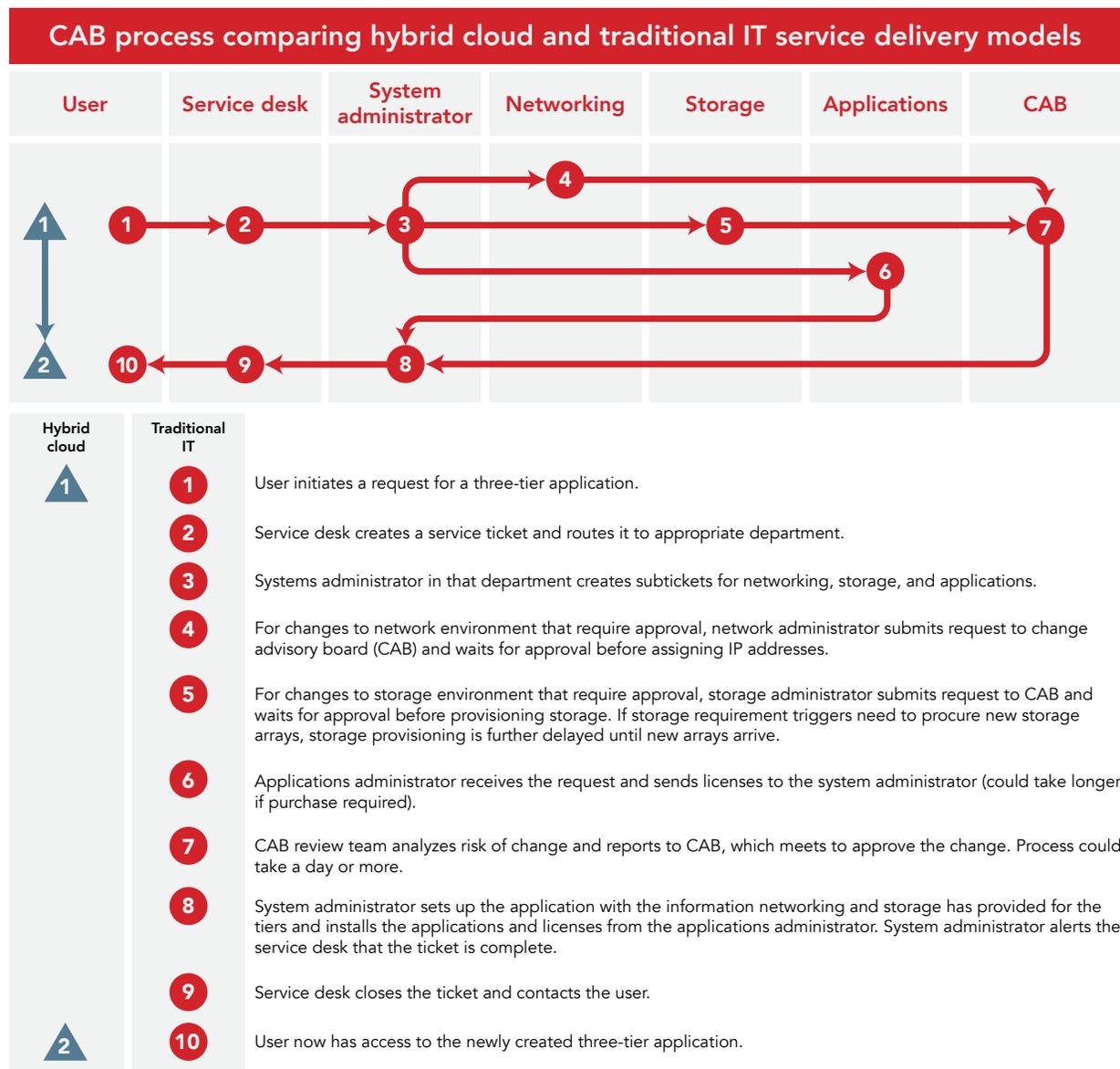


Figure 2: Comparison of hybrid cloud and traditional IT service delivery models.

A self-service delivery model stands in stark contrast to traditional IT services that require users to request resources from IT and wait for multi-level reviews and approvals for days or even weeks. With the hybrid cloud, provisioning of requested resources is an automated process that takes minutes or hours. In the rare event that IT approvals are required, the delays are minimal. These efficiencies enable IT to provide a better customer experience by delivering services and applications faster and more reliably. Knowledge workers who use a self-service portal and catalog can expect to be 2 to 4 percent more productive.⁵ While not all improvements are dramatic on their own, they are additive to the overall benefits an organization can realize.

2-4%
more productive users

With a hybrid cloud, procurement delays are less likely because resources come from a shared pool and analytics about resource consumption patterns allow predictive expansion of that pool. This ensures that resources will be available as demand increases. The self-service catalog can bypass the lengthy and unwieldy change advisory board (CAB) approval process often embraced by traditional IT organizations. The CAB review often involves network, storage, compute, and application administrators.

We estimate that the example in Figure 2 would require at least two days—and possibly, much longer⁶—in an organization with traditional IT services. The CAB usually involves IT and business decision makers. The preparatory materials for a CAB meeting are often reviewed by network, storage, compute, and application administrators. If physical infrastructure were unavailable, the request would take even longer to fulfill, increasing costs and wait times further. Figure 3 illustrates the advantages of resource request provisioning with a hybrid cloud over traditional IT processes.

Example resource request for a three-tier application	
Traditional IT	Hybrid cloud
Could take 2.35 days to fulfill, including a day and a half for required CAB approval*	Fulfilled in minutes without the need for CAB approval
Manual tasks require time and handoffs among service desk and the four IT administrators, creating the potential for delays	Automated processes finish quickly
Estimated cost of staff time per request, including CAB: \$560	No staff cost to fulfill request

*Requests that require the purchase of a storage array or other infrastructure could add weeks or even months to the process

Figure 3: Comparison of the efficiency of resource requests with traditional IT vs. with the hybrid cloud.

5 <http://i.dell.com/sites/doccontent/business/solutions/whitepapers/en/Documents/The-total-economic-impact-of-private-cloud.pdf>

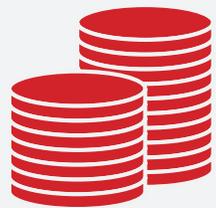
6 For our assumptions, see [Appendix A](#).

Hybrid cloud benefits: Automation and operational management

The hybrid cloud simplifies workflows, significantly reducing time associated with labor-intensive datacenter and DevOps processes. In addition, the standardization and automated execution hybrid cloud templates deliver can significantly reduce process complexity and make resource management easier. These efficiencies can provide hybrid cloud administrators with 56 percent time savings,⁷ which they can reallocate to higher-priority projects. Additionally, automation can help avoid errors that manual processes introduce, prevent problems that can result in downtime and cost, and ensure consistent service provisioning. Finally, standardization of IT processes helps ensure that the infrastructure is compliant with best practices. All these efficiencies can yield positive effects throughout your business.

By moving some of your traditional or virtualized applications to a hybrid cloud consumption model, you will be taking a key step toward improving IT operations. A cloud can deliver more value as you increase its scope to encompass more of the IT infrastructure.

56%
administrative
time savings



Save more than
50%
of CapEx

Hybrid cloud benefits: Enterprise-wide resource pool

A hybrid cloud offers the ability to virtualize your network infrastructure and pool resources. IT can use these abilities to optimize asset utilization and reduce network and storage size and costs, saving 50 percent of CapEx.⁸ Via the self-service portal, users can scale resource allocation up or down as needed and without the help of IT. At the same time, automated tools can help IT identify and eliminate capacity overprovisioning or underutilization. These are critical capabilities that can help you tame and better manage infrastructure growth. We estimate that by reclaiming inactive VMs, you can save 10 percent or more of your compute costs, adding to the CapEx savings.⁹ Additionally, the reduced infrastructure can help you use licensed resources more efficiently, potentially saving 1 to 2 percent of software license costs.¹⁰

The smaller infrastructure of an appropriately sized, virtualized, enterprise-scale resource pool offers OpEx advantages as well. With a smaller footprint and less hardware and software to manage, IT staff gains efficiencies, frees up facility space, and reduces power requirements.

7 <https://www.vmware.com/files/pdf/products/vCloud/Taneja-Group-Transforming-Costs-SDDC.pdf>

8 <http://www.vmware.com/files/pdf/customers/vmw-software-defined-architectures-technology-brief-tanejagroup.pdf>

9 PT estimate.

10 <http://i.dell.com/sites/doccontent/business/solutions/whitepapers/en/Documents/The-total-economic-impact-of-private-cloud.pdf>

Hybrid cloud benefits: Resiliency and data protection options

In the past, security concerns often overshadowed the benefits of the cloud—but no longer. The modern hybrid cloud offers many options to minimize risks and increase resiliency. It includes a variety of services for securing and protecting data, and it offers monitoring tools with analytics capabilities to identify and resolve problems. Such services and tools help minimize outages, reduce repair and maintenance costs, and enable easier and more efficient regulatory compliance.

Security issues with self-service provisioning also have been a particular concern for IT administrators. In a hybrid cloud, the freedom of users to request resources does not mean chaos and a lack of control for IT. In fact, quite the opposite occurs. By defining access rights and security control policies in a self-service catalog available via a hybrid cloud, IT maintains control and visibility. Users request IT and application resources as needed while the catalog provisions resources and workloads that are automatically aligned to pre-set cost, performance, and protection requirements.

A hybrid cloud's resiliency and data protection features can also decrease downtime, accelerate disaster recovery, and prevent security breaches. In our model, with the hybrid cloud, you can save at least 12 hours of downtime per year at a cost of \$50,000 per hour¹¹ while also eliminating two security breaches annually at an estimated cost of \$394,000 per breach.¹² Finally, a hybrid cloud's improved security and cloud efficiencies improve regulatory compliance, potentially saving you significant litigation fees and penalty costs.

Hybrid cloud benefits: ITaaS and DevOps

Through fast, efficient self-service provisioning of IT services, the hybrid cloud enables application developers and operations to deliver more projects faster at a lower cost. As a result, development-driven workloads are often the first to move to the cloud. Developers can provision their development environments as platform as a service (PaaS) with the ability to easily define their service-level agreement (SLA) needs. Platform and security requirements can follow the application from development through testing and deployment, where users can access the new application through the self-service portal. Overall, you can gain a 15- to 30-day average reduction in project delivery time per project.¹³

A hybrid cloud's ITaaS and DevOps efficiencies enable application developers to devote more time to delivering new business solutions, as well as improving existing applications. This results in increased business revenue. We estimate that new and improved business services can result in increased revenue of \$1.97M per year.¹⁴



11 Estimates based on findings from a Forrester study: <http://i.dell.com/sites/doccontent/business/solutions/whitepapers/en/Documents/The-total-economic-impact-of-private-cloud.pdf>

12 Ibid.

13 <http://i.dell.com/sites/doccontent/business/solutions/whitepapers/en/Documents/The-total-economic-impact-of-private-cloud.pdf>

14 Estimates based on findings from a Forrester study: <http://i.dell.com/sites/doccontent/business/solutions/whitepapers/en/Documents/The-total-economic-impact-of-private-cloud.pdf>

Extract even more value from your hybrid cloud

Moving more workloads to the hybrid cloud can further increase productivity and financial savings—while continuing to drive down IT staff time. In addition, the hybrid cloud delivers more value as it supports a broader array of IT resources and provides access to public cloud services.¹⁵

Businesses that are already running workloads on the hybrid cloud are reporting significant financial benefits. Respondents to a recent Dell EMC-sponsored IDG Global survey reported that their IT costs had dropped by 24 percent. Increasing the number of workloads in the hybrid cloud can help companies save even more, as respondents running more workloads reported even greater savings.¹⁶

Those savings can drive both innovation and revenue growth. Respondents to the Dell EMC survey reported their organizations were reallocating some of the savings to new initiatives, including digital business technologies, mobile tech, Internet and cloud services, social media, and predictive analytics.¹⁷

How to decide what is best for your organization

To meet end-user, developer, technological, and business demands, CIOs and CTOs alike are pushing for ITaaS technologies to help maintain their companies' competitive edge. As this paper has already described, the transformation from traditional IT services to the hybrid cloud consumption model can deliver significant savings and many operational and productivity benefits. Those time and financial savings offer IT the freedom to innovate, create new business solutions, and increase the company's overall competitiveness.

As more businesses embrace hybrid cloud services, organizations that continue offering traditional IT services run the risk of competitors with more efficient, nimble business models capturing their customers and market share. Consider the potential savings and benefits of the hybrid cloud as you assess your current IT state and identify the IT transformation path for your organization.

Once you have decided to move forward with a hybrid cloud consumption model, you need to choose between building your own or buying an engineered platform. The next section of this paper explores our hands-on testing and analysis comparing the buy vs. build approaches.

Choosing your path to hybrid cloud: Buy or build?

This section of the paper shares publicly available findings and our own experience and analysis of the BYO approach in addition to our observations of Dell EMC's delivery of the Enterprise Hybrid Cloud platform, which integrates hardware and software from Dell EMC, VMware, and Pivotal Software. While we recognize your own results may differ in terms of time, resources, and savings, the purpose of the paper is to outline considerations and potential savings as you contemplate the two options.



¹⁵ <http://www.emc.com/microsites/cio/articles/idg-research-study-hybrid-cloud/index.htm>

¹⁶ Ibid.

¹⁷ Ibid.

On the surface, it may appear cost-effective to buy new hardware components piecemeal, or better yet, repurpose your existing hardware and build your cloud on it. In reality, purchasing an engineered, validated, and preconfigured platform, such as the Enterprise Hybrid Cloud, may actually cost less. Choosing this path offers advantages worthy of consideration:

- Preconfigured, tested, and proven to meet your exact needs and specifications in order to reduce risks and improve the probability of a successful outcome
- A single provider eliminates the need to deal with multiple vendors
- Eliminates the need for a test lab for pilot and upgrades, reducing CapEx and OpEx investments
- Significantly reduced deployment time
- Accelerates time to achieve the benefits and savings delivered by a hybrid cloud consumption model
- Streamlined support for problems across the entire platform delivered by a single vendor
- Upgrade services and guidance reduce risk for component upgrades
- Less demand on existing IT staff, freeing them to focus on innovation and delivering business value

Conversely, the process of building your own hybrid cloud can be difficult, time-consuming, and prone to substantial risk:

- Compatibility testing and version control are needed to ensure all components work together as a platform, burdening IT staff with integration, vulnerability testing, and troubleshooting across multiple vendors' components.
- A pilot environment is required for issue resolution, quality assurance (QA), and scaling prior to moving into production. Often an iterative process, it is time- and resource-intensive, often bringing the IT team back to the drawing board more than once.
- Team members will vary in their work style and familiarity with the platform and components. Without devoting extra time and effort to internal communication and coordination, including providing detailed engineering designs, roadmaps, guidelines, and documentation—you run the risk of introducing errors and inconsistencies at every stage of the project.
- After months of effort, you may find that your platform falls short of expectations.

In our comparison of a BYO hybrid cloud platform and the Enterprise Hybrid Cloud, we found that the Enterprise Hybrid Cloud could be up and running in 66 fewer weeks, or 92 percent faster than building your own hybrid cloud. While our comparison dealt with only basic infrastructure-as-a-service cloud functionality, most organizations will require customizations such as data protection, multiple sites, and process integrations that would take both Dell EMC and a build-your-own platform longer to implement. In addition, we found that you could save up to 67 percent over three years by reducing costs related to deployment, support, and upgrades.¹⁸



67%
savings over 3 years
compared to BYO

¹⁸ For more information on what we tested, see [Appendix B](#). For more information on the BYO approach timeline, see [Appendix C](#). For more information on how we tested, see [Appendix D](#), and for more information on our cost model for the BYO approach vs. buying Enterprise Hybrid Cloud, see [Appendix E](#).

With faster deployment of Enterprise Hybrid Cloud, you gain the savings and advantages of a cloud environment sooner. By taking 1.3 years longer to build your own platform, your organization runs the risk of not realizing the benefits and savings offered by a hybrid cloud consumption model during that period. These include \$1.76M savings based on our hypothetical organization.

Helping you decide: Putting the platforms to the test

To compare the buy vs. build approaches, we completed a detailed investigation and analysis of the time, labor, and costs required to build your own hybrid cloud platform and observed the build of the Enterprise Hybrid Cloud.

The objective for both approaches was to deliver basic infrastructure services via a simple self-service catalog for provisioning Microsoft® Windows® and Linux® VMs, as well as multi-tier Linux and Windows VM applications with network isolation—all protected with Avamar® backup service and restore options. The self-service catalog also needed IT services to provide cloud storage provisioning and management of the self-service backup and restore options for utilization by the cloud administrators. Integration of all of these services with cost-transparency, intelligent monitoring, and deep logging and reporting capabilities would be needed to ensure full operational visibility and control.

Both Principled Technologies and the Dell EMC delivery team used the same hardware and software to build a hybrid-ready private cloud.

Our hands-on investigation of the BYO hybrid cloud approach explored how much we could accomplish in 28 business days while attempting to satisfy a set of success criteria for an Infrastructure as a Service (IaaS) deployment.¹⁹ Based on our available lab resources, both the BYO and Enterprise Hybrid Cloud environments needed to support up to 200 virtual machines, though Dell EMC delivered a platform designed to scale to thousands of VMs.

In the interest of full disclosure, Dell EMC provided us with compatible software and hardware versions, giving us a significant head start. This allowed us to bypass the complicated task of interoperability testing for the platform's software and hardware components, including Dell EMC Avamar, Dell EMC ViPR® Controller, VMware vCenter™, VMware vRealize® Suite, VMware vSphere®, VMware NSX® for vSphere, and Dell EMC Vblock® System 300. Access to the compatible versions saved time and experimentation while reducing overall risk.

In your specific BYO approach, your actual time and effort will depend on your company's cloud technical expertise and product knowledge, as well as the completeness and quality of compatibility information your vendors and other sources provide. In the cost savings model in the next section, we assumed that the IT staff collected this information during the project planning and training phases.

Within 28 workdays, our two-person team progressed well and met 70 percent of the success criteria.²⁰ Some of the harder tasks, such as implementing NSX and workflows, remained. Team members estimated it would take several additional months to finish just the proof of concept (POC) stage, the first step in the BYO process, and meet all of the criteria.

¹⁹ For our full list of success criteria and criteria results, see [Appendix F](#).

²⁰ For our full list of success criteria and criteria results, see [Appendix F](#).

Dell EMC states that it can deliver a basic infrastructure as a service (IaaS) platform with Enterprise Hybrid Cloud through its design and implementation service in 28 business days, after the hardware arrives in the customer's datacenter. During the first three weeks of the deployment, Dell EMC works with the customer to define its requirements. Dell EMC then deploys a production-ready cloud during the next five to seven business days, and provides a knowledge transfer to the customer complemented by 30 days of operational guidance. We challenged Dell EMC to prove this claim by deploying the same size small-scale cloud we attempted to build. Dell EMC deployed Enterprise Hybrid Cloud and met 100 percent of the success criteria within five days.

The Enterprise Hybrid Cloud team had several advantages that anyone, including our team at Principled Technologies, attempting a BYO approach would lack. For example:

- The Dell EMC deployment is production ready and validated. When building your own cloud, the first step is to conduct a POC to understand the nuances of integrating all of the components and determining their appropriate setup and configuration. After the POC, you will need to design, architect, build, and test a scalable pilot before you move the infrastructure into production.
- Dell EMC has extensive experience backed by pretested, documented, and proven installation processes, in contrast to our BYO approach.
- Dell EMC has built comprehensive blueprints and workflows, as part of the platform release lifecycle, to tie everything together. While we did not have time to create blueprints and workflows, the associated effort of doing so would add significant time and risk to the BYO process.

Our objective: Build a hybrid cloud POC for delivering infrastructure as a service

We set out to successfully deploy a hybrid cloud for delivering Infrastructure as a Service based on the success criteria used by Dell EMC for the Enterprise Hybrid Cloud team. The objective of our POC, the first phase in the BYO approach, was to ensure the hybrid cloud met the success criteria and delivered the desired features. We did not successfully meet the objective for our POC in the time we had.

Our hands-on experience helped us understand the level of effort required to implement a production-level hybrid cloud. Using this informed perspective, plus our industry knowledge and publicly available resources, we built a model to estimate staff time, costs, and lapsed time of a BYO approach vs. a scalable, production-ready hybrid cloud.²¹ We then compared these against the time and costs of using the Enterprise Hybrid Cloud Design and Implementation service. We found that the benefits of buying a Enterprise Hybrid Cloud extend well beyond deployment to the upgrade and support lifecycle. For this, we looked at time and cost savings for annual upgrades and Level 2 and Level 3 support using Enterprise Hybrid Cloud services versus BYO.

Our findings: Spend less and get more with Dell EMC

We estimated costs for both the BYO and the buy platform for a hypothetical enterprise with 5,000 VMs and 29,550 employees. Based on our analysis, we found Enterprise Hybrid Cloud could deliver up to \$17,208,727 in savings over three years²² for our hypothetical enterprise compared to an enterprise IT organization building a similar platform (see Figure 4).

²¹ See [Appendix E](#) for more information.

²² See [Appendix A](#) for more information.

²³ See [Appendix E](#) for more information.

Potential savings and benefits with Enterprise Hybrid Cloud platform



Figure 4: The Enterprise Hybrid Cloud platform can save a great deal of money for your business by providing both a faster time to production and cost savings over time.

Can save nearly

\$1.76

million

in three years
compared to BYO

Faster time to production

Our comparison demonstrated that buying Enterprise Hybrid Cloud delivers 92 percent faster time to value than the BYO approach, for a potential savings of nearly \$15.45M based on our hypothetical organization. With faster deployment of the Enterprise Hybrid Cloud, you start gaining the advantages and savings of a hybrid cloud sooner. The slower, less efficient BYO approach delays you from benefiting from 1.3 years of increased business value, as described in [What does a hybrid cloud do for your business?](#) That value is equal to \$15,451,315, with \$11,453,559²³ of those savings realized during the first year.

Three-year cost savings

Enterprise Hybrid Cloud can save nearly \$1.76 million in three years on enterprise staff, CAB approvals, training, and separate test beds for pilot and UAT testing, which are no longer necessary.

The BYO platform incurs higher staff costs due to a longer deployment. In addition, higher costs continue post-deployment. Specifically, the enterprise has to staff a Level 2 and Level 3 support team to offer the same support that Dell EMC provides as a single point of support for Enterprise Hybrid Cloud customers. The BYO approach also incurs high post-deployment costs for annual upgrades to the platform software, with each upgrade requiring rigorous testing in separate environments for compatibility, QA, scaling, and so on. Conversely, the Enterprise Hybrid Cloud upgrade service provides these upgrades faster and at a lower cost.

Another consideration is that IT staff can implement changes in the production environment only after CAB approval. CAB reviews and approvals of the bundled Enterprise Hybrid Cloud upgrades should be faster and more streamlined compared to CAB approvals of the multiple components and interconnections of the BYO platform.

To determine costs of the Dell EMC platform over three years, we calculated costs for the Enterprise Hybrid Cloud Design and Implementation service and upgrade services plus the costs of its lighter enterprise staff requirements. Based on these considerations, we estimated the three-year Enterprise Hybrid Cloud to be \$1.76 million less than our estimated BYO costs. The factors lowering the costs of the Enterprise Hybrid Cloud included low-effort deployment, elimination of test beds, a streamlined upgrade process, and the absence of any in-house Level 2 and Level 3 support requirements.

Benefits delivered by Enterprise Hybrid Cloud

After your purchased hardware arrives, the Enterprise Hybrid Cloud Design and Implementation service team guides the design and planning process and helps you efficiently gather requirements for the platform during the first few weeks of the implementation. Dell EMC staff deploys and configures the platform based on previously completed documentation, including blueprints and workflows for delivering IaaS with on-demand backup and recovery services. With Dell EMC's expert involvement, your IT staff can continue their daily tasks without distraction or delay and maintain high productivity.

With a BYO hybrid cloud, the design and implementation process is less structured and involves significantly more steps for the enterprise than the Enterprise Hybrid Cloud deployment. The BYO approach requires training your IT staff on the latest cloud technologies, conducting a POC test, creating a pilot, creating workflows and blueprints, performing QA testing, and then scaling the pilot into a production system. Along the way, you need to work with stakeholders in an iterative process to define the requirements for the cloud. All of these steps add time to the overall process, further delaying the benefits of the platform.

The BYO approach can involve complications that add extra time and risk. For example, the POC and pilot deployment teams may have to restart the pilot from the beginning—even returning to the planning phase—several times while trying to select compatible software versions. During these lengthy processes, IT staff must test and rework designs to ensure hardware compatibility for the hybrid cloud platform.

Enterprise Hybrid Cloud

can be built on Dell EMC Vblock, VxBlock™, or VxRack™ infrastructures. These converged or hyper-converged infrastructures simplify operations and drive business agility. By switching from a disparate infrastructure to a hybrid cloud platform, the Vblock converged infrastructure has been shown to deliver:²⁴

- 41% less IT time keeping the lights on (operational time investment)
- 96% less downtime
- 36% reduced infrastructure and staff costs

Enterprise Hybrid Cloud takes this convergence approach further to enable these benefits across your entire cloud infrastructure.

24 <http://www.vce.com/asset/documents/idc-business-value-whitepaper.pdf>

The Enterprise Hybrid Cloud deployment bypasses most of the stages in the BYO deployment and completes more quickly during stages shared by both approaches. In addition, the absence of a POC deployment or a pilot deployment and test represent the biggest savings compared to a BYO approach. Dell EMC has already invested substantial time and resources in engineering a production-ready platform, sparing your team of the labor-intensive and costly effort of planning, building, and testing POC or pilot environments.

Post-deployment operational support complements design and implementation service

After deployment, the Dell EMC team provides a knowledge transfer and delivers 30 days operational support remotely to ensure operational success. Operational guidance includes the following:

- High-level review of the Enterprise Hybrid Cloud platform
- Structure guidance on platform components
- Standard reports, benchmark data, performance and capacity reporting, health checks, and querying support incidents

For comparison, we included costs for the deployment team of the BYO approach to spend 30 days transitioning the cloud to the cloud operations team in our estimates. We estimate those costs at \$61,634.²⁵

Easier upgrades for platform components

With each release of the Enterprise Hybrid Cloud platform, Dell EMC tests and develops an upgrade service from one version to the next, providing you with proven, pre-tested upgrades and guidance. The process of upgrading a BYO hybrid cloud is far more complex and lengthy. The approach requires IT to test potential changes on a pilot environment first. Once IT has successfully validated changes in the pilot, staff can move them into the production environment. The same is true for security patches for the components. Enterprise Hybrid Cloud upgrade services and guidance eliminate the risk, time, and cost of upgrades and security patches year after year.

We estimated that buying the Dell EMC platform would save 2.6 months for each upgrade—making each upgrade 74 percent faster—and save \$278,419 over three years, providing a 42 percent cost savings compared to the BYO model.²⁶

Figure 5 compares the upgrade process with a BYO approach and the Enterprise Hybrid Cloud platform. For BYO, IT staff must test all changes and security patches in the testing lab to ensure that upgrading versions of one or more components do not result in compatibility issues or create security vulnerabilities. The test lab incurs significant CapEx costs and associated OpEx costs related to IT staff. As previously mentioned, all changes must then go before a CAB, which examines each individual change and approves or rejects it for the production environment. In the BYO model, your company assumes all of the financial and operational risk inherent in the upgrade process.

42%
savings
compared to BYO

²⁵ See [Appendix E](#) for more information.

²⁶ See [Appendix E](#) for more information.

Comparison of upgrade processes

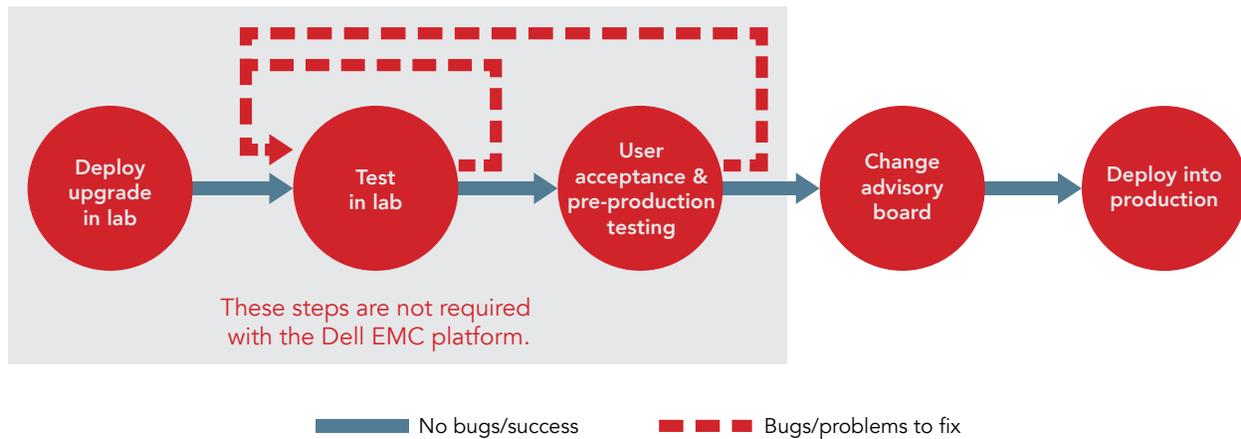


Figure 5: Upgrade process comparison: Build-your-own vs. Enterprise Hybrid Cloud.

By comparison, the upgrade process with the Enterprise Hybrid Cloud platform is significantly simpler and faster. Dell EMC thoroughly tests and validates all upgrades in their labs with each release of the platform before deploying them to your environment. This means the CAB has only one change to approve and your IT team can implement the upgrade quickly and with less risk for your organization.

Single source of support

With the BYO approach, your hybrid cloud platform will inevitably include components from numerous vendors. Interactions across these components can complicate troubleshooting and support. You may have cascading dependencies, where a version change in one component creates compatibility issues in other components. Vendors typically will not create a stable configuration for components that have dependencies on components from other vendors. If problems such as compatibility issues arise with the BYO hybrid cloud, you will need to hire a consultant or solve these problems on your own.

Working with multiple vendors means your IT staff will need multiple contact numbers for support and may find vendors will not support integration with other specific components or products. The burden of identifying the root cause is time consuming and can potentially affect service levels to the business.

The value of support for the Enterprise Hybrid Cloud should not be underestimated. In our sample company, support across the entire platform frees IT staff to focus on delivering higher-value services to the business. The single-contact support for Enterprise Hybrid Cloud is also simpler for IT staff to manage. By comparison, Level 2 and Level 3 support costs for BYO could reach \$864,871 over three years. The Enterprise Hybrid Cloud platform includes these support levels as part of the platform, delivering a 100 percent savings compared to BYO.

100%
savings
compared to BYO

Dell EMC and its partners, VMware and Pivotal Software, have developed a group of customer service specialists who focus exclusively on Enterprise Hybrid Cloud. This team diagnoses issues and interacts with relevant product support teams from Dell EMC, VMware, and Pivotal Software to resolve issues. When necessary, Dell EMC escalates diagnosis and problem resolution to the Enterprise Hybrid Cloud Engineering team.

There is no need to purchase additional maintenance beyond the support for the individual hardware and software components within the Enterprise Hybrid Cloud platform. Dell EMC delivers a simple support model that provides customers with the support they need, when they need it.

A look at Enterprise Hybrid Cloud

The most basic configuration of Enterprise Hybrid Cloud delivers IaaS. However, it offers customization options to deliver ITaaS through add-on modules implemented through associated professional services such as:

- Continuous Availability with Dell EMC VPLEX® – to help protect against outages, failover, and downtime
- Disaster Recovery with Dell EMC RecoverPoint® – to help restore applications quickly to a specific point in time
- Data Protection with Data Domain and Avamar – backup protection for your data in a manner that is both secure and efficient
- CloudLink SecureVM – to provide data security and encryption for virtual machines anywhere in the cloud
- Implementation for Engineered Blueprints – implement service blueprints for faster and easier provisioning of popular applications, including Microsoft Exchange, Microsoft SQL Server®, Microsoft SharePoint®, and Hadoop®
- End User Computing – to deliver applications and desktops at scale
- VMware vRealize Code Stream™ application lifecycle automation for continuous delivery – to automate delivery of application releases and reduce operational risks in the release cycle
- Integration with public clouds – to extend your hybrid cloud with public cloud endpoints including VMware vCloud® Air™

In addition to the modular add-on options delivered as part of the Enterprise Hybrid Cloud, Dell EMC offers professional services to extend the platform to meet unique business requirements such as:

- Operationalize the Hybrid Cloud to establish an ITaaS operating model including, organization, roles, process, and financial transparency
- Populate Workloads and Applications – understand application dependencies and efficiently and securely move workloads to the new hybrid cloud environment without disruption
- Create Service Blueprints for custom-engineered service offerings for environments such as SAP and Oracle Database, as well as add complementary third party extensions including, Puppet Labs™ for application configuration lifecycle management, InfoBlox® for IP address management, ServiceNow® for IT service management, and Palo Alto Networks® for network firewalls
- Enhance monitoring and management with custom dashboards and third-party monitoring system integrations
- Deploy NSX network virtualization and security for software-defined networking and micro-segmentation
- Extend resiliency to avoid downtime, enabling hybrid cloud backup infrastructure and ensuring continuous availability across one or more sites

What's inside the Enterprise Hybrid Cloud platform built in this study?

- Dell EMC Vblock, VxBlock, and VxRack systems. These converged and hyper-converged infrastructures integrate computer, network, and storage technologies to provide dynamic pools of resources that can be intelligently provisioned and managed as a single unified platform.
- Dell EMC Foundation for Enterprise Hybrid Cloud (available only with Enterprise Hybrid Cloud when purchasing the platform), which provides a “fit for purpose build” that pre-integrates and pre-validates the core Enterprise Hybrid Cloud software components on the Vblock, VxBlock, or VxRack System in the factory.
- Dell EMC ViPR Controller, which automates storage provisioning and integrates with vSphere and vRealize.
- VMware vRealize Automation, which provides a web-based interface for cloud users to access resources, health monitoring/reporting, and financial transparency to consumers.
- VMware vRealize Orchestrator, which can control resources through plug-ins and integrations and allows admins to build custom workflows.
- VMware NSX, a software-defined networking solution that can extend across datacenters and into remote cloud resources. Includes enhanced security for isolation.
- Dell EMC Avamar, which provides backup and recovery of virtual assets within the private cloud using VMware Changed Block Tracking (CBT) for rapid backup and recovery.
- VMware vRealize Operations Manager™ (vROps), which monitors the health of vSphere infrastructure. vROps can help admins diagnose problems before end-users are affected.

Conclusion

IT leaders are adopting hybrid cloud services at a rapid pace to increase business agility and cost containment. According to a February 2016 IDG study on Hybrid Cloud Computing, up to 83 percent of C-level respondents use or plan to use a hybrid cloud.²⁷ Transforming IT service delivery to a hybrid cloud consumption model is the clear path for the vast majority of organizations. The bigger issue is how quickly an organization can change.

While building your own hybrid cloud platform may seem attractive, you should seriously evaluate the challenges such an option presents to already overextended IT staff resources. As detailed in this paper, organizations must be prepared for the likelihood of higher costs, longer deployments, and greater risks than they may initially expect. In addition, the IT community as a whole is rapidly moving away from integrating components and delivering services manually to a more strategic focus on providing high-value services to businesses.

The race to deliver cloud-native applications and services to the business demands that traditional IT services and applications either evolve to a hybrid cloud consumption model or risk placing the business at a competitive disadvantage. An engineered platform not only saves time, money, and resources but also allows your IT staff to focus on innovation and delivering IT services that increase business value and align with the evolving marketplace of IT services for enterprise-level organizations.

Organizations should seize the opportunity to achieve the transformational efficiencies the hybrid cloud can deliver. When planning your journey, consider buying rather than building your own platform to speed time to value, minimize expenditures, and reduce risk.

²⁷ <http://www.emc.com/collateral/analyst-reports/idg-research-hybrid-cloud-white-paper.pdf>

83%
of CxOs in a recent
study use or plan to
use a hybrid cloud

Appendix A – Cost model for transforming IT

VMware estimated that enterprises could reduce compute, network, and storage CapEx by up to 50 percent²⁸ and reduce administrative costs by up to 56 percent²⁹ through VMware's cloud management platform.

We started with those estimates from VMware and supplemented them with findings from a Forrester study³⁰ of private cloud savings and our own estimates to arrive at the potential business value of a hybrid cloud. We include cost savings related to the increased user productivity, improved security, and faster development time that a hybrid cloud platform makes possible and the revenue advantages of new and improved cloud-based applications. We sorted savings into the five categories that we discuss in the body of this paper: automation and operational management, enterprise-wide resource pool, self-service portal and catalog, resiliency and data protection options, and information technology as a service (ITaaS) and development operations (DevOps) processes.

Target enterprise

For our analysis of the potential savings from a hybrid cloud, we use a hypothetical large enterprise with 5,000 VMs (see Figure 6). We assume that the enterprise has 5.91 times as many employees as VMs³¹ and generates \$246,667 in revenue per employee.³² We compare costs of the hybrid cloud platform to those of a vSphere-based virtualized solution. We do not include the cost of the virtualization or cloud software in the analysis.

28 "For Lowest Cost and Greatest Agility, Choose Software-Defined Data Center Architectures Over Traditional Hardware-Dependent Designs" is a report commissioned by VMware from the Taneja Group. It compares CapEx costs for deploying a vCloud solution with VMware Virtual SAN and NSX and a typical VMware virtualization environment that requires feature rich, hardware components. We used its results on compute, storage, and network savings for a 2,500 VM scenario and scaled them to our 5,000 VM scenario. <http://www.vmware.com/files/pdf/customers/vmw-software-defined-architectures-technology-brief-tanejagroup.pdf>

29 "Transforming the Datacenter with VMware's Software Defined Data Center vCloud Suite: An analysis of costs and capabilities in the software-defined datacenter" is a report commissioned by VMware from the Taneja Group. It uses customer research and lab tests to compare administrator time and effort for routine IT tasks for an infrastructure managed with vCloud and a traditional virtualized infrastructure where each administrator supports an average of 100VMs. Its key finding is that vCloud Suite could reduce OpEx costs related to the human effort of provisioning and on-going management by 56%. <https://www.vmware.com/files/pdf/products/vCloud/Taneja-Group-Transforming-Costs-SDDC.pdf>

30 "Total Economic Impact™ Of Private Cloud Cost Savings And Business Benefits Enabled By Private Cloud" is a report commissioned by Dell from Forrester Consulting. The report is based on Forrester's surveys and interviews of private cloud users. Forrester used the information gathered to create a composite enterprise and estimate the three-year financial impact for that enterprise of an investment in an on-premises private cloud. The composite enterprise had 15,000 employees and recent fiscal year revenue of \$3.7 billion US dollars. <https://marketing.dell.com/Global/FileLib/Forrester/The-total-economic-impact-of-private-cloud.pdf>

31 <http://www.vce.com/asset/documents/idc-business-value-whitepaper.pdf>

32 <https://marketing.dell.com/Global/FileLib/Forrester/The-total-economic-impact-of-private-cloud.pdf> creates a composite organization with annual revenue of \$3.7 billion and 15,000 employees, which averages to \$246,667 per employee.

Target enterprise	
Number of VMs	5,000
Estimated number of employees	29,550
Estimated annual revenue (USD)	\$7,289,009,850
Estimated revenue per employee	\$246,667

Figure 6: Our assumptions for our hypothetical enterprise.

We borrow some assumptions about the enterprise from our sources, including a Forrester study that assumes that at the end of three years, an enterprise has a third of its application portfolio in the private cloud and supports 42 percent of its business units with cloud services. The VMware-sponsored study that estimates CapEx savings assumes that the organization moves to a VMware-based private cloud using VMware NSX as the datacenter network virtualization solution, and replaces high-performing external NAS storage with VMware Virtual SAN™ and low-cost DAS storage. It compares those costs to purchasing feature-rich hardware for a typical VMware vSphere-based virtualization solution.

Business value of a hybrid-ready private cloud – Three-year potential savings and revenue improvements

Figure 7 summarizes the potential business value (three-year cost savings and revenue advantages) for this hypothetical enterprise.

Category	Benefits	Potential business value (3-year cost savings and revenue advantages)	Notes ³³
Automation and operational management	Save IT staff time due to faster deployment and provisioning and reduced management and support effort, gain operational benefits: <ul style="list-style-type: none"> • Reduce errors and associated costs • Manage more and higher-value projects and services • Forestall problems that can cause downtime and cost 	\$8,883,678	56% time savings ³⁴
Enterprise-wide resource pool	Reduce infrastructure capital expenditures (CapEx) with network and storage virtualization <ul style="list-style-type: none"> • Reduce size and cost of IT infrastructure 	\$8,823,798	Save 50% in CapEx ³⁵
	Reclaim inactive VMs <ul style="list-style-type: none"> • Avoid associated compute costs 	\$331,143	Save another 10% of compute CapEx ³⁶
	Save software costs <ul style="list-style-type: none"> • Use licensed resources more efficiently 	\$1,749,360	Save 1% to 2% in software costs
Self-service portal and catalog	Increase worker productivity with improved applications and faster application delivery <ul style="list-style-type: none"> • Deploy IT services in minutes/hours at lower cost • Improve customer experience 	\$8,643,570	Knowledge workers 2% to 4% more productive
Resiliency and data protection options	Reduce downtime <ul style="list-style-type: none"> • Reduced outages, repair costs, and regulatory impact 	\$1,800,000	Save \$50,000/hour for 12 fewer hours per year
	Save security costs <ul style="list-style-type: none"> • Protecting from expensive breaches 	\$2,364,000	Save \$394,000/breach for two breaches/year
	Save litigation and penalty costs <ul style="list-style-type: none"> • Improved compliance with regulations 	\$1,950,300	Better security and cloud efficiencies
ITaaS and DevOps processes	Increase business revenue from new and improved applications <ul style="list-style-type: none"> • Frees IT resources to focus on applications that add business value and revenue 	\$5,910,000	\$1.97M/per year increase
	Save developer time and deliver projects faster due to self-service access and DevOps efficiencies <ul style="list-style-type: none"> • Faster self-service provisioning of IT-as-a-service (ITaaS) and DevOps requirements 	\$610,719	15- to 30-day faster project delivery
Potential three-year business value		\$41,066,568	

Figure 7: The capabilities of the hybrid cloud can produce a number of potential cost savings and benefits.

33 Unless stated otherwise, these estimates are based on the Forrester study and scaled to our larger hypothetical enterprise where necessary. <http://i.dell.com/sites/doccontent/business/solutions/whitepapers/en/Documents/The-total-economic-impact-of-private-cloud.pdf>

34 <http://www.vmware.com/files/pdf/products/vCloud/Taneja-Group-Transforming-Costs-SDDC.pdf>

35 <http://www.vmware.com/files/pdf/customers/vmw-software-defined-architectures-technology-brief-tanejagroup.pdf>

36 PT estimate.

Automation and operational management

Cloud management solutions can improve IT staff productivity by replacing manual processes with automation and by consolidating tools (see Figure 8). VMware estimated operational savings of 56 percent with VMware cloud management technologies due to saved administration time vs. typical technologies used in traditional virtualized environments. Administrative time savings include 66 percent faster deployment and provisioning and the 46 percent reduction in management and support effort.³⁷ The 56 percent time savings means that administrators who could support 100 VMs in a traditional environment could handle 227 VMs in a vCloud environment. We used those findings to estimate savings for our 5,000-VM enterprise. We based our cost per administrator on an average systems administrator II salary and benefits package of \$105,858.³⁸

	Traditional IT	Cloud	Savings	Savings (%)
VMs per administrator	100	227	127 more VMs per administrator	127% more VMs per administrator
Three-year costs per VM	\$3,175.74	\$1,399.00	\$1,776.74	55.9%
Three-year costs for 5,000 VMs	\$15,878,700	\$6,995,022	\$8,883,678	55.9%

Figure 8: Breaking down administrative costs for 5,000 VMs in traditional IT and cloud environments.

Enterprise-wide resource pool

An enterprise-wide resource pool in a hybrid cloud platform shares virtualized compute, storage, and network resources among enterprise departments. It saves on compute, network, storage, and software costs compared to a typical virtualized solution. Virtualized compute and networking save considerable infrastructure resources. Cloud automation can detect and reclaim inactive VMs, saving additional compute costs. The enterprise saves on software costs because it has fewer resources to license.

Reduce infrastructure CapEx with network and storage virtualization

VMware estimated that enterprises could save up to 50 percent of their compute, network, and storage CapEx if they migrated to a VMware cloud platform with VMware NSX as the datacenter network virtualization solution and replaced high-performing external NAS storage with VMware Virtual SAN™ and low-cost DAS storage. They compare those costs to purchasing feature-rich hardware for a typical VMware vSphere-based virtualization solution. The VMware analysis estimated compute, network, and storage CapEx for an environment with 2,500 VMs, which we extended to 5,000 VMs in Figure 9. We estimated saving \$1,764.76 per VM, 50.5 percent of the CapEx of the platform without network and storage virtualization.³⁹ Your results will vary depending on existing hardware and future hardware choices.

37 Ibid.

38 <http://swz.salary.com/salarywizard/Systems-Administrator-II-Salary-Details.aspx?hdcxbonus=off&isshowpiechart=true&isshowjobchart=false&isshowsalarydetailcharts=false&isshownextsteps=false&isshowcompanyfct=false&isshowaboutyou=false>

39 <http://www.vmware.com/files/pdf/customers/vmw-software-defined-architectures-technology-brief-tanejagroup.pdf>

	CapEx for typical virtualized solution (USD)	CapEx for private cloud solution (USD)	Savings (USD)	Savings (%)
Storage	\$3,660,000	\$2,594,674	\$1,065,326	29.1%
Network	\$8,651,946	\$2,754,080	\$5,897,866	68.2%
Compute	\$5,172,034	\$3,311,428	\$1,860,606	36.0%
Three-year cost for 5,000 VMs	\$17,483,980	\$8,660,182	\$8,823,798	50.5%
Three-year cost per VM	\$3,496.80	\$1,732.04	\$1,764.76	50.5%

Figure 9: CapEx and savings for a large enterprise with 5,000 VMs using network and storage virtualization in a private cloud.

Reclaim inactive VMs

Cloud management tools enable a policy-based process of identifying inactive VMs and freeing up their compute resources. We estimated that 10 percent of VMs would be inactive in a traditional virtualized environment; by reclaiming them, the enterprise could save an additional 10 percent of compute CapEx.

Software savings

The Forrester study estimated that a 15,000-employee enterprise could see a 1 percent cost savings and avoidance for software costs in the first year after implementing the hybrid cloud and 2 percent in subsequent years based on an annual software cost of \$24M prior to savings.⁴⁰ Scaled for our 1.97 times larger hypothetical organization, software costs would be nearly \$35M and potential three-year savings would be \$1,749,360.

Self-service portal and catalog

Increased worker productivity with improved applications and faster application delivery

Enterprise workers using the private cloud benefit from new cloud-based applications and applications updated for the cloud and from being able to deploy needed applications and services more quickly using self-service portals. The Forrester study estimated that these savings would affect 8 percent of employees in a 15,000-employee enterprise and save 2 percent of their time in year one. These employees were knowledge workers (with an average salary of \$65,000) in business units that consume private cloud resources. Both percentages would double for years two and three as more business units and users adopted the cloud and the enterprise added more applications to the cloud. These employees would be able to use 30 percent of their reclaimed time for other productive activities.⁴¹ Based on those estimates, we calculated a savings per worker of \$390 in year one and twice that in years two and three, yielding savings of \$8,643,570 over three years for our hypothetical organization.

40 <https://marketing.dell.com/Global/FileLib/Forrester/The-total-economic-impact-of-private-cloud.pdf>

41 Ibid.

Resiliency and data protection options

Resiliency and data protection options in hybrid cloud platforms reduce outages and downtime for hosted applications, protect from expensive data breaches, and improve compliance with regulations.

Reduce downtime

The Forrester study estimates its target enterprise could save six hours of downtime per year on average, at an estimated savings per hour of \$50,000.⁴² Scaled to our larger organization, 12 hours of avoided downtime per year could save \$1,800,000 over three years in associated costs.

Save security costs

A hybrid cloud provides IT with greater control over its critical resources by hosting them securely on the private cloud behind the enterprise's firewall. The Forrester study estimates that a 15,000-employee enterprise with cloud security management practices and tools in place could avoid two security breaches per year on average, saving an average of \$200,000 per breach.⁴³ We scaled up this cost per breach for our larger hypothetical organization and estimated three-year potential savings of \$2,364,000.

Avoid litigation and penalty costs

The enterprise from the Forrester study could avoid litigation costs and fines with the hybrid cloud because the enterprise could comply with regulations better than with traditional IT due to improved security, reliability, and other cloud-related efficiencies. The Forrester study estimated \$330,000 savings per year for its target organization due to improved compliance,⁴⁴ which scales to \$1,950,300 in potential savings over three years for our larger hypothetical organization.

ITaaS and DevOps processes

Self-service provisioning of ITaaS and cloud-enabled development processes and tools can accelerate application development, enabling the enterprise to deliver more and better applications, including those that can drive business revenue.

42 Ibid.

43 Ibid.

44 Ibid.

Resource request for a three-tier application

Traditional IT and hybrid cloud handle resource requests very differently (see Figures 2 and 3). A request for resources in a traditional IT model involves at least six different staff members: the web developer making the request, help desk support staff fielding the request, and the system, storage, network, and application administrators doing the work. These requests require approval from a change advisory board (CAB). We estimate 2.35 business days (18.78 hours) to fulfill a resource request, which includes a 12 hours for CAB review and approval, 3.28 hours of active staff time, and 3.50 hours of time lost to waiting for staff to be available to do the tasks. The estimated 3.28 hours (197 minutes) of staff time includes:

- 150 minutes by system administrator III-level staff
- 30 minutes by system administrator II-level staff
- 15 minutes by service desk staff
- 2 minutes by the user to carry out the steps in Figure 2, not counting the CAB approval.

Using an average staff cost of approximately \$60, we estimate a \$195 staff cost to complete the tasks. CAB review adds \$365 for a total cost of \$560. The CAB cost is based on cost estimates for 12 managers and C-level administrators on the CAB, a 12-member CAB review team, and a change manager averaging 10 minutes each on the approvals for this request. This CAB time is less than the hour-long CAB reviews described in [Appendix E](#) for the BYO hybrid cloud implementation process. Those time and cost estimates also include time for the core specialists to make and prepare presentations for the more significant infrastructure changes involved in setting up the BYO hybrid cloud platform.

Appendix B – What we tested

Our testbed hardware configuration consisted of a Dell EMC Vblock System 320 with Dell EMC VNX® 5500 storage. Our compute nodes consisted of 10 Cisco® B200 M2 blade servers in a Cisco UCS® 5108 chassis. Figure 10 shows a detailed list of hardware and software versions used in our validation. This list excludes VMware ESX and other components that we did not install during our 28-day hands-on deployment test.

System	Dell EMC Vblock System 320
Compute	
Vendor and model number	Cisco UCS B200 M2
CPU vendor and model number	2x Intel® Xeon® processors X5670 / X5680 / X5690
Network adapters	Cisco UCS VIC 1280 10Gb
Total memory in system	128 GB
Networking	
Fabric interconnects	Cisco UCS® 6140
Storage switches	Cisco® MDS 9148 / Cisco Nexus® 5548
Storage	
Vendor and model number	Dell EMC VNX 5500
Total storage capacity	100 TB
Software versions	
ViPR Controller	2.3 Patch1 HF3
Avamar	7.1 SP1
NSX for vSphere	6.1.4
vCenter Orchestrator	5.5.2.1
vCenter Automation Center	6.1.0b
vRealize Automation	6.2.1
vRealize Operations Manager	6.0.2
vCenter Server for Windows®	5.5 Update 2e
vSphere ESXi™	5.5

Figure 10: Configuration information for the systems and software used in our tests.

Appendix C – The BYO process timeline

Figure 11 shows our time estimates for the design and implementation phase for the BYO approach compared to buying from Dell EMC. We also calculate the time to value starting with the training stage and ending with the stage that rolls out the platform at production size. For Dell EMC, that is the 28-day Enterprise Hybrid Cloud design and implementation engagement. That timeframe skips the project planning stage and the final phase that transitions the production cloud to the operations team.

Stages	Weeks	How Enterprise Hybrid Cloud delivers faster time to value
Plan project	1.0	Dell EMC estimates a 2-day pre-sale process that results in a purchase order for Enterprise Hybrid Cloud.
Train systems architects on hybrid cloud technologies	5.0	Dell EMC deploys the cloud, so there is no need for you to train members of your deployment team.
Build POC	17.0	Enterprise Hybrid Cloud eliminates the need to prove that components of a platform you define and assemble will work.
Plan and create foundation core for scalable pilot	18.0	The Enterprise Hybrid Cloud skips the pilot phase. The design process occurs during the first few weeks of the 28-day design and implementation process.
Create foundational service blueprints and workflows	11.6	The Enterprise Hybrid Cloud platform includes foundation blueprints so your staff doesn't spend time or introduce risks creating them from scratch.
Do QA and conduct pilot	12.0	Enterprise Hybrid Cloud requires no pilot.
Scale and onboard to roll out production size	8.0	Dell EMC team deploys the production system in the last few weeks of their 28-day design and implementation engagement.
Transition to operations team	6.0	Both platforms include a 6-week transition period during which the operations team takes control of the production cloud.
Time to value (from training to rolling out to production size)	71.6	Enterprise Hybrid Cloud delivers time to value in 5.6 weeks.
Total time	78.6	Total time for Enterprise Hybrid Cloud is 12.5 weeks.

Figure 11: A breakdown of the design and deployment phase when building a hybrid cloud yourself.

Project planning

For the BYO approach, we estimated one week for project planning for the POC and pilot processes.

For the Enterprise Hybrid Cloud platform, Dell EMC staff work with the customer over a couple of days to size the platform, create the bill of materials for the order, and then complete the design and implementation service. Dell EMC also provides worksheets for the customer to collect information on requirements for the platform.

Training Systems Architects on hybrid cloud technologies

We estimate that the BYO hybrid cloud requires five weeks of training for the staff members for POC and pilot tests. Their training includes one week each on vRealize Operations, Orchestration, and Business; Dell EMC ViPR Controller; and VMware NSX. We assumed these staff members would transmit their knowledge and training as needed to other staff. In making this estimate, we assumed there is no staff turnover; if there were, the enterprise would have to train new staff to fill in any knowledge gaps.

In the buy approach, Dell EMC staff deploy the Enterprise Hybrid Cloud, so your staff do not need training.

Building POC

We estimated 17 weeks for this hybrid cloud POC step based on our experiences doing the POC build to meet the success requirements for an IaaS deployment. During our POC build, we faced a number of challenges. At several points, we had to redeploy components more than once. Resolving networking issues and determining the proper way to integrate some of the components cost our team valuable troubleshooting time. Our team, consisting of a full-time systems architect and a three-quarter time systems administrator, worked a total of 390 hours over the equivalent of 28 business days. While the team completed several processes in parallel, they devoted the first week to setting up the networking and deploying all components. They spent the second and third weeks integrating all of the components. They spent the fourth week modifying several workflows and incorporating them into the self-service portal provided by vRealize Automation. By the end of the 28 business days, they had completed 70 percent of the success criteria.

Our team chose to spend their time on the tasks that they could complete with the greatest ease and speed; therefore, the remaining tasks would likely take a disproportionate amount of time. Our team spent no time on QA testing for robustness and scalability, a requirement before moving to the production stage.

For these reasons, we estimated that an IT team would need the rest of the 17 weeks for this phase to meet the remaining 30 percent of the success criteria and to do security and QA testing. We also included time and cost for CAB reviews.

Companies seeking to build their own platform run the risk of restarting the POC and pilot processes due to issues such as deployment order, integration, or version compatibility. In addition to the time and resource costs, each restart introduces opportunities for risk. Even without major environment revisions, successfully planning and building a hybrid cloud pilot environment requires valuable time and resources that have been diverted from other priorities.

Customers can bypass the POC phase entirely with the Enterprise Hybrid Cloud platform. Dell EMC has invested substantial time and resources in engineering the platform to be production ready, sparing companies the work of planning, building, and testing a POC and pilot environment, including revision control of the factory build on Dell EMC converged infrastructure.

Plan and create foundation core for scalable pilot

The next stage for the BYO hybrid cloud platform is to create a scalable pilot using the knowledge gained during the POC deployment. We estimated 18 weeks for this phase.

Planning and design

As a first step, the team building the platform would need to conduct a planning and design study to collect requirements for the custom production platform. This process requires significant time from the IT staff collecting the information and the stakeholders providing it. The process can be unfocused, with multiple iterations and revisions, and it can take much longer and use more staff time than the guided Enterprise Hybrid Cloud design process.

From an implementation perspective, a customer buying Enterprise Hybrid Cloud does not need to worry about reading the build documents. Instead, IT staff can focus on learning the tools they need to design and deploy new services, while interacting with the Dell EMC services team to design their desired cloud environment. Because of these advantages and the trained Dell EMC staff guiding the collection of requirements, the design process for Enterprise Hybrid Cloud moves smoothly and, according to Dell EMC, completes in three weeks.

In a BYO approach, this process runs in the background during the POC and pilot phases. We estimated it requires more than 3 times the staff commitment of the Enterprise Hybrid Cloud.

When planning for the production infrastructure, administrators must guarantee that the design of the hybrid cloud environment will support the desired number of VMs (5,000 for our cost analysis) and meet the organizations' requirements. In the BYO scenario, the IT team is responsible for creating the supporting documentation, manuals, and guides containing all of the configuration details and procedures for the production environment. Without a template, there is no guarantee that the first draft of the documentation and guides will address every element sufficiently. After completing the design for deploying to production scale, IT staff must create a comprehensive list of information about the environment, such as IP addresses, passwords, software version numbers, deployment order, and installation instructions. Additionally, these documents should include the company department needs and corresponding workflows so developers can create all necessary workflows. After creating first drafts, IT staff must gather even more information to complete the documents. If any document needs to be revised, staff must once again complete a draft of the document or collect the new information. This process can be time-consuming and tedious.

As part of the roadmap for your Enterprise Hybrid Cloud, Dell EMC has guides for components, documentation for configuration details, and manuals that can aid in maintaining the environment. The pre-deployment design phase occurs during the first few weeks of the 28-day design and implementation service engagement. During this planning phase, Dell EMC holds meetings with customer stakeholders to gather configuration information, so deployment is swift and smooth.

Create a foundation core for scalable pilot

At this point in the BYO process, the platform development team starts over on the pilot testbed with the goal of building a scalable pilot customized to meet the design specifications and work within the organization's infrastructure. This process will be iterative and involve stakeholders in requirements verification and user acceptance tests (UATs). The development team builds the platform until it requires the full set of foundational blueprints and workflows. Pilot deployment resumes after the workflow creation phase.

Create foundation service blueprints and workflows

For the BYO approach, we estimated 11.6 weeks for a team of four developers to create the 21 foundation workflows this platform requires and for a Systems Administrator(s) to do QA testing on the workflows.

Workflow development can be a difficult and time-consuming process that requires expertise in the tools and syntax necessary for creation, as well as the ability to troubleshoot any errors in creating new workflows. Additionally, IT staff must test each workflow before deployment into the pre-production environment.

Due to time constraints, we were unable to create foundation workflows comparable to those available with the Enterprise Hybrid Cloud; however, based on information from Dell EMC and our team's examination of completed workflows that Dell EMC provided, we estimated at least 2.3 weeks per workflow plus time for QA and UAT testing in the pilot environment.

With the Enterprise Hybrid Cloud platform, Dell EMC can provide the foundation workflows your company needs. These include workload data protection, storage services, and Dell EMC workflows. Some of these workflows will be associated with catalog items, such as create or delete Avamar backup policies; others define resource actions, such as add or delete an ESXi host. Dell EMC tests their workflows for robustness and QA as part of the platform release cycle, so there's no troubleshooting or testing needed in the environment.

Do QA and conduct pilot

For the BYO approach, we estimated 12 weeks for the QA of the pilot environment followed by a pilot test with a subset of users. During this stage, the development team—including the developers—will adjust the pilot environment and workflows based on UAT and robustness testing results.

When you buy Enterprise Hybrid Cloud, your IT staff will not encounter this phase.

Scale and onboard to production size

We estimated 8 weeks for this stage with a BYO approach.

Prior to production, companies need to plan for scaling the pilot environment infrastructure to production size. They must also procure the production infrastructure hardware and licenses. After all of the components arrive, the team redeploys the pilot environment to the production equipment to complete UAT and pre-production testing. Finally, IT creates any customized workflows to meet the requests of the various company departments.

Because our hypothetical company building a platform would be procuring the same components that Dell EMC needs, we assume that procurement time for the components would be identical for both scenarios. For this reason, we do not include procurement time in our analysis.

We based time estimates on our BYO approach of the POC environment as well as our observation of Dell EMC's deployment of the Enterprise Hybrid Cloud platform foundation.

Learning from mistakes made in the pilot stage, staff can more quickly deploy and integrate components than they did initially; however, they must also maintain the old infrastructure and respond to requests to keep users in the company working. Handling daily tasks and deploying a fully scaled production environment can reduce productivity and response times for IT staff, as well as further delay the completion of the new environment.

In contrast, companies that purchase the Enterprise Hybrid Cloud have an experienced Dell EMC team come on-site to install, deploy, and configure all components in a fraction of the time. In our observation of the Dell EMC platform deployment process, the team completed the platform foundation in five business days, requiring only one day each for many of the tasks that took our team a week. For example, integrating ViPR Controller and vRealize Automation required a week of troubleshooting and reconfiguring from our team; in contrast, the Dell EMC team completed the configuring and integration in a single business day. In addition, the Dell EMC team created and configured several workflows in vRealize Automation that our team did not have time to attempt.

Finally, a BYO cloud platform needs to complete user acceptance testing, which analyzes functionality and performance. UAT can ensure the platform meets users' needs. If any issues arise from a functionality or ease-of-use perspective, the IT team needs to modify the environment to resolve them. Any modifications to the environment will mean modifying the documentation and guides, along with performing additional QA testing and UAT steps. After UAT is completed and test users are satisfied with the environment, pre-production testing is necessary to confirm that the platform is ready to deploy as the production environment. This round of testing must be rigorous and include all custom workflows in order to prevent possible future issues.

In contrast, the Enterprise Hybrid Cloud platform requires no additional testing from the company. The Dell EMC team of specialists has already thoroughly tested the platform to ensure an easy-to-use self-service portal and a robust architecture that can scale to any size needed.

Transition to operations team

Dell EMC offers post-deployment operational support as a complement to the design and implementation service.

The Dell EMC team provides knowledge transfer and delivers 30 days of operational support remotely to ensure operational success. We estimate that the BYO deployment team would collaborate with the cloud operations team during a transition period that would also take six weeks.

Appendix D – How we tested

Installing VMware ESXi 5.5

1. Attach the installation media.
2. Boot the server.
3. At the VMware Installer screen, press Enter.
4. At the EULA screen, press F11 to Accept and Continue.
5. Under Storage Devices, select the appropriate disk, and press Enter.
6. Select US as the keyboard layout, and press Enter.
7. Enter the root password twice, and press Enter.
8. Press F11 to start installation.
9. After the server reboots, press F2 and enter root credentials.
10. Select Configure Management Network, and press Enter.
11. Select the appropriate network adapter, and select OK.
12. Log into the server using the VMware vSphere client.
13. Select the Configuration tab, and click Networking.
14. Click Add Networking...
15. Create the management network.
16. Click on the Configuration tab, and select Time configuration to configure server time.
17. Click DNS and Routing, and confirm the settings.

Setting up the vCenter Server

Setting up a VM to host the vCenter Server

1. Connect to the server via the VMware vSphere client.
2. Log in as root
3. In the VMware vSphere client, under Basic Tasks, select Create a new virtual machine.
4. Choose Custom, and click Next.
5. Assign the name `vcenter` to the virtual machine, and click Next.
6. Select the host, and click Next.
7. Select the appropriate storage, and click Next.
8. Choose Virtual Machine Version 8, and click Next.
9. Choose Windows, choose Microsoft Windows Server® 2012 (64-bit), and click Next.
10. For CPUs, select two virtual processor socket, and one core per virtual socket, and click Next.
11. Choose 4 GB RAM, and click Next.
12. Click 1 for the number of NICs, select VMXNET3, connect to the VM network, and click Next.
13. Leave the default virtual storage controller, and click Next.
14. Choose to create a new virtual disk, and click Next.
15. Make the OS virtual disk size 50 GB, choose thin-provisioned, specify storage, and click Next.
16. Keep the default virtual device node (0:0), and click Next.
17. Click Finish.
18. Connect the VM virtual CD-ROM to the Microsoft Windows Server 2012 R2 installation disk.
19. Start the VM.

Installing Windows Server 2012 R2 on the vCenter VM

1. Right-click the VM, and select Open Console.
2. At the Windows Language Selection screen, click Next.
3. Click Install Now.
4. Enter the product key, then click Next.
5. Select Windows Server 2012 R2 Datacenter (Server with a GUI), and click Next.
6. Click the I accept the license terms check box, and click Next.
7. Click Custom.
8. Click Next.
9. Enter the desired password for the administrator in both fields, and click Finish.

10. Log into the VM, and install VMware tools.
 - a. Set up networking for the data network:
 - b. Click Start, Control Panel, right-click Network Connections, and choose Open.
 - c. Right-click the VM traffic NIC, and choose Properties.
 - d. Uncheck TCP/IP (v6).
 - e. Select TCP/IP (v4), and choose Properties.
 - f. Set the IP address, subnet, gateway, and DNS server.
11. Connect to the internet, and install all available Windows updates. Restart as necessary.
12. Enable remote desktop access, disable firewalls, and disable IE security as necessary.
13. Change the hostname, join the domain.local domain, and reboot when prompted.

Installing VMware vCenter 5.5

1. Log into the vCenter VM.
2. From the VMware vCenter 5.5 install media, click Autorun.
3. Click Run to start the install wizard.
4. Click the Install button on the VMware vSphere 5.5 Simple Install wizard.
5. At the Install wizard welcome screen, click Next.
6. Agree to the License Agreement, and click Next.
7. Enter and confirm the password you wish to use with the Administrator account for vCenter Single Sign On, and click Next.
8. Click Next.
9. Accept the default https port, and click Next.
10. Accept the default installation path, and click Next.
11. Click Install.
12. Click Finish to exit the wizard.
13. Click OK to confirm completion.
14. Click Exit on the installer.
15. Restart the server.
16. Using the vSphere client, log into the vCenter server as Administrator@vsphere.local
17. Right-click the root of vCenter, and click New Data center.
18. Name the new data center.
19. Add servers to host the components and tenants.

Setting up ViPR Controller

Deploying the ViPR Controller appliance

1. In the vSphere client, log into the vCenter server.
2. Click File, and select Deploy OVF template....
3. Browse for the OVA file, and click Open.
4. Click Next.
5. Click Next.
6. Accept the EULA, and click Next.
7. Name the appliance, and select the appropriate inventory location. Click Next.
8. Select the datastore, then click Next.
9. Select Thin Provision, then click Next.
10. Enter the desired IPv4 addresses, network netmask, and IPv4 default gateway. Click Next.
11. Click Finish.
12. When deployment completes, click Close.

Configuring ViPR Controller

1. Open a web browser and connect to the client access address provided in the previous steps. We used 10.128.175.50
2. Log on with the default root credentials (root / ChangeMe).
3. When prompted, click browse to locate the license file.
4. Locate the license file, and click Open.
5. Click Upload License file.
6. When prompted to change the password for root and system, enter desired passwords.
7. Enter the DNS and NTP server IP addresses.
8. For ConnectEMC, change the transport setting to None.
9. Click Finish.

10. In the sidebar to the left, click Tenant Settings.
11. Click Projects.
12. Click Add to create a project.
13. For Name, provide the name for a default project. We used `PT Test Project`.
14. Click Save.

Adding Storage

1. Log into the EMC ViPR Controller console.
2. In the sidebar to the left, click Physical Assets.
3. Select Networks.
4. Click Add IP Network.
5. Name the network. Click Add.
6. In the sidebar to the left, click Virtual Assets.
7. Click Virtual Arrays.
8. Click Add, name the virtual array, and click Save.
9. Check Grant Access to Tenants, and check Provider Tenant. Click Save.
10. Click Networks.
11. Click the network created in step 5.
12. Check the virtual array created in step 9.
13. Click Save.
14. In the sidebar to the left, click Physical Assets.
15. Select Storage Systems.
16. Click Add.
17. Select the appropriate type. We used EMC VNX File.
18. Name the storage, enter the IP for the target VNX array, and enter the username and password for VNX.
19. Enter the IP for storage provider, user, and password.
20. Click Save.

Adding vCenter Server

1. Log into the EMC ViPR Controller console.
2. In the sidebar to the left, click Physical Assets.
3. Select vCenters.
4. Click Add.
5. Name the vCenter, enter the IP address, username, and password. Click Save.

Setting up vRealize Orchestrator

Deploying the vRealize Orchestrator appliance

1. In the vSphere client, log into the vCenter server.
2. Click File, and select Deploy OVF template....
3. Browse for the OVA file, and click Open.
4. Click Next.
5. Accept the EULA, and click Next.
6. Name the appliance, and select the appropriate inventory location. Click Next.
7. Click Next.
8. Select the datastore, then click Next.
9. Select Thin Provision, then click Next.
10. Enter an initial root password and configuration interface password, enable SSH service, enter vRO for the hostname, and enter the desired IPv4 addresses.
11. Enter the same network netmask, default gateway, and DNS as the ViPR Controller appliance. Click Next.
12. Click Finish.
13. Open a web browser. Use https to connect to the IP address assigned to vRO, using port 8281. Click Download vCenter Orchestrator Client Installable.
14. Choose the download for Windows 64-bit.
15. Click Run.
16. Click Run.
17. When the installer appears, click Next.
18. Accept the EULA, and click Next.

19. If an earlier version of Orchestrator has been found, click Continue With Update.
20. Click Next.
21. Click Next.
22. Click Next.
23. Click Install.
24. Click Done.

Updating Network Settings

1. Open a web browser. Use https to connect to the IP address assigned to vRO, using port 8283.
2. Enter the configuration credentials (username is `vmware` and the password is whatever was assigned in the previous section). Click Login.
3. Select Network from the menu to the left.
4. Select SSL Trust Manager.
5. Enter the vCenter server address to import a certificate (e.g. `https://10.128.15.19:7444`). Click Import.
6. Review the certificate information, and click the Import link beneath it.
7. Click Network.
8. Use the pull-down menu for IP address to select the IP address assigned to your vRO server.
9. Click Apply changes.

Adding the vCenter Server to vRO

1. Log into the Orchestrator client (default credentials are `vcadmin` for both username and password).
2. Select the Workflows tab, and go to Library/vCenter/Configuration. Run the Add a vCenter Server instance workflow.
3. Enter the IP address of the vCenter, use the default port and SDK location, and select Yes for orchestrating and ignoring certificate warnings. Click Next.
4. Enter the username and password to access the vCenter, then click Submit.
5. Go to Library/Microsoft/Active Directory/Configuration, and run the Configure Active Directory server workflow.
6. Enter the IP address for the DNS, enter the Root distinguished name (DC=domain, DC=local), and click Next.
7. Select Yes for shared session, and enter the username and password for the DNS. Click Submit.
8. Go to Library/vCenter/Configuration. Run the Register vCenter Orchestrator as a vCenter Server extension workflow.
9. Click Not Set to select the vCenter. Click Submit.

Integrating ViPR Controller with vRO

1. Log into the vRO configuration client.
2. From the left menu, select Plug-ins.
3. Scroll down to Install new plug-in. Click the magnifying lens icon.
4. Navigate to the EMC ViPR Controller Plugin (2.3.0.0 build 25). Select `EMC-ViPR-vCO-Plugin-2.3.0.0.25.dar`, and click Open.
5. Click Upload and Install.
6. In the left menu, click EMC ViPR Controller Plugin (2.3.0.0).
7. Enter the IP address of the ViPR Controller instance (e.g. `10.128.175.50`).
8. Enter the ViPR Controller username and password. We used the root account and password.
9. Click Verify Connection.
10. Click Apply changes.
11. Restart the vRealize Orchestrator service (using Startup Options on the left menu).

Setting up vRealize Automation

Deploying the vRA Identity Appliance

1. In the vSphere client, click File, and choose Deploy OVF template...
2. Choose Local file, and browse to the OVA file. Click Next.
3. Review the details, and click Next.
4. Accept the EULA, and click Next.
5. Select the datacenter where your host is stored, and click Next.
6. Select the host, and click Next.
7. Select the correct storage, and click Next.
8. Select Thin Provision, and click Next.
9. Enter a password and confirm it, then enable SSH.
10. Enter the host name of the vCenter. Assign IPs to the DNS, address, gateway and netmask fields. Click Next.
11. Click Finish to deploy the VM.

Configuring the vRA Identity Appliance

1. Power on the Identity VM.
2. Using the IP assigned in the deployment section, navigate to `https://IPofappliance:5480/`
3. Log in as root with the password you assigned.
4. Go to System, click Time Zone, and choose your time zone from the dropdown menu. Click Save Settings.
5. Go to SSO, and enter the Password you want to apply to the admin user. Click Apply.
6. Click SSL, and choose Generate Self Signed Certificate from the dropdown menu.
7. Enter the Organization and Organizational Unit fields, and click Replace Certificate.
8. Click Active Directory®.
9. Enter the Domain Name, Domain User, and Password fields. Click Join AD Domain.

Deploying the vRealize Automation Appliance

1. In the vSphere web client, click File, and choose Deploy OVF template....
2. Choose Local file, and navigate to the OVA file. Click Next.
3. Review the details, and click Next.
4. Accept the EULA, and click Next.
5. Select the datacenter where your host is stored, and click Next.
6. Select the host, and click Next.
7. Select the correct storage, and click Next.
8. Select Thin Provision, and click Next.
9. Enter a password and confirm it, then enable SSH.
10. Enter the host name of the vCenter. Assign IPs to the DNS, address, gateway and netmask fields. Click Next.
11. Click Finish to deploy the VM.

Configuring the vRA VM

1. Power on the vRA VM.
2. Using the IP you assigned in the deployment section, navigate to `https://IPofappliance:5480/`
3. Log in as root with the password you assigned.
4. Go to System, click Time Zone, and choose your time zone from the dropdown menu. Click Save Settings.
5. Go to vRA Settings, click Resolve Host Name, and click Save Settings once the hostname is resolved.
6. Click SSL, and choose Generate Self Signed Certificate from the dropdown menu.
7. Enter the Organization and Organizational Unit fields, and click Replace Certificate.
8. Click SSO, and enter the FQDN of the Identity Appliance in the SSO Host and Port box (FQDN:port).
9. Enter the default administrator user and password in the boxes (administrator@vsphere.local).
10. Click Save.
11. Click Licensing, enter the license key, and click Submit Key.

Creating the IaaS VM

1. In the vSphere client, right-click the management host, and choose New Virtual Machine...
2. Select Custom, and click Next.
3. Name the VM IaaS, select the datacenter, then click Next.
4. Select the host, then click Next.
5. Select the storage, then click Next.
6. Select Virtual Machine Version: 8, then click Next.
7. Select Microsoft Windows Server 2012, then click Next.
8. Select 2 virtual sockets, then click Next.
9. Select 8GB of memory, then click Next.
10. Select VMXNET 3 as the adapter, then click Next.
11. Click Next.
12. Click Next.
13. Select Thin Provision, then click Next.
14. Click Next.
15. Review the settings, then click Finish.

Installing Windows Server 2012 R2 on the IaaS VM

1. Boot the server, and connect the Windows 2012 R2 installation media.
2. At the Language Selection screen, click Next.
3. Click Install Now.

4. Enter the product key, then click Next.
5. Select Windows Server 2012 R2 Datacenter (Server with a GUI), and click Next.
6. Click the I accept the license terms check box, and click Next.
7. Click Custom.
8. Click Next.
9. Enter the desired password for the administrator in both fields, and click Finish.
10. Log into the VM, and install VMware tools.
11. Connect the machine to the Internet, and install all available Windows updates. Restart as necessary.
12. Enable remote desktop access.
13. Change the hostname, and reboot when prompted.

Installing SQL Server 2012 SP1

1. Connect the SQL Server 2012 SP1 installation media, and run the SQL Server 2012 SP1 setup.
2. Click Installation, then select New installation or add features to an existing installation.
3. On the Setup Support Rules screen, click OK.
4. Enter the product key or specify a free edition, and click Next.
5. Check I accept the license terms, and click Next.
6. Click Install to install the setup support files.
7. On the Setup Support Rules screen, and click Next.
8. Choose SQL Server Feature Installation, and click Next.
9. Select the Database Engine Services, Full-Text Search, Client tools Backwards Compatibility, Management Tools Basic and Complete, and click Next twice.
10. Accept instance configuration defaults, and click Next.
11. Accept defaults for disk space requirements, and click Next.
12. Choose NT Service\System for the Agent and Database Engine services, and click Next.
13. Select Mixed Mode, and enter a password for the SA account. Click Add Current User, and click Next.
14. Accept defaults for error reporting, and click Next.
15. Review installation configuration rules check, and click Next.
16. To begin installation, click Install.
17. At completion screen, click Close.
18. Open the SQL Server Configuration Manager, and expand SQL Server Network Configuration.
19. Verify that TCP/IP is enabled, and close the manager.
20. Reboot the server.
21. Install the SP1 and SP2 SQL updates.

Installing pre-requisites on the IaaS VM

1. Follow the instructions at blogs.vmware.com/PowerCLI/2014/12/vrealize-automation-vra-6-2-pre-req-automation-script-formerly-vcac.html to download the pre-requisite automation script.
2. After saving the file, open the script using Notepad, and comment in the section titled Logon Service Settings. Save and close the file.
3. Download Java® SE Runtime Environment 7u17 from Oracle, and run the installer.
4. Press the Windows key, type powershell, and right-click the Windows Powershell® result.
5. Click Run as Administrator.
6. Type Set-ExecutionPolicy Unrestricted, and press Enter.
7. To confirm the setting, type Y, and press Enter.
8. Navigate to the unzipped directory you downloaded, and type `.\scriptnamehere.ps.1` to run the script.
9. Type 2 to use the Internet, and press Enter.
10. When the script finishes, restart the VM.

Installing IaaS on the VM

1. Open a browser, and navigate to `https://vrahostname.domain.name:5480/installer/`
2. Click the setup.exe hyperlink to download the IaaS installation file.
3. Right-click "setup_vcac.hostname@5480.exe" and choose Run as Administrator.
4. Click Next on the Welcome screen.
5. Accept the EULA, and click Next.
6. Enter root as the user and the relevant password, accept the certificate, then click Next.
7. Choose Complete Install, and click Next.
8. All prerequisites should have passed the check, so click Next.
9. Enter the domain administrator username and password.

10. Create a Passphrase and confirm it, and click Next.
11. Leave defaults, and click Next.
12. Leave the default server, and click Load for SSO Default Tenant (should auto-populate to vsphere.local).
13. Click Download to receive the certificate, and check Accept Certificate.
14. Enter the domain administrator username (username@vsphere.local) and Password, accept the default IaaS server, and click Next.
15. Click Install.
16. Click Finish.

Configuring IaaS Tenants

1. Open a browser window and navigate to `https://vra-appliance-hostname.domain.local/shell-ui-app`
2. Log in with `administrator@vsphere.local` and the SSO password.
3. In the Tenants box, click vsphere.local.
4. Go to Identity stores, and click the green +.
5. Enter the name of the Identity store.
6. Choose Active Directory from the dropdown box.
7. Enter the URL to the Identity store (i.e. `ldap://activedirectoryserver.domain.local:389`)
8. Enter the domain.
9. Enter the domain administrator's distinguished name (i.e. `CN=Administrator, CN=Users, DC=domain, DC=local`)
10. Enter the user password.
11. Enter the Group search base distinguished name (i.e. `DC=domain, DC=local`), test connection, and click Add.
12. Go to Administrator, and assign administrator rights to users for both Tenant Administrator roles and Infrastructure roles.
13. Click Update to finish.
14. Log out of the website, and log back in as the domain administrator instead of the vsphere.local admin as before.
15. You should successfully log into a new screen with Home, Inbox, Administration, and Infrastructure tabs.
16. Go to Infrastructure>Administration>Licensing, and enter your license.

Creating and configuring the vSphere Endpoint

1. Log into the vRA appliance site with your domain administrator credentials (you should already be logged in if coming directly from the previous section).
2. Go to Infrastructure>Endpoints>Credentials, and click New Credentials.
3. Enter an identifying name for the new user, enter the domain administrator (e.g. `administrator@domain.local`), and the password.
4. Click the green checkmark to save.
5. Click Endpoints.
6. In the dropdown menu for New Endpoint, choose Virtual>vSphere (vCenter).
7. Type in `vCenter` for the name, and enter the URL to the vCenter sdk (e.g. `https://vcenter.domain.local/sdk`).
8. Enter the vSphere administrator credentials, and click OK.
9. If Compute Resources do not appear for the vCenter, restart the vRA, Identity Appliance, and IaaS VMs.

Creating a Fabric Group

1. Go to Infrastructure>Groups>Fabric Groups, and click New Fabric Group.
2. Enter a name and description.
3. Add the domain administrator and the vsphere.local administrator from the dropdown menu.
4. Select the compute resources, and click OK.

Configuring the machine prefix

1. The Fabric Group is set to the same administrator as which we are logged in. Log out and back in to update the server.
2. Go to Infrastructure>Blueprints>Machine Prefixes, and click New Machine Prefix.
3. Enter a prefix name without including spaces.
4. Enter the ending number for the maximum number of VMs (3 = three digits, or 999 maximum VMs) and a starting number (usually 1).
5. Click the green checkmark to save.

Creating a Business Group

1. Go to Infrastructure>Groups>Business Groups, and click New Business Group.
2. Name the group (e.g. IT or Sales).
3. Click the ... button, and choose the previously created prefix.
4. Add the domain administrator and the vsphere.local administrator as the email recipient.

5. Add the domain administrator and the vsphere.local administrator as the Admin user.
6. Click OK.

Creating a Reservation

1. Navigate to Infrastructure>Reservations>Reservation, and click on New Reservation>Virtual>vSphere.
2. Select a compute resource.
3. The name and tenant should auto-populate.
4. Enter a priority of 1.
5. Click Resources.
6. Specify the amount of RAM to reserve.
7. Choose which datastores the reserve can access, and set a priority for each datastore (can share the same priority).
8. Click Network.
9. Select the networks that you want to have available for users when they provision their VMs, and click OK.

Creating a Service and Entitlement

1. Navigate to Administrator>Catalog Management>Services
2. Click Add.
3. Enter a name for the service, set the status to Active, and click Add.
4. Go to Administrator>Catalog Management>Entitlements
5. Click Add.
6. Enter a name for the entitlement, set the status to Active, and enter the domain user in Users & Groups. Click Next.
7. Click the green + for Entitled Services, and choose the service you created.
8. Click the green + for Entitle Actions, and check every box. Click OK.
9. Click Add.

Creating a Blueprint

1. Navigate to Infrastructure>Blueprints>Blueprints.
2. Click New Blueprint>Virtual>vSphere.
3. Enter a name for the blueprint, choose the prefix you created, and enter a number of archive days. Enter a cost if desired.
4. On the Build Information tab choose the Clone action in the dropdown menu, and choose the relevant template.
5. Add any properties needed (e.g. to define where each VMDK should reside on the storage), and click OK.
6. Mouse over the new blueprint, click Publish, and click OK.
7. Navigate to Administration>Catalog Management>Catalog Items.
8. Click on the new Blueprint, set the status to Active, and choose the Service you created in the dropdown menu. Click Update.
9. Check the catalog tab to ensure that the blueprint is available.

Integrating vRO with vRA

1. Use ssh or the vSphere console to access the vRA appliance directly.
2. Type `service vco-configurator start`, and wait for the status to report the service is running.
3. In the web browser, navigate to `https://vra-appliance.domain.local:8283/` and log in. The default username and password are both `vmware`.
4. Enter a new password, and confirm it. Click Apply changes.
5. Verify that everything loads and all options are green.
6. In the web browser, navigate to `https://vra-appliance.domain.local`, and click the vCenter Orchestrator Client link.
7. Log in with the vsphere.local user and password.
8. After verifying that both vRO consoles are functioning, go back to the vRA console logged in with the domain administrator.
9. Navigate to Administration>Orchestration Configuration>Server Configuration.
10. Select Use an external Orchestrator server.
11. Enter the name, host IP, and port (default is 8281) of vRO. Choose Basic authentication, and enter the username and password for vRO.
12. Test connection, then Update.
13. Navigate to Administration>Orchestration Configuration>Endpoints.
14. Click Add, and choose Active Directory from the dropdown box.
15. Name the endpoint, and enter the Active Directory IP in the details tab, port 389, root Active Directory (DC=domain, DC=local), and the domain administrator and password.
16. Click Add to finish.
17. Click Add again, and choose vCenter Server in the dropdown menu.
18. Enter a name for the endpoint.
19. In the details tab, enter the FQDN of the vCenter server, port 443, and the path (`/sdk`) in the instance properties tab.

20. In the Log-in Properties tab, enter the domain user name and password (not the vSphere user).
21. Click Add to finish.
22. Navigate to Administration>Groups, and click the group listed in the right pane. If there is no group, click Add to create a group.
23. Check Service Architect, and click Update.
24. Log out of the management console, and log back in. The Advanced Services tab should appear, and you can now access the vRO resources.
25. Log into the vRO configuration client.
26. From the left menu, select Plug-ins.
27. Scroll down to Install new plug-in. Click the magnifying lens icon.
28. Navigate to the vRA plug-in (6.2). Select o11nplugin-vcac-6.2.0-2287231.vmoapp, and click Open.
29. Click Upload and Install.
30. Restart the vRealize Orchestrator service.
31. Log into the Orchestrator client.
32. Select the Workflows tab, then go to Library/vCloud Automation Center/Configuration. Run the Add a vCAC host workflow.
33. Enter the FQDN of vRA, the URL (including `https://`) of vRA, select Yes to import certificate, and click Next.
34. Enter the default tenant (`vsphere.local`), and the vsphere.local admin username and password. Click Submit.
35. Run the Add the IaaS host of a vCAC host workflow.
36. Click Not Set to select the vRA instance just added.
37. Enter your IaaS FQDN and URL. Click Next.
38. Enter the username (without the domain name) and password for the IaaS server. Click Next.
39. Enter the appropriate domain name. Click Submit.
40. Go to Library/vCloud Automation Center/Infrastructure Administration/Extensibility/Installation, and run the Install vCO customization workflow.
41. Click Not Set to select the vRA instance. Click Next.
42. Click Next, then click Submit.
43. Restart the vRealize Orchestrator service.

Setting up vRealize Operations Manager

Deploying the vROps VM

1. In the vSphere client, log into the vCenter server.
2. Click File, and select Deploy OVF template....
3. Browse for the OVA file, and click Open.
4. Click Next.
5. Verify the details, then click Next.
6. Accept the End User License Agreement, and click Next.
7. Enter a name, and choose the inventory location. Click Next.
8. Choose the deployment size (we chose small), and click Next.
9. Select the resource pool, and click Next.
10. Select the storage, and click Next.
11. Select Thin Provision, and click Next.
12. Choose the time zone, and enter the default gateway, DNS, IP address and netmask. Click Next.
13. Click Finish.
14. After deployment completes, click Close.

Setting up vROps

1. Power on the VM.
2. Open a web browser and navigate to the vROps IP address.
3. Select New Installation.
4. Click Next.
5. Enter a password for the admin account, and click Next.
6. Use the default certificates, and click Next.
7. Enter a Master Node Name, an NTP Server Address, and click Add.
8. Click Next.
9. Click Finish.
10. Click Start vRealize Operations Manager.
11. After vROps goes online, log into the online client to continue setup.

12. Choose New Environment, and click Next.
13. Accept the End User License Agreement, and click Next.
14. Enter the product license key (or keep in evaluation mode), and click Next.
15. Click Finish.

Installing Service and Management Packages

1. Log into the vROps client.
2. Select Solutions, and click the green + to add.
3. Browse to the desired PAK file and click Open.
4. Click Upload. After the PAK file has been uploaded, click Next.
5. Accept the End User License Agreement, and click Next.
6. Click Finish.
7. Repeat steps 2 through 6 as needed for other management packages. We used `emc-vipr-dist-pak-2.3.0.0.17.pak` only.
8. Select the EMC-VIPR plugin, and click Configure (gears icon).
9. Enter a display name and the public IP address, then add the login credentials for ViPR Controller.
10. Click Test Connection. After successful test, click OK.
11. Click Save Settings. Click Close.

Integrating vROps and vRA

1. Log into vRA using the service administrator (`vsphere.local`) credentials.
2. Navigate to Administration>Tenant Machines>Metrics Provider Configuration.
3. Select vRealize Operations manager endpoint.
4. Enter the URL, username, and password for vROps. Click Test Connection.
5. After a successful connection, click Save.

Setting up Avamar

Deploying the Avamar VM

1. In the vSphere client, log into the vCenter server.
2. Click File, and select Deploy OVF template...
3. Browse for the OVF file, and click Open.
4. Click Next.
5. Verify the details. Click Next.
6. Accept the EULA, and click Next.
7. Name the appliance, and select the appropriate inventory location (datacenter and resource pool). Click Next.
8. Select the datastore, then click Next.
9. Select Thick Provision Lazy Zeroed, then click Next.
10. Click Finish.
11. When deployment completes, click Close.
12. Right-click the Avamar VM, and select Edit Settings...
13. On the Hardware tab, select Memory and set memory size to 6GB.
14. Select CPUs and specify 2 CPUs (we chose two virtual sockets with one core per socket).
15. Verify that Network adapter 1 is connect to the correct network.
16. Click Add, select Hard Disk, and click Next.
17. Select Create a new virtual disk, and click Next.
18. For Disk Size, type 250 GB.
19. For Disk Provisioning, select Thick Provision Lazy Zeroed.
20. For Location, select Store with the virtual machine, and click Next.
21. For Mode, select Independent. Accept the default settings, and click Next.
22. Click Finish.
23. Complete steps 16 through 22 two more times.

Setting up Avamar

1. Power on the Avamar VM.
2. At login, type `root` for the username and `changeme` for the password.
3. Type the command `yast2`, and press Enter.
4. Select Network Devices, and press Enter.
5. Select Network Settings, and press Enter.

6. Use the tab key to select Edit, and press Enter.
7. Select Statically assigned IP Address. Tab to IP address and enter the desired IP address, subnet mask, and hostname.
8. Select Next, and press Enter.
9. From Network Settings, use the tab key to select Overview.
10. Select Hostname/DNS.
11. Enter the desired hostname, domain name, name server, and domain search.
12. Select the Routing menu, and enter the default gateway. Select OK, and press Enter.
13. Select Quit, and press Enter.
14. Verify the network settings by pinging the gateway and DNS.

Installing Avamar

1. Open a web browser and type `https://Avamar-server:7543/avi/avigui.html`
2. Enter the username and password used in setup.
3. At the top right of the page, click the gray lock, and type `SupportHarV1` to unlock.
4. When the configuration package appears, click Install.
5. When the Installation Setup page appears, type 0 and click Save.
6. Select ConnectEMC, and enter email sender address, email server, and site name. Click Save.
7. Select Passwords, and specify passwords for the accounts. Click Save.
8. Select Customer Contact Info, specify the contact information, and click Save.
9. Select Server Settings. Enter the IP address for the Avamar server, select the time zone, and click Save.
10. Click Continue.

Installing Avamar Administrator

1. From a Windows VM, navigate to `https://Avamar-server`.
2. From the Downloads tab, locate the JRE install package, and click the link to launch the installer.
3. Follow the onscreen instructions to complete the JRE installation.
4. Navigate to Downloads, and click the link for AvamarConsoleMultiple.
5. Open the installation file, accept the EULA, and click Install.

Adding vCenter certificates to Avamar

1. Open a command shell and log in as root. Enter the password chosen during the Installing Avamar section.
2. Stop the MCS by typing `dpnctl stop mcs`.
3. Copy `rui.crt` from the vCenter machine to `/tmp` on the Avamar server.
4. Type `cp /usr/local/avamar/lib/rmi_ssl_keystore /tmp/` to copy the MCS keystore to `/tmp`.
5. Type `cd /tmp` followed by the command `$JAVA_HOME/bin/keytool -import -file rui.crt -alias rui.crt -keystore rmi_ssl_keystore` to add the default vCenter certificate to the temporary MCS keystore file.
6. Enter the keystore password. Type `yes`, and press Enter to trust this certificate.
7. Navigate to `/usr/local/avamar/lib` and type the command `cp rmi_ssl_keystore rmi_ssl_keystore.backup` to back up the live MCS keystore.
8. Type `cp /tmp/rmi_ssl_keystore /usr/local/avamar/lib` to copy the temporary MCS keystore to the live location.
9. Type `dpnctl start mcs` to start the MCS.
10. Type `dpnctl start sched` to start the scheduler.

Integrating vCenter and Avamar

1. Log into the Avamar Administrator. Enter the Avamar VM IP, username, and password. Click Login.
2. Click Administration.
3. Click Account Management.
4. Select Actions, Account Management, New Client...
5. For Client Type, select VMware vCenter.
6. Enter the vCenter IP address, root username, and password. Click OK.
7. Select VMware, then select Proxy Deployment Manager.
8. Accept the default settings, and click Create Recommendation.
9. Select the newly created proxy, and click Edit...
10. Choose a name for the proxy and an IP address, and enter the DNS, default gateway, and netmask. Choose a new domain, or use the root domain.
11. Click Save.
12. Click Apply. Close the window.
13. Go to Administration, expand the vCenter domain, and select VirtualMachines.
14. Click New Client.

15. Select VMs & Templates, and click the datacenter.
16. Choose the VMs you would like to add to Avamar, or click Select All. Click OK.
17. Click OK.
18. Click Close.
19. To verify, go to Policy, select Default Virtual Machine Group, and click Edit.
20. Uncheck disabled, then click OK.
21. Click the Clients tab, select a VM, and click Back Up Now.

Integrating vRO/vRA and Avamar

1. Open a web browser, and navigate to the vRealize Orchestrator Configuration page (<https://<vRO-IP>:8283/>).
2. Click Plug-ins.
3. Scroll to Install new plug-in, navigate to the location of the .vmoapp, and click Upload and install.
4. Accept the license agreement.
5. After successful installation, restart the vRO service.
6. Log back into vRO Configuration and check that the EMC Data Protection Plugin has the status "Installation OK."
7. Log into the Orchestrator client.
8. Select the Workflow tab, and go to Library/EMC/Data Protection/vCAC/Installation. Run the Install default setup for tenant workflow.
9. Click Not Set to select the vRA instance. Click Next.
10. Click Not Set to select the catalog service previously created. Click Next.
11. Click Not Set to select the entitlement previously created for administrators. Click Next.
12. Click Not Set to select the entitlement previously created for users. Click Next.
13. Enter the FQDN, username, and password for Avamar. Click Submit.

Appendix E – Cost model for build vs. buy comparison

We estimated three-year costs for an enterprise that implements a Enterprise Hybrid Cloud using both the Enterprise Hybrid Cloud Design and Implementation service and later the Enterprise Hybrid Cloud Upgrade service.

We divided cloud deployment and three-year costs into three phases and estimated staff time and cost for those phases: project planning, design, and implementation; two annual upgrades; and Level 2 and Level 3 support over three years (see Figure 15). Dell EMC provides services and support for all these phases.

- Enterprise Hybrid Cloud Design and Implementation service covers project planning, design, and implementation, and is complemented by 30-Day Operational Guidance (post-install)
- Enterprise Hybrid Cloud Upgrade Service assists with annual upgrades
- The Enterprise Hybrid Cloud platform covers Level 2 and Level 3 support as an addition to the support purchased for the individual platform components

We compared those costs to our estimates of the costs of a hybrid cloud that enterprise staff would deploy, support, and upgrade in-house using a build-your-own (BYO) approach.

Key assumptions

- We did not include the hardware and software costs for the production systems. We assumed those were the same for the BYO and Enterprise Hybrid Cloud platforms.
- We did not include Dell EMC Vblock System hardware and software upgrade costs because they would be the same for both scenarios.
- We did not include support costs because they would be the same for both platforms given that customers would purchase support for the individual components used to build the platform. Enterprise Hybrid Cloud does not require customers to purchase any additional support services.
- We estimated costs for a hypothetical enterprise that plans to scale its platform to 5,000 VMs.
- We assumed that the enterprise dedicates a small development team to the project. The team includes the following:
 - compute, network, security, and storage systems architects equivalent to a maximum of two full-time employees (FTEs) at any time
 - a Systems administrator II
 - during blueprint development stage, four FTE developers, who would do the deployment work
- We assumed that for both platforms the enterprise would handle Level 1 support in-house at the same cost. Our cost comparison excludes those costs but includes costs for Level 2 and Level 3 support.

Time to value for project planning, design, and implementation phase

We calculated time to value for the design and implementation phase. For the Enterprise Hybrid Cloud, this time is the 28-day period for the design and implementation service engagement. It excludes the 30-day operational support that complements the design and service engagement and the 2-day pre-sale planning process. It includes the corresponding steps for the BYO approach starting with training and ending with the step that scales and onboards the platform to production size. The faster deployment of the Enterprise Hybrid Cloud means the enterprise gains the advantages and savings of a cloud environment sooner.

Figure 12 shows the enterprise can have its hybrid cloud running and start gaining value over 1.27 years sooner with Enterprise Hybrid Cloud. See [Appendix C](#) for more details of the BYO time to value.

Time to value for the two platforms		
	Build-your-own approach	Enterprise Hybrid Cloud platform
Design and implementation	71.6 weeks	5.6 weeks
Faster time to value		66.0 weeks 15.2 months 1.27 years
Faster time to value (%)		92.2%
Time to value savings		\$15,451,315

Figure 12: Advantages of faster time to value for Enterprise Hybrid Cloud.

With BYO, you could be missing 1.27 years of the savings and benefits that we describe for hybrid clouds in the [What does a hybrid cloud do for your business?](#) section of this paper. Those three-year savings and benefits totaled \$41,066,568. Savings over the first year were \$11,453,559 and rose to \$14,806,505 in years two and three due to increasing user productivity benefits and additional software cost savings. We calculate time to value savings based on the first year savings plus 0.27 times the second year savings of \$14,806,505. Figure 13 shows our total three-year cost comparison of the build and buy approaches.

Three-year cost summary

Three-year costs of Enterprise Hybrid Cloud and a BYO cloud approach				
	Build-your-own approach	Enterprise Hybrid Cloud platform	Savings	Percentage savings
Project planning, design, and implementation	\$1,094,695	\$480,573	\$614,122	56.1%
Level 2-3 support (3-year)	\$864,871	\$0	\$864,871	100.0%
Upgrade (end of years 1 and 2 post-deployment)	\$668,419	\$390,000	\$278,419	41.7%
Three-year costs	\$2,627,985	\$870,573	\$1,757,412	66.9%

Figure 13: Our three-year cost comparison of the build and buy approaches. Costs for all three phases for the BYO approach include staff costs, including training, and costs for a pilot/UAT testbed. Costs for the Enterprise Hybrid Cloud include customer staff costs and costs of the Enterprise Hybrid Cloud Design and Implementation service (for the first phase) and upgrade services (for the third phase).

Project planning, design, and implementation estimates include staff costs for both platforms. The estimate for the Enterprise Hybrid Cloud platform also includes the cost of the Enterprise Hybrid Cloud Design and Implementation service. The estimate for the BYO approach includes staff training costs and costs for the pilot testbed. Costs cover a project planning period, a design and implementation period, and 30 days of post-deployment time to transition the production cloud to the operations team.

Level 2 and Level 3 support estimates for the BYO approach include staff compensation, staff training costs, and costs for the UAT testbed for such support during the first three years post-deployment. The Enterprise Hybrid Cloud platform has no additional Level 2 or Level 3 support costs because the platform service covers that support (provided the enterprise purchases support for the individual components within the platform).

Upgrade costs for the BYO approach include staff compensation and costs for the UAT testbed used during the upgrades at the end of each of the first two years post-deployment. For the Enterprise Hybrid Cloud platform, we include the costs of the Enterprise Hybrid Cloud Upgrade Service for two upgrades. We also estimated elapsed time for the project planning, design, and implementation phase and the annual upgrades based on the amount of effort required; elapsed time for support is the three years post-deployment.

Figure 14 shows the BYO approach cost summary.

Build-your-own summary	Cost
Project planning, design, and implementation	
Enterprise staff time and training	\$827,963
Pilot/UAT testbed (prorated cost during 72.6 weeks of project design through transition to operations team)	\$266,732
Design and implementation total	\$1,094,695
Level 2 and Level 3 support over 3 years	
Enterprise staff time and training	\$291,789
Pilot/UAT testbed (3-year cost)	\$573,082
3-year support total	\$864,871
Two annual upgrades	
Enterprise staff time	\$557,464
Pilot/UAT testbed (prorated cost during the two 15.1 week upgrades)	\$110,955
Upgrade cost total	\$668,419
Total	\$2,627,985

Figure 14: Summary of BYO approach costs.

Figure 15 shows the Enterprise Hybrid Cloud cost summary.

Cost analysis summary	Cost
Project planning, design, and implementation	
Project planning, design, and implementation costs (customer staff)	\$51,729
Enterprise Hybrid Cloud Design and Implementation Service	\$428,844
Project planning, design, and implementation total	\$482,222
Level 2 and Level 3 support over three years	
3-year Level 2 and Level 3 support cost	\$0
Two annual upgrades	
Enterprise Hybrid Cloud Upgrade Service (end of years 1 and 2)	\$390,000
Total	\$870,573

Figure 15: Summary of Enterprise Hybrid Cloud platform costs.

Cost categories

Testbeds for the build-your-own platform only

The BYO enterprise would require smaller versions of the production platform to use as testbeds for proof of concept testing, the pilot test, debugging support issues post-deployment, and testing annual upgrades. According to Dell EMC, the three-year cost of the smallest such test environment would be \$573,082 after a standard discount.

We included the full cost of one of these testbeds for the Level 2 and Level 3 support because support staff might need the testbed at any time during our three-year analysis. For the design and deployment and upgrade phases, we included only a percentage of the cost for a testbed based on the lapsed time of the phases. For the rest of the time, those testbeds would be available for other enterprise uses.

Service costs for the Enterprise Hybrid Cloud only

We included the \$428,844 list price and showed the value of the Enterprise Hybrid Cloud Design and Implementation Service, which provides support throughout the planning, design, and implementation process and is complemented by 30 days of operational guidance (post-installation), which is optional but included in this price.

We also included the \$195,000 list price of each of two instances of the Enterprise Hybrid Cloud Upgrade Service, and showed the value of this service that supports annual platform upgrades.

The Enterprise Hybrid Cloud also includes a single source of support for the Level 2 and Level 3 support incidents that we included in this cost analysis. We showed the value of that support.

Enterprise staff costs for both platforms

Enterprise Hybrid Cloud deployment requires some enterprise staff involvement to help define platform requirements and support the Enterprise Hybrid Cloud deployment team. Dell EMC provided an estimate of these enterprise staff requirements for each week of the six-week deployment process for the Enterprise Hybrid Cloud. We call this the cloud technical team. The team would include an executive sponsor, project manager, core specialists, and OS, application, and database leads. We added a system architect during the project-planning phase and a systems administrator to accompany the Dell EMC team when it is on site during the design and implementation phase. We calculated the staff cost based on our estimate of their total compensation (salary plus benefits).

We assumed that the BYO approach would require work by that same cloud technical team, spending more time on iterative tasks and working more weeks during the deployment.

In addition, enterprise staff for the BYO approach would have to perform in-house the work that Dell EMC does as part of the release cycle for the Enterprise Hybrid Cloud platform, including the development work of creating foundational blueprints. They also would have to conduct POC and pilot tests, which the Enterprise Hybrid Cloud platform does not require. We assume that a small deployment team of compute, network, security, and storage systems architects would do the work. This is equivalent to a maximum of two FTE system architects at any time, a systems administrator II, and during blueprint development stage, four FTE developers.

We included five weeks of training for two systems architects at the beginning of the phase and include its costs in with staff costs. We estimated the enterprise staff time for each phase and assign costs based on estimated salary plus benefits for the staff members. Figure 16 presents the total annual compensation that we used in our calculations.⁴⁴

Change Advisory Board

Roles in building and buying a hybrid cloud	Total annual compensation (salary + benefits)
Executive sponsor (Chief Information Technology Officer)	\$393,258
Project manager (Computer Operations Manager)	\$160,029
Core specialists (Systems Administrator III)	\$132,183
OS/Application/DB leads (Systems Administrator III)	\$132,183
Systems Architect (Systems Architect)	\$171,511
Systems Administrator II (Systems Administrator II)	\$105,858
Software Developer (Software Developer III)	\$141,288

Figure 16: Total compensation for the enterprise staff participating in the cloud deployment.

44 <http://www.salary.com/>

We include estimates of Change Advisory Board (CAB) costs for both platforms. The CAB would need to meet multiple times during both approaches to deploying a hybrid cloud. Fewer CAB meetings and less CAB oversight would be necessary to discuss Enterprise Hybrid Cloud because it is bundled and backed by a single source of support.

We estimated the number of one-hour CAB meetings required to gain necessary approvals for each platform. We assumed a 12-member CAB board would attend the meeting, 12 members of a review team would each spend one hour reviewing and commenting on topics up for review prior to the meeting, a change manager would spend one hour running the meeting, and a core administrator would spend four hours preparing a presentation for the meeting. We estimated the cost of each CAB meeting at \$2,444.39, based on the compensation of these staff members.

Project planning, design, and implementation phase costs for Enterprise Hybrid Cloud

Dell EMC provided us with estimates for the elapsed time for the planning, design, and implementation phase. With Enterprise Hybrid Cloud, the project planning, design, and implementation phase takes six weeks, of which the first two days are used for project planning with the customer to size and create an order for the platform. After the Dell EMC factory-installed platform arrives in the datacenter, a 28-day design and implementation period follows, which results in a scalable production hybrid cloud. This phase is followed by a six-week post-installation operational guidance period.

Time to value

The platform's time to value is 28 days for a basic infrastructure-as-a-service, the length of the design and implementation period.

CAB approvals

We included CAB staff costs for a one-hour CAB meeting to deliver needed CAB approvals during this phase.

Customer staff costs

Dell EMC staff carries out most of the work in the much shorter Enterprise Hybrid Cloud Design and Implementation phase as part of the Enterprise Hybrid Cloud Design and Implementation service; customer staff commitment is lighter than for the BYO platform. The Enterprise Hybrid Cloud platform includes foundational workflows, saving the customer the effort of developing those.

Dell EMC provided the time estimates for the cloud technical team for each of the six weeks of the project planning and the design and implementation stages, which we averaged. We added time for a systems administrator to stay with the Dell EMC team in the customer datacenter during those weeks. We did not include customer staff effort for the operational guidance phase, during which Dell EMC provides on-demand support. Figure 17 shows our estimates.

	Roles	Project planning, design, and implementation	Operational guidance
Lapsed time (weeks)		6	6
Hours per week per stage for enterprise staff			
Cloud technical team	Executive sponsor	2.3	0
	Project manager	31.7	0
	Core specialists	40	0
	OS/Application/DB leads	12	0
Deployment team	Systems Architect	0	0
	Systems Administrator II	40	0
	Software Developer	0	0
CAB approvals per stage	CAB approval (1-hour meetings)	1	0
Cost			
Cloud technical team	Executive sponsor	\$2,609	\$0
	Project manager	\$14,634	\$0
	Core specialists	\$15,252	\$0
	OS/Application/DB leads	\$4,576	\$0
Deployment team	Systems Architect	\$0	\$0
	Systems Administrator II	\$12,214	\$0
	Software Developer	\$0	\$0
CAB approvals per stage	CAB approval (1-hour meetings)	\$2,444	\$0
Total		\$51,729	\$0
Grand total			\$51,729

Figure 17: Customer staff costs for the Enterprise Hybrid Cloud platform project planning, design, and implementation phase.

Total Enterprise Hybrid Cloud platform project planning, design, and implementation phase costs

We estimated costs for this phase, including the staff costs plus the costs of the Dell EMC Design and Implementation service (see Figure 18).

Project planning, design, and implementation phase	Cost
Customer staff costs	\$51,729
Enterprise Hybrid Cloud Design and Implementation Service	\$428,844
Total	\$482,222

Figure 18: Total estimated costs for the Enterprise Hybrid Cloud project planning, design, and implementation phase.

Project planning, design, and implementation phase costs for the BYO

Elapsed time

Appendix C gives details of our 78.6-week elapsed time estimate and our 71.6-week time-to-value estimate. Time-to-value starts after project planning and ends prior to the transition to the operations team.

CAB approvals

We included costs for seven CAB approvals throughout this phase. Each approval requires a one-hour CAB meeting.

Training costs

We assumed the in-house systems architects have minimal experience deploying private clouds. To familiarize them with the technologies and concepts, we included five weeks of training estimated at \$15,000 each for two systems architects at the start of the design and implementation process. Training includes one week each on vRealize Operations, Orchestration, and Business; Dell EMC ViPR Controller; and VMware NSX.

Enterprise staff costs

Cloud management team

We included time estimates for the same cloud management team that would support the Enterprise Hybrid Cloud deployment. We assumed they would need to commit more time during the more iterative process of the BYO deployment. We estimated the project manager would work 10 to 20 hours a week and the project sponsor 1 to 2 hours a week. For the core specialists and OS/application/DB leads, we estimated that they would spend roughly three times their total time for the Enterprise Hybrid Cloud deployment during the BYO POC, plan and create foundation core for scalable pilot, and QA and conduct pilot stages of BYO and additional time supporting the development team during the other stages.

Development team

We estimated time for one FTE systems architect and one system administrator to create the POC pilot. We added a second FTE systems architect to work on the scalable pilot. Four FTE developers would assist with the blueprints. For their effort, we estimated that the platform requires 21 data protection, storage services, and Dell EMC workflows that require on average 2.3 FTE weeks of developer time each. Remaining stages require fewer hours of developer time.

Figure 19 shows the staff time commitments we estimated for the BYO deployment and the costs of that time. We included the CAB costs and staff training costs.

	Roles	Project planning	Training	Build POC	Plan and create foundation core for scalable pilot	Create foundational service blueprints and workflows	Do QA & conduct pilot	Scale and onboard to roll out production size	Transition to operations team
Lapsed time (weeks)		1	5	17	18	11.6	12	8	6
Hours per week per stage for enterprise staff									
Cloud management team	Executive sponsor	1	0	0	1	1	1	1	1
	Project manager	20	0	20	20	10	10	10	10
	Core specialists	0	0	15	10	5	15	15	0
	OS/Application/DB leads	0	0	0	3	0	5	5	0
Deployment team	Systems Architect(s)	80	80	40	80	10	80	80	80
	Systems Administrator II(s)	0	0	40	40	5	0	0	0
	Software Developer III(s)	0	0	0	0	160	10	10	40
CAB approvals per stage	CAB approval (1-hour meeting)	0	0	1	2	2	2	0	
Cost									
Cloud management team	Executive sponsor	\$189	\$0	\$0	\$3,403	\$2,193	\$2,269	\$1,513	\$1,134
	Project manager	\$1,539	\$0	\$26,160	\$27,698	\$8,925	\$9,233	\$6,155	\$4,616
	Core specialists	\$0	\$0	\$16,205	\$11,439	\$3,686	\$11,439	\$7,626	\$0
	OS/Application/DB leads	\$0	\$0	\$0	\$3,432	\$0	\$3,813	\$2,542	\$0
Deployment team	Systems Architect(s)	\$6,597	\$32,984	\$56,073	\$118,742	\$9,565	\$79,162	\$52,774	\$39,581
	Systems Administrator II(s)	\$0	\$0	\$34,605	\$36,641	\$2,952	\$0	\$0	\$0
	Software Developer III (s)	\$0	\$0	\$0	\$0	\$126,078	\$8,152	\$5,434	\$16,303
CAB approvals per stage	CAB approval (1-hour meeting)	\$0	\$0	\$2,444	\$4,889	\$4,889	\$4,889	\$0	\$0
Training fees	Training at \$15,000 each for 2 staff over 5 weeks.	\$0		\$0	\$0	\$0	\$0	\$0	\$0
Staff cost subtotals		\$8,325	\$62,984	\$135,487	\$206,244	\$158,288	\$118,957	\$76,044	\$61,634

Figure 19: Total staff costs, including CAB and training, for the BYO approach project planning, design, and implementation phase.

Testbed

The BYO approach also requires a testbed for the development team to use for the POC and pilot tests. We included a portion of the three-year cost for that testbed based on the length of the phases from build POC to transition to operations team.

Total Enterprise Hybrid Cloud platform project planning, design, and implementation phase costs

Figure 20 shows the total project planning, design, and implementation phase costs for the BYO approach.

Build your own summary	Cost
Planning, design, and implementation (staff, CAB, and training costs)	\$827,963
Pilot/UAT testbed (prorated cost during 72.6 weeks of project design through transition to operations team stages)	\$266,732
Planning, design, and implementation total	\$1,094,695

Figure 20: Total estimated costs for the BYO approach project planning, design, and implementation phase.

The BYO planning, design, and implementation estimate of \$1,094,695 is \$614,122 more (or 56.1 percent more) than the cost of \$480,573 we estimate for the Enterprise Hybrid Cloud platform.

Enterprise Hybrid Cloud post-implementation Level 2 and Level 3 support phase costs for BYO

Both the Enterprise Hybrid Cloud and BYO platforms assume the purchase of support for the individual components within the platform. We exclude these costs from our comparison.

Our cost comparison includes only Level 2 and Level 3 support costs.

We assumed that there are no additional Level 2 or Level 3 support costs for the Enterprise Hybrid Cloud platform. This support is provided through Dell EMC single support contact as part of the Enterprise Hybrid Cloud platform. The enterprise incurs no additional support charges for the Enterprise Hybrid Cloud platform beyond the support purchased for the individual components.

We estimated costs for the support phase based on the following assumptions:

- Level 2 support incidents average one incident a week over three years and require 1.5 hours of Level 2 support on average. Systems administrator II-level staff provide the Level 2 support. These support incidents would be covered under Enterprise Hybrid Cloud support services.
- Level 3 support is needed for 48 of those incidents over three years. Level 3 incidents add two hours per incident for the Level 2 Support Administrator to document the incident and transition it to Level 3 support, and an average of 2.5 days is needed by a three-member Level 3 support team made up of systems architects.
- We assume none of the incidents involves the CAB.

Total time for the Level 2 systems administrators is 5.1 40-hour weeks over three years. Total time for each of the members of the Level 3 team is 24 40-hour weeks over three years.

Training costs

We included five weeks of training estimated at \$15,000 for two systems architects prior to deployment. This training does not add to the elapsed time for the deployment. Training includes one week each on vRealize Operations, Orchestration, and Business; Dell EMC ViPR Controller; and VMware NSX. We included another week of refresher training to coincide with each of the annual upgrades.

Testbed

The BYO approach also requires a testbed for the support team to use for testing updates. We included the three-year cost for that testbed.

Three-year support staff costs	Training	Level 2 support	Level 3 support
Number FTE weeks	7	5.1	24
Cost			
Systems Architect(s)	\$46,178	\$0	\$79,162
Systems Administrator II(s)		\$10,382	\$48,854
Software Developer		\$0	\$65,213
Training for two Systems Architects at \$3,000 a week each for 7 weeks	\$42,000	\$0	\$0
Staff cost subtotals	\$88,178	\$10,382	\$193,229

Figure 21: Total staff costs for Level 2 and Level 3 support in the BYO approach.

Level 2 and Level 3 support over three years	
Enterprise staff time and training	\$291,789
Pilot/UAT testbed (3-year cost)	\$573,082
3-year support total	\$864,871

Figure 22: Total estimated costs for Level 2 and Level 3 support in the BYO approach.

Figure 21 presents our estimate of the enterprise staff costs, including training, and Figure 22 gives our estimate of the total costs of Level 2 and Level 3 support over three years for the BYO approach.

Annual upgrades

	Build-your-own approach	Enterprise Hybrid Cloud platform	Savings (time)	Savings (percentage)
Upgrade time	15.1 weeks 3.5 months	4 weeks	11.1 weeks 2.56 months	73.5%

Figure 23: Estimated time costs for Level 2 and Level 3 support in the BYO approach.

We included time costs for two annual upgrades of the entire platform to the latest firmware and software versions. Figure 23 shows the total time cost of these annual upgrades.

Enterprise Hybrid Cloud

Dell EMC provided us with the list price of the Enterprise Hybrid Cloud Upgrade Service. Use of that service at the end of years 1 and 2 post-deployment would cost \$390,000. The Dell EMC upgrade team would complete each upgrade in 4 weeks. We assumed Dell EMC or partners provide all the work of the upgrade. Additional customer costs would be minimal.

Build-your-own approach

We assumed the upgrade staff team would include two systems architects, two systems analysts, and two and a half developers. We estimate that it would take three and a half months to plan and execute each upgrade. Planning and other tasks would require time from the same cloud management team that was involved in the deployment. Each upgrade would also require CAB approval.

We estimated the following staff time and costs for each of the two upgrades. Figure 24 shows our estimates for each of the upgrades to the BYO approach.

	Roles	Annual Upgrade
Lapsed time (weeks)		15.1
Hours per week for enterprise staff		
Cloud management team (hours per week)	Executive sponsor	1
	Project manager	20
	Core specialists	15
	OS/Application/DB leads	3
Deployment team (hours per week)	Systems Architect(s)	80
	Systems Administrator II(s)	40
	Software Developer III(s)	100
CAB approvals	CAB approval (one-hour meeting)	1
Cost		
Cloud management team	Executive sponsor	\$2,855
	Project manager	\$23,236
	Core specialists	\$14,394
	OS/Application/DB leads	\$2,879
Deployment team	Systems Architect(s)	\$99,612
	Systems Administrator II(s)	\$30,738
	Software Developer	\$102,574
CAB approvals		
Staff cost subtotals		\$278,732

Figure 24: Estimated staff time and costs, including CAB approval, for each of two upgrades in the BYO approach.

Testbed

The BYO approach also requires a testbed for the development team to use to test upgrades. We included a 15.1-week portion of the three-year cost for that testbed for each update. Figure 25 estimates the costs of two annual upgrades for the BYO approach.

Two annual upgrades	
Enterprise staff time	\$557,464
Pilot/UAT testbed (prorated cost)	\$110,955
Upgrade total	\$668,419

Figure 25: Total estimated costs for upgrades in the BYO approach.

Enterprise Hybrid Cloud costs \$390,000, while our estimates place the cost of a build-your-own cloud at \$668,419. The Enterprise Hybrid Cloud provides a 41.7% cost savings, or a total of \$278,419.

Appendix F – Success criteria

Figure 26 presents our criteria for a successful deployment and implementation and our corresponding findings. A blue check means the platform met the criterion and a red X means the platform did not. Figure 27 totals the success criteria met. In both figures, the Build column represents the build-your-own approach, and the Buy column represents Enterprise Hybrid Cloud.

Sub-category	Objectives to achieve	Build	Buy
General cloud infrastructure design			
Cloud infrastructure design	Leverage Active Directory to demonstrate authentication and authorization	✓	✓
	Delegate groups of business administrators and users	✓	✓
	Allocate resources (compute, memory, storage) between logical business groups	✓	✓
	Create secure delegated infrastructure administration	✓	✓
	Create a fully secured SSL-certified environment trusted by the enterprise	✓	✓
Total (of 5)		5	5
Percent of criteria met		100%	100%
End user-initiated functions			
General server provisioning			
Provision the Windows server from self-service catalog	Assign the number of CPUs	✓	✓
	Assign RAM	✓	✓
	Assign a backup policy	✓	✓
	Assign storage tier	✓	✓
	Select deployment across multiple tiers of storage	✓	✓
	Provision with and without an approval policy	✓	✓
	Receive notification of successful provisioning	X	✓
	Log into the new Windows Server from the self-service portal	✓	✓

Sub-category	Objectives to achieve	Build	Buy	
Provision the Linux server from self-service catalog	Assign the number of CPUs	✓	✓	
	Assign RAM	✓	✓	
	Assign a backup policy	✓	✓	
	Assign storage tier	✓	✓	
	Select deployment across multiple tiers of storage	✓	✓	
	Provision with and without an approval policy	✓	✓	
	Receive notification of successful provisioning	X	✓	
	Log into the new Windows Server from the self-service portal	✓	✓	
Provision the multi-tier Linux application	Include web, application, and database tiers	X	✓	
	Add multi-tier support for each application layer	X	✓	
	Isolate the application and database tier from the network	X	✓	
	Assign backup policies independently for each tier	X	✓	
Total (of 19)		13	19	
Percent of criteria met		69%	100%	
VM lifecycle management				
Back up and protect a Windows VM	Back up	Initiate from the self-service portal and perform an on-demand backup	✓	✓
		Receive an email of job success and details	X	✓
		Generate a report of the VM's backup history	X	✓
	Restore	Initiate from the self-service portal and perform an on-demand VM restore	✓	✓
		Receive an email of job success and details	X	✓
		Restart a VM from Restore and validate success	✓	✓
	Decommission a VM and view it in the final archive		✓	✓

Sub-category	Objectives to achieve	Build	Buy	
Back up and protect a Linux VM	Back up	Initiate from the self-service portal and perform an on-demand backup	✓	✓
		Receive an email of job success and details	X	✓
		Generate a report of the VM's backup history	X	✓
	Restore	Initiate from the self-service portal and perform an on-demand VM restore	✓	✓
		Receive an email of job success and details	X	✓
		Restart a VM from Restore and validate success	✓	✓
	Decommission a VM and view it in the final archive		✓	✓
Total (of 14)		8	14	
Percent of criteria met		58%	100%	
Administrator-initiated functions				
Back up and protect a Windows VM	Demonstrate an approval policy in action on the deployment of a virtual server		✓	✓
	Generate an administrative action via user request		✓	✓
	Create a new backup policy with a backup schedule, retention, and final archive duration from the self-service portal		X	✓
	New backup policy availability	Perform an on-demand backup with the new policy	X	✓
		Validate backup success via user-generated report	X	✓
		Perform an on-demand backup with the new policy	X	✓
		Validate backup success via user-generated report	X	✓
Administrative reporting	Document the existing backup policies currently available to cloud users	✓	✓	
Backup policy management	Remove an existing backup policy from the list of available policies	X	✓	
Storage management (cloud administrator)	Storage capacity	View consumption	✓	✓
		Use multiple storage tiers associated with storage reservation policies	✓	✓
		Distribute storage tier capacity across multiple logical tenants	✓	✓

Sub-category	Objectives to achieve	Build	Buy	
Financial transparency	Show the running cost for the cloud infrastructure and operations	✓	✓	
	Show the distribution of the infrastructure costs by logical cloud tenant	✓	✓	
Monitoring and reporting	VMware-based capacity and alerting	Send alert on compute resources	✓	✓
		Send alert on storage resources	✓	✓
		Send report on risk and anomalies	✓	✓
	Storage reporting and alerting	Enable and send alert on capacity and performance	✓	✓
		Send report on physical LUNs and disk-level performance and capacity	✓	✓
		Send report on physical storage array health, performance, and capacity	✓	✓
		Send report on virtual pool storage tier aggregation reporting	✓	✓
		Show detailed log of all storage actions and events	✓	✓
	Total (of 22)		16	22
	Percent of criteria met		73%	100%

Figure 26: Detailed breakdown of success criteria met by each platform.

Success criteria–Total	Build	Buy
Total (of 60)	42	60
Percent of criteria met	70%	100%

Figure 27: Overall total of success criteria met by each platform.

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