Where should you run your applications?

A research-based comparison of public cloud, private on-premises cloud, and hybrid cloud

Spending on public cloud is exploding in 2021. The reasons for this growth range from the pandemic-fueled trend toward working from home to the growing use of technologies that take particular advantage of the cloud to the numerous advantages the cloud can offer. Alongside this great adoption of cloud, however, is another trend: Many companies who have moved their applications to the public cloud are reconsidering. As their cloud service provider (CSP) bills balloon, they are concluding that the cloud math no longer works in their favor and are undergoing the expensive process of moving their workloads back to the on-premises data center.

In this paper, we take a look at the current the state of cloud solutions and draw on research to explore some of the advantages and disadvantages of three places to run applications: public cloud, on-premises private cloud, and hybrid cloud. We also review solutions that Dell Technologies offers to companies choosing each of these approaches.

Snapshot of the cloud in 2021

Cloud usage is growing at an accelerating rate. Gartner, Inc. forecasts that end-user spending on public cloud will increase from $270B worldwide in 2020 to $332B in 2021.[1] One thing fueling this rapid growth has been the COVID-19 pandemic. Great numbers of employees working from home shifted collaboration and virtual desktops to the cloud to "enable a distributed and secure workforce."[2] The pandemic "allowed CIOs to overcome any reluctance of moving mission critical workloads from on-premises to the cloud."[3] At the same time, "employers quickly learned that their staff could be productive even when they weren't sitting in the same building. Now it seems it will be difficult to put the genie back in the bottle."[4] As communities reopen, many companies are adopting hybrid work models as the new normal.

The past several years have seen the increasing adoption of technologies—including virtualization, containerization, and edge computing—that are especially well-suited to cloud.[5] Also shifting rapidly to the cloud are "disaster recovery and scale-out applications that benefit from the elasticity of cloud."[6]

With cloud infrastructure and platform services (CIPS) innovating at a rapid pace, companies are turning to the cloud for both new digital services and traditional applications.[7] Gartner predicts that enterprise workloads deployed in CIPS will double from 20 percent in 2020 to 40 percent in 2023.[8] BCG estimates that, by 2025, "up to 60% of consumer-facing applications, almost 40% of data warehouse and analytics workloads, and more than 30% of core business applications will be running on public clouds operated by the likes of Amazon, Microsoft, and Google."[9]

Coinciding with the enthusiasm for cloud is a growing understanding that the cloud has limitations and that on-premises data centers are not going away. While Forrester estimated that 20 percent more firms would move disaster recovery operations to the public cloud in 2021, they also noted "[It] doesn't mean that some managed DR services or active-active data center models will be wholly obsolete, as there may be applications and infrastructure that run on proprietary stacks that can't recover in the public cloud."[10]

Finance is one of the industries taking a cautious approach to cloud. As BCG notes, "For industry-unique reasons—including mainframe technology, regulatory frameworks, and organizational digital maturity—financial institutions have been slower than businesses in other industries to move their core infrastructure workloads to CSPs."[11]

Large companies surveyed by McKinsey "host 10 to 15 percent of their applications in the cloud but continue to host the core of their technology environment in traditional data centers."[12]

Another reason companies might resist the lure of the cloud is the expense of developing new cloud-native apps. A Bain survey found that only a third of companies planning to refactor or rebuild workloads in the public cloud, noting that "[m]ost prefer the cleaner approach of developing new apps in the cloud. But this takes time and money, and, at the moment, most IT departments are cutting budgets."[13]

Some companies adopt cloud enthusiastically, only to find that as they scale, the enormous OpEx outlay that cloud requires can reduce profit margins to a degree that outweighs the flexibility benefits. These companies then must "repatriate" workloads by transitioning them from the cloud back to the on-premises data center, which can be very costly.[14]

Interest in hybrid cloud is on the rise, especially among companies in regulated industries. Gartner is fielding increasing client requests to discuss hybrid[15] and a Quince Market Insights report entitled "Global Hybrid Cloud Market is Anticipated to Grow at a CAGR of 17.8% from 2020 to 2028" states, "Owing to high flexibility, low price, increased scalability, and stable deployment options, the adoption of the hybrid cloud by businesses has become an essential part of the business process and is expected to increase further in the near future."[16]

Table 1 summarizes some of the potential strengths and weaknesses of each computing approach. We expand on these strengths and weaknesses (and cite sources for each) in the following pages.

Table 1: Potential benefits and downsides of different approaches to cloud.

	Potential benefits	Potential downsides
Public cloud	• Flexibility to scale easily to accommodate fluctuating demand and pay for only what you use • Ability to experiment with new technologies as they become available with little risk • Minimal CapEx • Increased reliability and protection from weather- and utility-related outages due to having resources distributed across multiple geographic regions	• Greater OpEx • Lack of data control • Complexity and cost of transforming workloads to make optimal use of public cloud offerings • Large, unexpected expenses • High cost of repatriating data • Single vendor lock-in • Regulatory compliance concerns for some multinational organizations
On-premises private cloud	• Cost-effectiveness • Data control, which is especially important to organizations in finance and other highly regulated industries • Complete control over hardware, software, and data • Avoiding the complex and costly process of transforming workloads to make optimal use of public cloud offerings • Accounting flexibility due to a mix of CapEx and OpEx • Regulatory compliance advantages for some multinational organizations	• Must purchase gear to accommodate anticipated needs, which can lead to overprovisioning • Requires CapEx as well as OpEx for maintenance, licensing, power and cooling, etc. • For organizations located in a single geographic region, there is potential vulnerability to outages due to weather and utility events
Hybrid cloud	• Can offer a best-of-both-worlds solution where companies keep certain workloads on premises and take advantage of public cloud for other workloads • Can provide a cost-effective way of meeting temporary processing capacity needs by shifting workloads to public cloud for short periods	• Can be complex to implement and maintain • Maintaining visibility over the many components of a hybrid solution can be challenging

Public cloud approach

Introduction

Public cloud offers many attractions, including flexibility, the shift from capital expenditures (CapEx) to operating expenditures (OpEx), and the protection that geographical distribution offers from regional outages due to weather and other utility events. These advantages come with a price, however, and companies employing public cloud can find themselves paying dearly in the costs of optimizing workloads for cloud and repatriating data down the line—not to mention increased, potentially enormous OpEx. They can also find themselves vulnerable to security issues and single vendor lock-in and pay a latency penalty.

Potential benefits

Perhaps the greatest appeal of public cloud lies in the flexibility it offers. For young companies or those planning to make changes in their business, it can be difficult to anticipate computing need. By running workloads on servers maintained by CSPs, they can scale easily to accommodate fluctuating demand and pay for only what they use. Companies can also choose gear and tools with granularity. As one Element Critical blog writer put it, "When renting space and assets from a cloud services provider, the options to customize the services/ subscription are nearly infinite. It is not just server space that is being rented but virtual machines, storage accounts, advanced analytics tools, and much more. This customization allows a company to pick and choose just the services that fit their business needs. Companies that would have struggled to amass computing infrastructure can now grow quickly."[17]

Public cloud also allows experimentation with new technologies as they become available with minimal risk. In a New Economy interview, David Curbishley of IBM states: "… you can get access to new technologies that you wouldn't have on premise. AI, machine learning, deep analytics. And you can use those to embed new capabilities into applications, and use those applications in new ways and innovative front ends to applications."[18]

When businesses can avoid making large upfront capital expenditures for hardware, they enjoy greater cash flow on a day-to-day basis and gain the flexibility to invest in new services or products as they become necessary. Of course, reducing CapEx only to increase operating expenditures dramatically is not necessarily a net win. As one VMware CloudHealth blog[19] discusses, advantages that help offset the high OpEx of public cloud include avoiding the following:

- The cost of internal resources—human and otherwise—dedicated to running, maintaining, and repairing the infrastructure
- Unexpected costs for infrastructure maintenance and repairs
- Concerns that technology investments will become redundant or obsolete before the end of their lifetime

Yet another advantage of public cloud stems from the fact that CSPs typically distribute their physical resources across multiple geographic regions. The New York Times states, "…as climate change accelerates, many electric grids will face extreme weather events that go far beyond the historical conditions those systems were designed for, putting them at risk of catastrophic failure."[20] By running their workloads in the cloud, companies can increase reliability and protection from outages due to weather and utility events. A Summit Hosting blog puts it this way: "Power outages accompanying severe weather can mean significant financial hits to businesses. Research has found that weather events cause more than 40 percent of all U.S. power outages, with costs up to $70 billion annually. When power outages result in a lack of access to critical data — and the resulting business downtime — the negative financial impact can mount quickly."[21]

The anonymous, geographical distribution of hardware resources also provides benefits in terms of data security. A Lucidchart blog discusses the advantage of anonymity: "[Because cloud providers] host many organizations, and embrace many different points of entry, they're not tied to the physical location or servers of any single organization. These numerous points of entry actually make it more difficult for data and systems to be compromised and increase public cloud security. Cloud providers also invest heavily in security protection to alleviate fears—top cloud vendors offer protection measures including armed guards, fences, facial recognition and other biometric security devices, and surveillance cameras to prevent any cloud storage security issues."[22]

According to a May 2021 article from Security Week, one factor driving the plans of many enterprise executives to migrate applications to the cloud is their perception that data is more secure in a cloud environment than in an on-premises data center. "While it's difficult to prove definitively, cloud companies usually have more robust cybersecurity measures in place to protect sensitive data. It's a cloud provider's sole responsibility to ensure its clients' data integrity and that its systems have the most up-to-date security. To that end, cloud security providers must also ensure that data is kept compliant and up to code, something that helps mitigate risk too."[23]

Potential downsides

Some of the greatest downsides to the public cloud are financial, in terms of both accounting flexibility and total costs. While replacing CapEx with OpEx offers certain business benefits, it also has disadvantages, as the author of a CloudHealth blog points out:

- "Businesses paying OpEx don't have many options to make their income statements look different within a given year because expenses are deducted as they incur."[24]
- "It can be difficult for a business to show future value to a potential investor because they are paying as they go."[25]

Transforming workloads to make optimal use of public cloud offerings can be complex and costly. The McKinsey article "How CIOs and CTOs can accelerate digital transformations through cloud platforms" put it this way: "[The] thousands of applications a large enterprise might have built over the past three decades need remediation or re-architecting to run efficiently, securely, and resiliently in the cloud. In some cases, companies have found existing applications cost more to run in the cloud before remediation. Required investments often result in an unexciting ROI for cloud migration, at least for companies that have already aggressively optimized their on-premises infrastructure environment."[26]

Even once the costs of transitioning to the cloud are behind them, a company's monthly CSP bill continues to increase along with usage; ultimately, public cloud can become extremely expensive. As Wang and Casado outline in the Andreesen Horowitz paper "The Cost of Cloud, a Trillion Dollar Paradox,"[27] paying a "flexibility tax" for the public cloud often makes good business sense early in a company's journey when the growth curve is relatively steep. However, as the company scales and growth tapers off, the enormous OpEx outlay that cloud requires can reduce profit margins to a degree that can outweigh the flexibility benefits. Businesses may reach a point where the most economically viable path is repatriating workloads by transitioning them from the cloud back to the on-premises data center, which can be very costly.

Wang and Casado express it this way: "[While] cloud clearly delivers on its promise early on in a company's journey, the pressure it puts on margins can start to outweigh the benefits, as a company scales and growth slows. Because this shift happens later in a company's life, it is difficult to reverse as it's a result of years of development focused on new features, and not infrastructure optimization. Hence a rewrite or the significant restructuring needed to dramatically improve efficiency can take years, and is often considered a non-starter."[28]

In the 2020 article "4 reasons cloud data repatriation is happening," Paul Kirvan stated, "Many organizations are doing the math and discovering that the ROI for cloud isn't as good as with on-premises storage, particularly, if they aren't moving everything to the cloud and can't just turn off what's left behind in the data center."[29] Moving workloads back to the on-premises data center can also be disruptive. Data from ESG revealed that 43% of organizations that made this shift experienced downtime and related costs.[30]

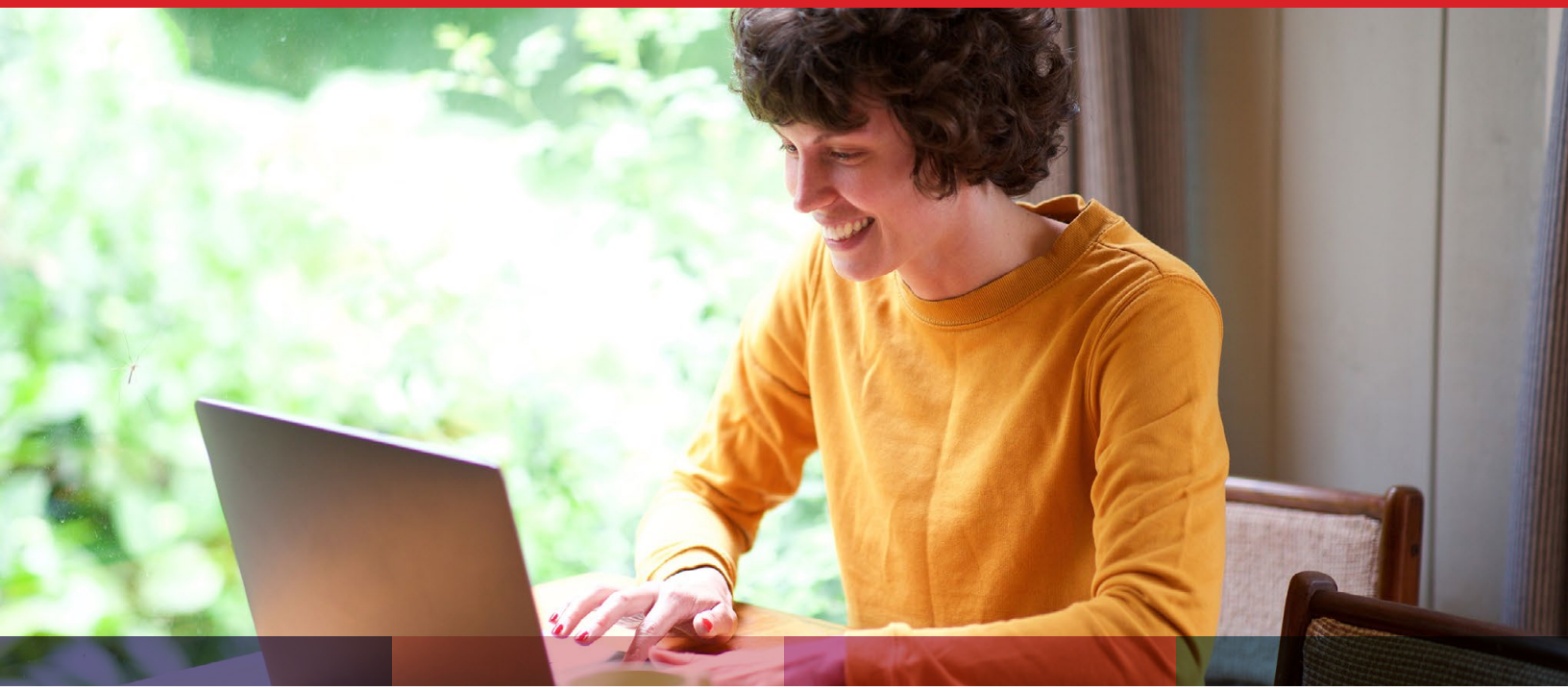
In addition to steadily rising OpEx, which is at least somewhat predictable, companies that run their workloads in the public cloud also risk incurring large, unexpected expenses. According to Element Critical, in 2020, "Adobe accidentally incurred a daily charge of $80,000 for a single computing job while Capital One saw a 73% spike in the price it paid its AWS cloud platform. Smaller businesses that might overspend could have tragic consequences with unexpected cloud costs that could hamper corporate growth or delay much-needed improvements, despite the agility the cloud provides."[31]

While some perceive the public cloud as more secure, others have concerns that make them reluctant to embrace such solutions. A Carnegie Endowment for International Peace report outlines the flip side of the security advantages of the public cloud: "One key area for regulation is the delineation of the burden sharing, and codification of the 'shared responsibility' for security and robustness between CSPs and their clients, and in some cases also the operators of supporting telecommunications networks. These models define the respective responsibilities of each party for securing data and underlying infrastructure, and are already emerging as a highly confused and contested space; there is significant concern that the asymmetric market power of CSPs over their customers could well produce unfavorable overall outcomes."[32]

Another risk of partnering with a CSP is vendor lock-in. As a Cloudflare article states, "[It] is very difficult to move databases once they're set up, especially in a cloud migration, which involves moving data to a totally different type of environment and may involve reformatting the data. Also, once a third party's software is incorporated into a business's processes, the business may become dependent upon that software."[33]

Some workloads that require ultra-low latency—such as credit card authorization for financial institutions—may incur a detrimental increase in latency, or a "latency tax" when running in the public cloud. The BCG article "Financial Institutions Need to Pursue Their Own Path to the Cloud" points out the limitations of cloud for such workloads: "The geographic distance between the data centers of a financial institution and a CSP affects latency and performance… Shifting systems from data centers to public cloud environments may introduce extra latency to end-to-end processes and transactions, especially when engagement systems are decoupled from record systems."[34]

For some multinational organizations, public cloud also poses a problem in terms of regulatory compliance. The Carnegie Endowment report touches on some of the inherent conflicts: "In some jurisdictions, privacy rights constitute the tantamount concern; for others, systemic risk to the economy or specific sectors thereof is of utmost importance. And for still others, access by certain governmental authorities (but not others) to the data stored on the cloud, and the capacity to both track and censor it, as well as the discretion of CSPs to do these things on their own, are the most critical issues."[35]



On-premises private cloud approach

Introduction

Running applications in on-premises data centers offers companies a host of very real benefits. At the top of the list is cost-effectiveness and complete control over hardware, software, and data. Companies can build on their optimized workloads without having to transform them for cloud, enjoy the accounting flexibility that comes with having a mix of CapEx and OpEx, more easily meet requirements for extremely low latency, and maintain regulatory compliance. Several considerations mitigate these benefits. The organization must anticipate their compute and storage requirements, incur the costs of maintaining physical gear—including both personnel and space, power, and cooling—and possibly expose themselves to region-specific outages.

While keeping your applications on premises might seem like the traditional way of doing things, many companies are innovating to bring new efficiencies and ease to the private cloud. Among these is a new solution from Dell, APEX Private Cloud, which we discuss in a later section of this paper.

Potential benefits

Running applications in on-premises data centers can be extremely cost-effective, particularly for mature companies, and offers complete control over all aspects of hardware, software, and data. Dell EMC Titanium partner Future Tech sees on-premises solutions delivering a savings of at least 40 percent over public cloud solutions.[36] Future Tech CEO Bob Venero explains: "In the public cloud you pay for usage. There is a cost associated with every drink you take from the public cloud well versus having your own well where you can produce all the IT water you want for your business."[37]

The control that companies retain when they employ on-premises solutions is important. The Carnegie Endowment report we mentioned earlier paints a concerning picture of the risks organizations take when they choose to rely on public cloud: "Asymmetry in power between providers and clients could lead to price gouging, lower quality of services, and fewer choices—even large and powerful enterprises have complained that they are at the mercy of CSPs when it comes to service negotiations."[38]

As we noted earlier, once a business grows beyond a certain point, paying extra for the flexibility of the public cloud can become financially unviable and threaten profit margins. Wang and Casado explain the enormous potential savings from not using the cloud this way: "As the cost of cloud starts to contribute significantly to the total cost of revenue (COR) or cost of goods sold (COGS), some companies have taken the dramatic step of 'repatriating' the majority of workloads (as in the example of Dropbox) or in other cases adopting a hybrid approach (as with CrowdStrike and Zscaler). Those who have done this have reported significant cost savings: In 2017, Dropbox detailed in its S-1 a whopping $75M in cumulative savings over the two years prior to IPO due to their infrastructure optimization overhaul, the majority of which entailed repatriating workloads from public cloud."[39]

Some smaller companies using public cloud have also found that shifting their workloads to an in-house private cloud solution can slash costs. The TechTarget article "Cloud repatriation is a symptom of a wider cloud storage trend" quoted an interview with New Belgium Brewing IT operations manager Jake Jakel. When the brewery tried to upgrade its VMware deployment, Jakel said, "a managed service provider 'was holding us hostage'." He went on to say that shifting from the public cloud to an in-house private cloud built on Dell EMC VxRail hyper-converged appliances would save the brewery approximately $1 million over three years.[40]

As we noted in our discussion of the downsides of public cloud, shifting CapEx to OpEx is not a wholly positive move for a company: "CapEx is seen as an investment in improving the business that will return value in the future. This is usually a good sign for potential investors."[41] By investing their capital in on-premises data center gear, companies can retain appeal to investors and gain some flexibility by being able to choose in which year they account for depreciation. Keeping applications in on-premises data centers can also reduce latency.[42]

While the security advantages of private cloud are difficult to prove—one DNSstuff writer summarized the issue by saying "the cloud is no more or less secure than on-premises security because people on both sides can make mistakes and compromise security"[43]—compliance benefits are different story. As a TechTarget article notes, "National boundaries can come into play, with regulatory limitations on where companies store data and operate computing workloads. This complicates the move to purely public cloud for some multinational organizations."[44] For such organizations, the on-premises approach is a way to remain compliant.

Potential downsides

A company running workloads on premises must purchase gear based on estimates of their needs, which can lead to over- or under-provisioning. They also have to find space for the gear and handle the operational expenses associated with it, which include power and cooling as well as admin time for management and maintenance. In exchange for full control, they also sacrifice a certain amount of flexibility for the following reasons:

- An upfront capital investment can reduce the cash available for day-to-day operations or new investments.[45]
- They can lock themselves into a long-term commitment.[46]
- The internal purchase approval process can be lengthy.[47]

They also run the risk of their investments becoming redundant or obsolete before the end of their lifetime.[48]

For organizations located in a single geographic region, keeping data on premises can introduce vulnerability to outages due to weather and utility events.

Hybrid cloud approach

Introduction

A hybrid cloud approach can give companies the flexibility to keep certain workloads on premises, while utilizing public cloud for other workloads, and can also offer "bursting capacity," space into which spiking workloads can expand when on-premises resources become insufficient. In exchange for these advantages, IT staff can find the approach complicated to implement and maintain and can have trouble tracking and securing the many components of a hybrid solution.

Potential benefits

While public cloud usage can incur extremely high OpEx and a private, on-premises cloud can require large capital investments, hybrid cloud has appeal as a cost-effective, best-of-both-worlds solution. For applications that experience bursts of compute demand, organizations can use a hybrid cloud model to meet temporary processing capacity needs by shifting workloads to public cloud for short periods. A TechTarget article put it this way: "An enterprise can mitigate costs with a connection between its private cloud and a public cloud. The connection helps smooth spikes in demand, drawing upon public cloud resources when local demand stresses capacity. Similarly, the public cloud suits temporary, experimental or general-purpose workloads the company does not want to source, set up and manage in-house. Use finite private cloud resources for critical data and workloads -- or simply run workloads where the costs are lowest."[49]

A hybrid cloud can also offer advantages in the area of regulatory compliance: "A business can operate sensitive workloads in its private cloud and move data to and from the public cloud as the regulatory landscape changes, or as data and workloads evolve. For example, an organization could collect personally identifiable customer data in a private cloud, sanitize it, and send it to a public cloud application for processing or analysis."[50]

Potential downsides

A hybrid cloud can be complex to implement, maintain, and secure. As a Forrester survey of chief information security officers (CISOs) notes, "Because of the complicated nature of hybrid cloud, building effective, ongoing security is a difficult process. Tackling this task should be something you are prepared for before loading sensitive information into your hybrid cloud."[51]

The LinkedIn article "The Pros and Cons of Adopting a Hybrid Cloud Architecture" expressed the challenges of maintaining visibility over the many components of a hybrid solution: "When workloads reside in a hybrid cloud environment, it's difficult or nearly impossible to get a singular view of everything you're managing, monitoring and securing. This is especially true if you're using different providers for multiple clouds."[52]

Dell Technologies offerings for each approach

Determining where to run your applications depends on many factors: your industry, the size and maturity of your business, the nature of the applications themselves, and more. No single solution is right for all companies at all points in their lifecycle. Like other OEMs, Dell Technologies has developed offerings to help customers with each of the approaches we've discussed in this paper: public cloud, on-premises private cloud, and hybrid cloud. In this section, we provide an overview of each offering.

Public cloud

Partner clouds

Dell Technologies states, "Dell Technologies Cloud provides a seamless hybrid cloud experience that can be extended to Amazon Web Services (AWS), Microsoft Azure, Google Cloud Platform and more than 4,200 cloud partners."[53] These partnerships include solutions such as:

- Dell EMC™ AWS Backup and Recovery Solutions: "With its integration and partnerships with Amazon, Dell is a trusted partner in data protection whether your workloads are running on-premises or in the cloud."[54]
- Dell EMC PowerScale for Google Cloud: "PowerScale for Google Cloud enables enterprises to run the most demanding, file-based workloads, which require extreme performance and throughput."[55]

Many Dell Technologies servers are available with AMD processors

As you select hardware for your cloud solution, consider models powered by AMD EPYC processors. According to AMD, 3rd Gen EPYC processors offer up to 64 cores, 3200Mhz memory bandwidth, 7nm x86 CPU technology, 256MB total L3 cache, and security features such as Secure Encrypted Virtualization (SEV).[56]

Principled Technologies has tested several Dell EMC servers powered by AMD EPYC processors. Learn about them in the following reports:

Prepare images in Kubernetes for machine learning faster with a Dell EMC cluster powered by AMD EPYC 7543 processors

Support more VDI users with a Dell EMC PowerEdge R7515 server powered by an AMD EPYC 75F3 processor

Enjoy better data analytics performance by upgrading to Dell EMC PowerEdge R7525 servers and Dell EMC PowerStore storage

On-premises private cloud

VMware Cloud Foundation on VxRail

According to Dell, VMware Cloud Foundation™ (VCF) on VxRail™ "delivers a simple and direct path to the hybrid cloud and Kubernetes at cloud scale with one, complete, automated platform."[57]

The solution offers full stack integration "with both the HCI infrastructure layer and VMware cloud software stack," delivery flexibility, available single-vendor support, and unique integration capabilities with VCF. In addition, according to Dell, "Automated lifecycle management is provided as a single, complete, turnkey hybrid cloud experience greatly reducing risk and increasing IT operational efficiency."[58]

With VCF on VxRail, Dell markets a coherent experience, with "a consistent infrastructure and consistent operations with edge, private, and native public cloud workload deployment options for a true hybrid cloud solution, while allowing businesses to maintain flexibility of networking and topology."[59] VCF on VxRail users also get a consistent interface to "manage their full stack and leverage native VMware management tools to perform both Cloud Foundation management as well as VxRail HCI infrastructure management."[60]

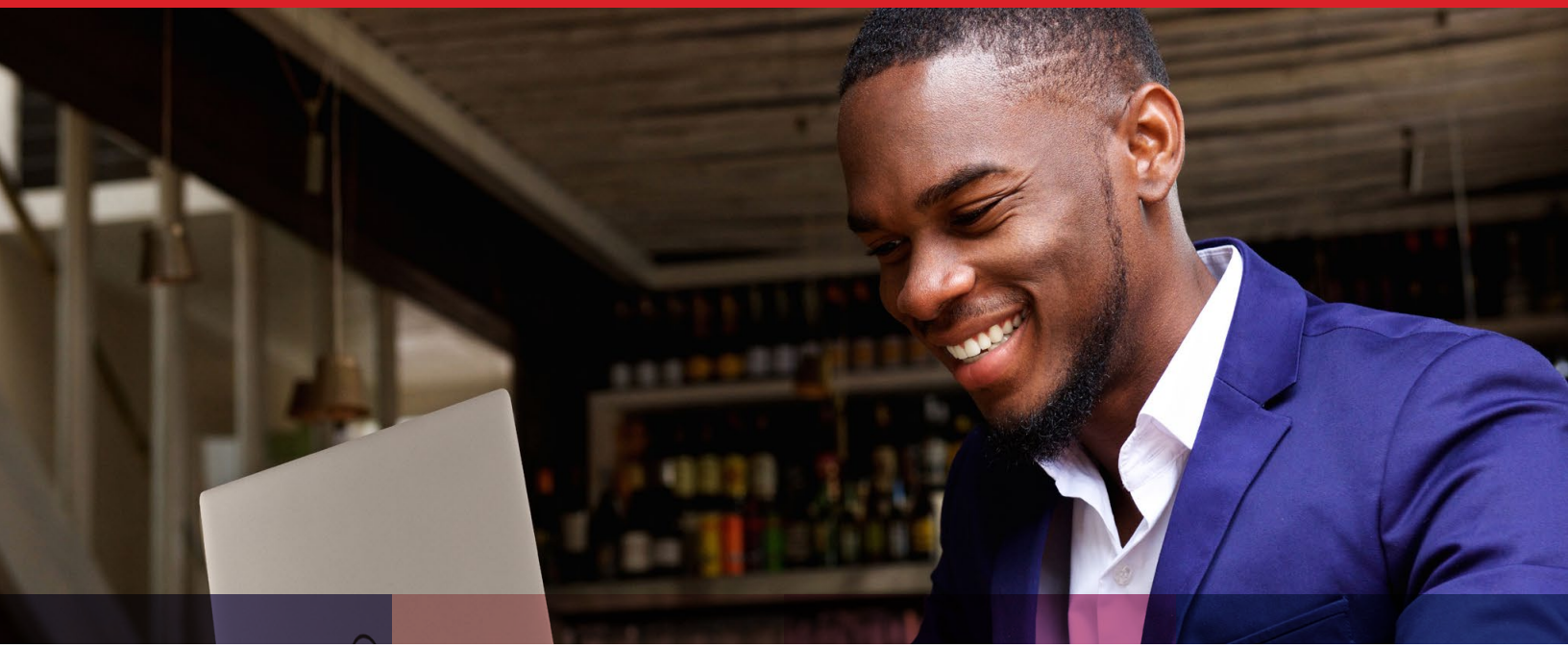
VMware Cloud on Dell EMC

VMware Cloud on Dell EMC is a fully managed subscription-based on-premises cloud solution that, according to Dell, "combines the latest VMware Cloud infrastructure software with Dell EMC VxRail hardware, creating a unique and powerful combination. This solution gives organizations greater control of their workloads by deploying modern hyperconverged infrastructure across on-premises datacenters, edge, and co-locations."[61]

Solution highlights include cloud infrastructure delivered as-a-service on-premises; VMware Software-Defined Data Center (SDDC), including compute, storage, and networking; transparent hybrid control plane to provision and monitor resources; and ongoing security updates and software patching.[62]

Dell positions VMware Cloud on Dell EMC as ideal for "any edge location where business is transacted and there is a need for compute, storage or networking capabilities."[63]

Users can customize their cloud's rack size, host instances, and network requirements through the VMware Cloud Services portal, which supports growth and scaling non-disruptively from three to 24 nodes.[64]



Dell Technologies APEX Private Cloud

A new solution from Dell Technologies, APEX Cloud Services offer "integrated compute, storage, networking, and virtualization resources that enable consistent, secure infrastructure and operations for your workloads across public and private clouds."[65] With the APEX Console platform, users can discover, subscribe to, deploy, monitor, optimize, and grow IT services with a single web interface. They could also use the APEX Console to build a cloud to suit their unique needs and deploy it in as few as 14 days, according to Dell.[66] They call APEX the "fastest private and hybrid cloud deployment," with which you could also "expand your private or hybrid cloud in as few as 5 days."[67]

With both on-premises private cloud and hybrid cloud offerings, APEX Cloud Services are "designed to support you wherever you are in your cloud journey." According to Dell, APEX Private Cloud includes virtualized compute and storage infrastructure with VMware vSphere Enterprise Plus and vSAN Enterprise. This private cloud offering is optimized for edge workloads, such as a manufacturing line.[68]

Hybrid cloud

Dell EMC Integrated System for Microsoft Azure Stack Hub is "an on-premises hybrid cloud platform for delivering infrastructure and Platform-as-a-Service with a consistent Azure cloud experience on-premises or in the field."[69]

The APEX Cloud Services solution we describe above also includes hybrid cloud offerings. According to Dell, APEX Hybrid Cloud includes virtualized compute, storage, and networking infrastructure on a VCF cloud stack. Workload examples for the APEX Hybrid Cloud include virtual desktop infrastructure (VDI), artificial intelligence/machine learning (AI/ML), and high-performance relational databases.[70]

Customizable, flexible, and streamlined with a single interface, APEX Cloud Services aim to help organizations simplify their IT experience, meet changing business needs, and maintain control of their cloud strategy.[71]

Dell Technologies also offers a wide variety of compute, storage, and networking products for customers who do not wish to adopt a private cloud or hybrid cloud solution.

Conclusion

Public cloud, on-premises private cloud, and hybrid cloud all offer distinct attractions. Depending on your industry, the nature of your workloads, and other factors, each approach can make good business sense. We hope that our research into the advantages and disadvantages of each has given you food for thought as you seek the most appropriate solutions for your unique situation.

---

1 "Gartner Forecasts Worldwide Public Cloud End-User Spending to Grow 23% in 2021," accessed July 7, 2021, https://www.gartner.com/en/newsroom/press-releases/2021-04-21-gartner-forecasts-worldwide-public-cloud-end-user-spending-to-grow-23-percent-in-2021.

2 "Gartner Predicts the Future of Cloud and Edge Infrastructure," accessed June 22, 2021, https://www.gartner.com/smarterwithgartner/gartner-predicts-the-future-of-cloud-and-edge-infrastructure/.

3 "Gartner Forecasts Worldwide Public Cloud End-User Spending to Grow 23% in 2021," accessed July 7, 2021, https://www.gartner.com/en/newsroom/press-releases/2021-04-21-gartner-forecasts-worldwide-public-cloud-end-user-spending-to-grow-23-percent-in-2021.

4 "Tech companies are looking at more flexible work models when offices reopen," accessed July 7, 2021, https://techcrunch.com/2021/06/11/tech-companies-are-looking-at-more-flexible-work-models-when-offices-reopen/?guccounter=1.

5 "Gartner Forecasts Worldwide Public Cloud End-User Spending to Grow 23% in 2021," accessed July 7, 2021, https://www.gartner.com/en/newsroom/press-releases/2021-04-21-gartner-forecasts-worldwide-public-cloud-end-user-spending-to-grow-23-percent-in-2021.

6 "Gartner Predicts the Future of Cloud and Edge Infrastructure," accessed June 22, 2021, https://www.gartner.com/smarterwithgartner/gartner-predicts-the-future-of-cloud-and-edge-infrastructure/.

7 "Gartner Predicts the Future of Cloud and Edge Infrastructure," accessed June 22, 2021, https://www.gartner.com/smarterwithgartner/gartner-predicts-the-future-of-cloud-and-edge-infrastructure/.

8 "Gartner Predicts the Future of Cloud and Edge Infrastructure," accessed June 22, 2021, https://www.gartner.com/smarterwithgartner/gartner-predicts-the-future-of-cloud-and-edge-infrastructure/.

9 "Financial Institutions Need to Pursue Their Own Path to the Cloud," accessed June 22, 2021, https://www.bcg.com/publications/2021/strategies-for-financial-institutions-transitioning-to-the-cloud.

10 "Top cloud trends for 2021: Forrester predicts spike in cloud-native tech, public cloud, and more," accessed June 22, 2021, https://www.techrepublic.com/article/top-cloud-trends-for-2021-forrester-predicts-spike-in-cloud-native-tech-public-cloud-and-more/.

11 "Financial Institutions Need to Pursue Their Own Path to the Cloud," accessed June 22, 2021, https://www.bcg.com/publications/2021/strategies-for-financial-institutions-transitioning-to-the-cloud.

12 "How CIOs and CTOs can accelerate digital transformations through cloud platforms," accessed June 22, 2021, https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/how-cios-and-ctos-can-accelerate-digital-transformations-through-cloud-platforms.

13 "The Pandemic Isn't Boosting Cloud Spending," accessed June 22, 2021, https://www.bain.com/insights/the-pandemic-isnt-boosting-cloud-spending/.

14 "The Cost of Cloud, a Trillion Dollar Paradox," accessed June 22, 2021, https://a16z.com/2021/05/27/cost-of-cloud-paradox-market-cap-cloud-lifecycle-scale-growth-repatriation-optimization/.

15 "The CIO's Guide to Distributed Cloud," accessed June 22, 2021, https://www.gartner.com/smarterwithgartner/the-cios-guide-to-distributed-cloud/.

16 "Global Hybrid Cloud Market is Anticipated to Grow at a CAGR of 17.8% from 2020 to 2028," accessed June 22, 2021, https://www.lineareastafrica.net/global-hybrid-cloud-market-is-anticipated-to-grow-at-a-cagr-of-17-8-from-2020-to-2028/.

17 Element Critical, "Part II - The Advantages and Disadvantages of Cloud Computing," accessed June 22, 2021, https://elementcritical.com/blog/the-advantages-and-disadvantages-of-cloud-computing/.

18 The New Economy, "How cloud can help businesses experiment, innovate, and improve agility," accessed June 22, 2021, https://www.theneweconomy.com/technology/how-cloud-can-help-businesses-experiment-innovate-and-improve-agility.

19 "CapEx vs. OpEx: Key Considerations for Your Cloud Cost Management Strategy" accessed June 22, 2021, https://www.cloudhealthtech.com/blog/capex-vs-opex-cloud-cost-management.

20 New York Times, "A Glimpse of America's Future: Climate Change Means Trouble for Power Grids," accessed July 2, 2021, https://www.nytimes.com/2021/02/16/climate/texas-power-grid-failures.html.

21 "The Cloud Protects Data From Natural Disasters and More," accessed June 22, 2021, https://www.summithosting.com/blog/cloud-protects-data-natural-disasters-more/.

22 "Cloud vs on-premises comparison," accessed June 22, 2021, https://www.lucidchart.com/blog/cloud-vs-on-premises-comparison.

23 "The Benefits of Cloud Services Far Outweigh On-Premises in 2021," accessed June 22, 2021, https://www.securityweek.com/benefits-cloud-services-far-outweigh-premises-2021.

24 "CapEx vs. OpEx: Key Considerations for Your Cloud Cost Management Strategy" accessed June 22, 2021, https://www.cloudhealthtech.com/blog/capex-vs-opex-cloud-cost-management.

25 "CapEx vs. OpEx: Key Considerations for Your Cloud Cost Management Strategy" accessed June 22, 2021, https://www.cloudhealthtech.com/blog/capex-vs-opex-cloud-cost-management.

26 "How CIOs and CTOs can accelerate digital transformations through cloud platforms," accessed June 22, 2021, https://www.mckinsey.com/business-functions/mckinsey-digital/our-insights/how-cios-and-ctos-can-accelerate-digital-transformations-through-cloud-platforms.

27 "The Cost of Cloud, a Trillion Dollar Paradox," accessed June 22, 2021, https://a16z.com/2021/05/27/cost-of-cloud-paradox-market-cap-cloud-lifecycle-scale-growth-repatriation-optimization/.

28 "The Cost of Cloud, a Trillion Dollar Paradox," accessed June 22, 2021, https://a16z.com/2021/05/27/cost-of-cloud-paradox-market-cap-cloud-lifecycle-scale-growth-repatriation-optimization/.

29 "4 reasons cloud data repatriation is happening," accessed June 22, 2021, https://searchstorage.techtarget.com/opinion/4-reasons-cloud-data-repatriation-is-happening.

30 "What's involved in cloud repatriation cost calculation?" accessed June 22, 2021, https://searchdatacenter.techtarget.com/feature/Whats-involved-in-cloud-repatriation-cost-calculation.

31 Element Critical, "Part II -The Advantages and Disadvantages of Cloud Computing," accessed June 22, 2021, https://elementcritical.com/blog/the-advantages-and-disadvantages-of-cloud-computing/.

32 "Cloud Governance Challenges: A Survey of Policy and Regulatory Issues," accessed July 6, 2021, https://carnegieendowment.org/2020/11/09/cloud-governance-challenges-survey-of-policy-and-regulatory-issues-pub-83124.

33 "What is vendor lock-in? | Vendor lock-in and cloud computing," accessed June 22, 2021, https://www.cloudflare.com/learning/cloud/what-is-vendor-lock-in/.

34 "Financial Institutions Need to Pursue Their Own Path to the Cloud," accessed June 22, 2021, https://www.bcg.com/publications/2021/strategies-for-financial-institutions-transitioning-to-the-cloud.

35 "Cloud Governance Challenges: A Survey of Policy and Regulatory Issues," accessed July 6, 2021, https://carnegieendowment.org/2020/11/09/cloud-governance-challenges-survey-of-policy-and-regulatory-issues-pub-83124.

36 "Michael Dell: On-Premises Solutions Are More 'Cost Effective' Than Public Cloud For 85 To 90 Percent Of Workloads," accessed July 7, 2021, https://www.crn.com/news/data-center/300100761/michael-dell-on-premises-solutions-are-more-cost-effective-than-public-cloud-for-85-to-90-percent-of-workloads.htm.

37 "Michael Dell: On-Premises Solutions Are More 'Cost Effective' Than Public Cloud For 85 To 90 Percent Of Workloads," accessed July 7, 2021, https://www.crn.com/news/data-center/300100761/michael-dell-on-premises-solutions-are-more-cost-effective-than-public-cloud-for-85-to-90-percent-of-workloads.htm.

38 "Cloud Governance Challenges: A Survey of Policy and Regulatory Issues," accessed July 6, 2021, https://carnegieendowment.org/2020/11/09/cloud-governance-challenges-survey-of-policy-and-regulatory-issues-pub-83124.

39 "The Cost of Cloud, a Trillion Dollar Paradox," accessed June 22, 2021,https://a16z.com/2021/05/27/cost-of-cloud-paradox-market-cap-cloud-lifecycle-scale-growth-repatriation-optimization/.

40 "Cloud repatriation is a symptom of a wider cloud storage trend, " accessed June 22, 2021, https://searchstorage.techtarget.com/opinion/Cloud-repatriation-is-a-symptom-of-a-wider-cloud-storage-trend.

41 "CapEx vs. OpEx: Key Considerations for Your Cloud Cost Management Strategy" accessed June 22, 2021, https://www.cloudhealthtech.com/blog/capex-vs-opex-cloud-cost-management.

42 "Financial Institutions Need to Pursue Their Own Path to the Cloud," accessed June 22, 2021, https://www.bcg.com/publications/2021/strategies-for-financial-institutions-transitioning-to-the-cloud.

43 "Is Cloud More Secure than On-Premises Security? Cloud vs. On-Premises Security Tools," accessed June 22, 2021, https://www.dnsstuff.com/cloud-vs-on-premise-security.

44 "Top 5 benefits and advantages of hybrid cloud," accessed July 6, 2021, https://searchcloudcomputing.techtarget.com/tip/Top-5-benefits-of-hybrid-cloud.

45 "CapEx vs. OpEx: Key Considerations for Your Cloud Cost Management Strategy," accessed June 22, 2021, https://www.cloudhealthtech.com/blog/capex-vs-opex-cloud-cost-management.

46 "CapEx vs. OpEx: Key Considerations for Your Cloud Cost Management Strategy," accessed June 22, 2021, https://www.cloudhealthtech.com/blog/capex-vs-opex-cloud-cost-management.

47 "CapEx vs. OpEx: Key Considerations for Your Cloud Cost Management Strategy," accessed June 22, 2021, https://www.cloudhealthtech.com/blog/capex-vs-opex-cloud-cost-management.

48 "CapEx vs. OpEx: Key Considerations for Your Cloud Cost Management Strategy," accessed June 22, 2021, https://www.cloudhealthtech.com/blog/capex-vs-opex-cloud-cost-management.

49 "Top 5 benefits and advantages of hybrid cloud," accessed July 6, 2021, https://searchcloudcomputing.techtarget.com/tip/Top-5-benefits-of-hybrid-cloud.

50 "Top 5 benefits and advantages of hybrid cloud," accessed July 6, 2021, https://searchcloudcomputing.techtarget.com/tip/Top-5-benefits-of-hybrid-cloud.

51 "What Is Hybrid Cloud? Advantages and Disadvantages," accessed June 23, 2021, https://blog.gigamon.com/2019/12/05/what-is-hybrid-cloud-advantages-and-disadvantages/.

52 "The Pros and Cons of Adopting a Hybrid Cloud Architecture," accessed July 6, 2021, https://www.linkedin.com/pulse/pros-cons-adopting-hybrid-cloud-architecture-vince-arneja.

53 Dell Technologies, "Public Cloud," accessed June 22, 2021, https://www.delltechnologies.com/en-us/learn/cloud/public-cloud.htm

54 Dell Technologies, "AWS Backup and Recovery Solutions," accessed June 22, 2021, https://www.delltechnologies.com/en-us/data-protection/aws.htm.

55 Dell Technologies, "Dell EMC PowerScale for Google Cloud," accessed June 22, 2021, https://www.delltechnologies.com/en-us/solutions/cloud/powerscale-for-google-cloud.htm.

56 AMD EPYC™ 7003 Series Processors, accessed July 29, 2021, https://www.amd.com/en/processors/epyc-7003-series.

57 "VMware Cloud Foundation on Dell EMC VxRail: Accelerating the Journey to VMware Software-Defined Data Center and Hybrid Cloud," accessed June 22, 2021, https://www.delltechnologies.com/asset/en-us/products/converged-infrastructure/industry-market/h17854-vmware-cloud-foundation-on-dell-emc-vxrail-wp.pdf.

58 "VMware Cloud Foundation on Dell EMC VxRail: Accelerating the Journey to VMware Software-Defined Data Center and Hybrid Cloud," accessed June 22, 2021, https://www.delltechnologies.com/asset/en-us/products/converged-infrastructure/industry-market/h17854-vmware-cloud-foundation-on-dell-emc-vxrail-wp.pdf.

59 "VMware Cloud Foundation on VxRail datasheet," accessed June 22, 2021, https://www.delltechnologies.com/asset/en-us/products/dell-technologies-cloud/technical-support/h17766-ds-vmware-cloud-foundation-on-vxrail.pdf.

60 "VMware Cloud Foundation on VxRail datasheet," accessed June 22, 2021, https://www.delltechnologies.com/asset/en-us/products/dell-technologies-cloud/technical-support/h17766-ds-vmware-cloud-foundation-on-vxrail.pdf.

61 "Simplify your IT infrastructure with VMware Cloud on Dell EMC," accessed June 21, 2021, https://www.delltechnologies.com/en-us/solutions/cloud/vmware-cloud-on-dellemc.htm.

62 "VMware Cloud on Dell EMC solution brief," accessed June 21, 2021, https://www.delltechnologies.com/asset/en-us/products/dell-technologies-cloud/briefs-summaries/vmware-cloud-on-dell-emc-solution-overview.pdf.

63 "VMware Cloud on Dell EMC data sheet," accessed June 21, 2021, https://www.delltechnologies.com/asset/en-us/products/dell-technologies-cloud/technical-support/h17765-ds-vmware-cloud-on-dell-emc.pdf.

64 "Simplify your IT infrastructure with VMware Cloud on Dell EMC," accessed June 21, 2021, https://www.delltechnologies.com/en-us/solutions/cloud/vmware-cloud-on-dellemc.htm.

65 "Accelerate your cloud adoption" accessed June 21, 2021, "https://www.delltechnologies.com/en-us/apex/cloud-services/

66 "Introducing APEX Cloud Services," accessed June 22, 2021, https://www.delltechnologies.com/asset/en-us/solutions/apex/briefs-summaries/h18181-apex-cloud-services-solution-brief.pdf.

67 "Introducing APEX Cloud Services," accessed June 22, 2021, https://www.delltechnologies.com/asset/en-us/solutions/apex/briefs-summaries/h18181-apex-cloud-services-solution-brief.pdf.

68 "Introducing APEX Cloud Services," accessed June 22, 2021, https://www.delltechnologies.com/asset/en-us/solutions/apex/briefs-summaries/h18181-apex-cloud-services-solution-brief.pdf.

69 "Dell EMC Integrated System for Microsoft Azure Stack Hub," accessed June 22, 2021, https://www.delltechnologies.com/en-us/hyperconverged-infrastructure/microsoft-azure-stack/microsoft-azure-stack-hub.htm.

70 "Introducing APEX Cloud Services," accessed June 22, 2021, https://www.delltechnologies.com/asset/en-us/solutions/apex/briefs-summaries/h18181-apex-cloud-services-solution-brief.pdf.

71 "Introducing APEX Cloud Services," accessed June 22, 2021, https://www.delltechnologies.com/asset/en-us/solutions/apex/briefs-summaries/h18181-apex-cloud-services-solution-brief.pdf.

This project was commissioned by Dell Technologies.

Facts matter.®