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Composable Infrastructure

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Learn to:

- Identify the serious IT challenges facing today's businesses
- Use composable infrastructure to create and deliver new value instantly and continuously
- Apply idea economy principles to your infrastructure environment

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Scott D. Lowe

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Table of Contents

Introduction

The data center is at the beginning of a transformation — a renaissance of sorts. No longer is the business willing to be shackled by inefficient, inflexible data center systems that impose delay into critical business objectives.

Although IT has to maintain a number of existing line of business applications, it's also being pushed into helping to support the new way of doing business in what is called the idea economy.

About This Book

There is more data center opportunity available than meets the eye. This 48-page journey will help you to understand all the options at your disposal and how they stack up to one another. After reading this book, you'll know just how composable infrastructure fits into the landscape and how it can help you to propel your business into the 22nd century.

Foolish Assumptions

For this book, I assume that you have at least a basic understanding of data center computing, virtualization, and storage. The general audience for this book is anyone in IT who may want to learn more about data center architectures. The audience is intended to be technical staff as well as managerial and executive staff.

Icons Used in This Book

Throughout this book, you will find a number of icons intended to help you better understand and remember key concepts.

REMEMBER

I use the Remember icon when you need to stop for a second and make sure you recall a key concept before forging ahead in a chapter.

TIP

When you see the Tip icon, put that information in your back pocket to save for later, when you analyze your own data center environment.

TECHNICAL STUFF

I don't go super deep into technical stuff in this book, but you'll find some technical elements in various places. They're marked with the Technical Stuff icon.

WARNING!

Sometimes you need a little extra nudge to watch out for certain things that can become problems for you. Throughout this book, I point out places where you might need to take some extra care.

Beyond the Book

There's only so much I can cover here. To learn even more about composable infrastructure when you're done, look around HPE's website for composable-focused materials. Visit `www.hpe.com/info/composable` for more information.

Where to Go from Here

Even if you choose to ignore everything else you've read in this book, never forget that, no matter how much money is saved, if the users can't get their work done in a reasonable way, IT will be seen as a failure. It's up to forward-thinking technologists and leaders to figure out how to turn the IT function into a driver of the business.

Chapter 1

Introducing the Idea Economy

In This Chapter

- Identifying the two operational models that modern IT must support
- Discovering why the idea economy requires new ways of thinking about IT
- Gaining insight into why traditional IT methodologies are no longer enough

According to HPE CEO Meg Whitman, "We're now living in an idea economy where success is defined by the ability to turn ideas into value faster than your competition."

The world of the IT department is undergoing a fundamental change in how to do business.

Is that scary?

For many, it may be. But there are really good reasons for this change, and many revolve around the increasing need to deliver applications and services faster than ever before. This is not to say that IT has been doing anything wrong for a decade. Far from it. IT departments have worked hard to meet the needs of the business.

But times change. Companies change. The world changes around us. And that's where we are today.

What is the idea economy?

CIOs and line-of-business executives are at the forefront of a major transformation aimed at leveraging the competitive advantages of the new hyper-connected enterprise. Industry research firm IDC describes the new IT for mobile devices, cloud services, social networks, and big data analytics as the "third platform." Gartner calls it "Bimodal IT."

HPE calls this evolution for infrastructure the "idea economy" because it gives IT the ability to drive new business opportunities by quickly delivering revenue-generating products, services, and experiences. Instead of just providing technology to automate internal business processes, IT can now directly impact business strategy and revenues by creating software-based services that

- ✓ Energize growth
- ✓ Strengthen profitability
- ✓ Boost productivity
- ✓ Enhance innovation
- ✓ Increase organizational agility
- ✓ Improve the customer experience
- ✓ Provide a competitive advantage

It's with this definition in mind that I present the challenges facing and opportunities afforded IT in moving ahead.

Although IT was hard at work building out the current data centers, the world changed. "The cloud" became ubiquitous with efficiency. Virtualization became the norm, but then stalled out even as it supported more and bigger workloads. Businesses became far more tech-savvy than they were a decade ago.

This new business paradigm — labeled the *idea economy* — requires a different mindset and a different kind of infrastructure. In this chapter, I explain why this is so.

The Pitfalls of Traditional Infrastructure

Let's face some cold, hard facts. For all the advances in technology and the tools we use to manage the infrastructure today, the complexity and inefficiency from operational and resource silos seems to continue unabated. The business needs IT at the forefront for driving new efficiencies through productivity, reducing costs, and innovating to create new opportunities for the business to remain competitive. However, IT is burdened with maintaining the existing infrastructure with little or no tolerance for downtime from the business. The constant struggle to manage both the existing and the new is a tipping point for change within many organizations.

REMEMBER

A good chunk of the challenges in IT today is the direct result of the outcomes borne from the trees of the modern IT department, which has its roots way back in the 1970s. Although the hardware and software have changed, for many IT departments, it's been business as usual ever since.

Don't believe me? Read on to learn why this is the case and, more important, how we're going to fix it.

Operations driven

There is a joke that goes like this:

> Announcer: "What do we want!?"
>
> Crowd: "TIME TRAVEL!"
>
> Announcer: "When do we want it!?"
>
> Crowd: "THAT'S IRRELEVANT!"

Today's businesses want to jump forward in time, but IT is struggling to keep up with the demands of business. So, today's IT functions need to take a hard look at the kinds of services they're supporting so they can take action *today,* and not at some nebulous point in the future. All too often, issues with data center infrastructure add delays to business-critical projects, creating issues that are far from irrelevant.

Cost and efficiency focus

Simply put, in many organizations, IT is seen as a cost center and is deployed as a support function. And, like any cost, the business is constantly looking for ways to reduce or eliminate based on the age old adage of more for less.

We all know that there comes a point at which this paradigm no longer works. There is only so much perceived inefficiency that can be driven out of a system before you start to cut important elements, resulting in poor service delivery, which results in poor business outcomes.

Often, in these cases, data center density becomes a topic of conversation, with a desire to cram as much as is physically possible into as little space as possible because data center expansion can be costly for both operating and capital budgets. A common approach has been to consolidate through virtualization, hosting more applications on less hardware in an effort to reduce costs.

Overall, the goal for a traditional data center and the associated IT staff is to drive costs out of the business. As smart people often say, “You can’t cut your way to prosperity.”

Slow to change

Perhaps one of the biggest frustrations from the business is just how slow data center infrastructure is to change. The business is demanding new and improved services and cannot wait for the infrastructure to catch up.

Here’s the deal, though: IT is also charged with ensuring stability and data protection, goals that are sometimes incompatible with constant innovation and a high change rate in the infrastructure.

WARNING!

This scenario won’t change anytime soon. There will always need to be a part of IT that is focused on rock-solid stability over all else.

Keeping the lights on

As a cost center pushed to do things as inexpensively as possible, IT is often forced to do the bare minimum possible within the confines of its budget, a situation often referred to as "keeping the lights on." IT's role in this scenario is relegated to a simple maintenance role, ensuring that systems meet basic business needs.

IT is being held back from new services by maintenance. It's unfortunate that IT is put into this position; keeping critical business applications running is really important, but it has become an underappreciated outcome in many places. The focus on maintaining basic operations as efficiently as possible is one of the reasons that we see so much outsourcing and cloud migrations taking place. These kinds of services have, in many ways, become commoditized.

Modern Business and IT Drivers

What would happen if the power of IT was harnessed for the entire business versus back office or support functions? What would happen if the IT infrastructure was developed in such a way as to enable the business to treat IT and the underlying infrastructure to drive growth and new opportunities rather than simply as a cost to be managed?

Apps driven

In the modern world, apps rule the day. There are apps for everything. Customers and employees need to be able to access business services from any device, whether that be through a remote office PC/thin client or mobile. A lot of these apps today are merely an interface to access information from and make changes to applications that live in the data center. A good example is mobile banking, whereby many people expect the convenience of being able to access all their day-to-day financial services without having to visit a bank. But they also run in local data centers and in other cases, on cloud services or as a part of Software-as-a-Service (SaaS) platforms.

Bimodal IT

Realistically, IT won't be exiting the operational support business anytime in the near future. Many of the existing systems are critical to the business, so it's more about bridging the existing and the new to enable IT to spend more time supporting business initiatives versus being confined to maintaining back office applications. If you can't get the basics — the "keeping the lights on" stuff for the business — right, you have no hope of leveraging IT in other ways.

At the same time, though, there exists the urgent need to enable IT to be a revenue generator at the same time that it's helping manage costs and efficiency. Gartner calls this bifurcated IT operational model "bimodal IT." Mode 1 is the traditional stability-focused model that emphasizes safety and accuracy. Mode 2, according to Gartner, is "exploratory and nonlinear, emphasizing agility and speed."

In reality, both modes are important. In this book, I explain how composable infrastructure can help you achieve the goals of both of the IT modes with a single infrastructure.

Regardless of where they run, business units need to be able to update or change applications continuously as they respond to changing customer demands and opportunities for new services, and IT must be able to reliably and rapidly implement these changes.

Agility focused

Business agility is increasingly important. Those that are agile gain a competitive advantage over those that are stuck in old IT silos. As individual business units have become more aware of how the right technology tools can enable the business, there is far less tolerance for old paradigms that require formal IT approval and then the IT-managed deployment of infrastructure to support it.

The idea economy demands that business units have the ability to, within reason, deliver services using infrastructure that is seamlessly and transparently provisioned. Yes, this infrastructure may still be maintained by IT, but IT now becomes the broker of new applications and services at the speed of light.

This concept also demands that IT itself have the ability to more seamlessly deploy new services. IT administrators have to be able to quickly and easily stand up entire environments from a centralized console without having to involve teams of specialists.

TIP

This shifts the IT department from its traditional role into one that enables business units to meet their goals and, by extension, to meet the goals of the business.

Revenue generating

Today's new breed of apps and services can help drive growth throughout an organization and ensure survival for the business. Even the services supported by central IT can be revenue generating. In a bank, for example, consider the deployment of new mobile applications, which customers absolutely require as a part of their services portfolio. By having infrastructure that can scale quickly and easily and that is easier to manage and that is programmatic — stuff you learn more about later — it becomes far easier to develop these new services in ways that, even if supported by IT, are more automated than was possible in the past.

Consider this

Consider that mobile banking application for a moment. Suppose that most of your customers are paid on the last day of the month, so you know to expect a spike at that time. It becomes easy to set up a schedule to deploy more resources to support that spike.

But what about when you *don't* always know when to expect a spike? What if the application could, for example, automatically spin up additional web servers to handle this increased load? What if these additional web servers could automatically become a part of a load-balancing group, all controlled by the application, and all happening without the need for ongoing human intervention?

This is one of the challenges of the idea economy and is just one of the ways that composable infrastructure can help to transform IT operations.

Agility, velocity, and reality

The mantra for traditional IT revolves around stability.

But, in the modern data center, *agility* (the ability for IT and its provided services to adjust to meet new demands) and *operational velocity* (the speed by which new services or products can be delivered to market) rule the roost. The faster this can happen, the faster the organization can begin to benefit from new revenue streams or enhanced customer satisfaction. Figure 1-1 depicts this balancing act.

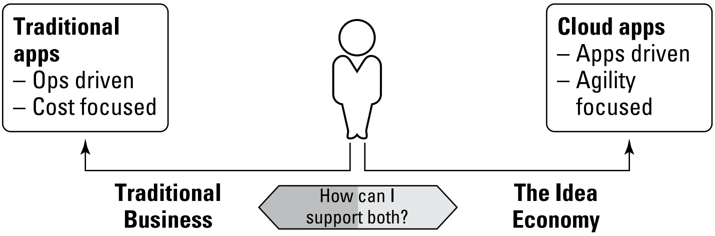


Figure 1-1: Modern IT is a careful balancing act between two divergent paradigms.

With these competing demands comes a harsh reality. In the traditional environment, IT is bogged down in hardware silos. In the cloud environment, there are operational silos with multiple cloud vendors.

What's an IT department to do?

Traditional IT and the Idea Economy

Earlier in this chapter, I describe two vastly different classes of applications:

- **Traditional applications** that are designed to support and automate existing business processes such as collaboration, data processing and analytics, supply chain, and web infrastructure. These kinds of applications are key to maintaining operational stability in the enterprise.

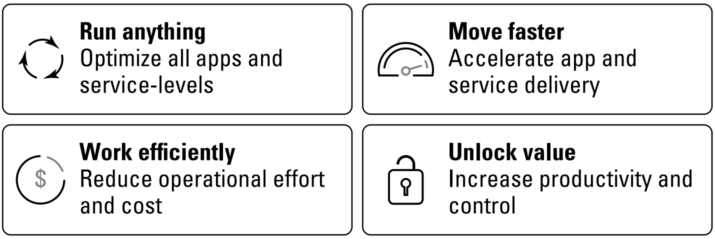
- **A new breed of applications and services** that drive revenue and new customer experiences by leveraging mobility, big data, and cloud native technologies. These kinds of applications are key drivers of the digital/idea economy.

IT is being stretched in traditional environments to lower operating costs while at the same time being stretched in the new application environment to increase operational velocity. Obviously, something has to change.

Meeting today's challenges means leveraging the power of technology to quickly fuel the creative process and bring ideas to life. IT's role must evolve from keeping the business running to accelerating time to business value. Even when IT agrees with this new charter, it's difficult for the department to deliver on these priorities as traditional infrastructure is optimized for stability, scalability, and performance but not for speed. In the idea economy, infrastructure must be the engine of value creation, not the bottleneck to success.

What if you could run *both* kinds of workloads on the same infrastructure? What if IT could easily maintain those business-critical, keeping-the-lights-on, stability-seeking applications while also providing an environment that is fully fluid and extensible?

Enter composable infrastructure, a top-level overview of which is displayed in Figure 1-2.



Run anything
Optimize all apps and service-levels

Move faster
Accelerate app and service delivery

Work efficiently
Reduce operational effort and cost

Unlock value
Increase productivity and control

Figure 1-2: A high-level overview of composable infrastructure.

Run anything

Even the most advanced business can't just stop running legacy business-critical applications. Further, these applications still need a robust environment in which to operate.

At the same time, you need an environment that can support the new breed of applications. With composable infrastructure, you no longer have to choose. You can run all your existing applications, as well as new apps, and optimize each for appropriate service levels. You can reduce capital expenditure (CapEx) and free up resources with a single infrastructure with fluid pools of physical and virtual compute, storage, and fabric.

Move faster

With a single cohesive infrastructure that provides native support for new apps and services, IT can quickly accelerate app and service delivery and move from cost center to revenue generator. With composable infrastructure, it becomes possible to accelerate application and service delivery through a single interface that precisely composes infrastructures at near-instant speeds.

Not bad, eh?

Work efficiently

Attempting to maintain silos of infrastructure for different purposes is one of the fastest ways to waste time and money. You'll need to orchestrate multiple tools, people, and processes to maintain the silos. With a single infrastructure that can support all needs, you can reduce operational effort and cost and focus on innovation.

TIP

Beyond streamlining the physical environment, composable infrastructure will allow you to reduce operational effort and cost through internal software defined intelligence with template driven, frictionless operations.

Unlock value

At the end of the day, IT must provide value. In the idea economy, that means supporting those traditional applications while also supporting new apps and services. With composable infrastructure, IT can increase productivity and control across the data center by integrating and automating infrastructure operations and applications through a unified application programming interface (API).

Chapter 2

Achieving Utopia

In This Chapter

- Deploying infrastructure that can support anytime, anywhere, any workload computing
- Building a bridge from the old to the new, and why that bridge may never go away
- Seeing how programmable infrastructure helps organizations streamline operations and deliver value to the business

IT needs a makeover, and it's time to establish a better way that revolves around the concepts discussed in Chapter 1. For this new order to succeed, you need to understand what's possible and then make a plan to ensure you will succeed.

The three key areas for consideration are described in this chapter. These concepts form the foundation for composable infrastructure, which I describe in greater detail later in this book.

Anytime, Anywhere, Any Workload with the Right Service Level

Supporting the idea economy requires rethinking IT, but you knew that. When it comes to outcomes, what goals are you really trying to achieve through the implementation of a composable infrastructure, which forms the basis for supporting this new business landscape?

Anytime

Infrastructure deployment should become an on-demand activity that can be carried out by those who use it. Perhaps one of the most popular examples of how this kind of demand-based deployment can be beneficial is DevOps.

The idea economy demands that IT become part of the fabric of products and services that are rapidly innovated at every company. IT must keep up and even lead if a business is to remain competitive.

This has led to the rise of the DevOps approach currently sweeping the IT landscape. For organizations that seek to embrace DevOps, collaboration is the cultural norm. No longer are development and operations separated by different chains of command. In a DevOps environment, development and operations staff work side-by-side to support software across its entire life cycle, from initial idea to production support.

To provide DevOps groups — as well as other stakeholders — the IT infrastructure at the rate at which it is demanded, IT must increase its speed, agility, and flexibility to enable people anytime creation and re-creation of resources.

Composable infrastructure enables this anytime paradigm.

Anywhere

Although hypervisor vendors might wish otherwise, a great many enterprise workloads run on — gasp! — bare metal! In other words, there are applications that are not virtualized. They simply run on a server.

A number of today's really hot technologies seem to forget this fact. For example, as awesome as hyperconverged infrastructure can be for many organizations, with most hyperconverged solutions, having fully virtualized workloads is one of the core prerequisites. In general, they won't support bare-metal workloads.

Bare-metal and virtualized workloads are just two application foundations that need to be supported in the modern data center. Today, containers are emerging as a compelling construct, providing significant benefits for certain kinds of workloads. Unfortunately, with traditional infrastructure approaches, IT needs to build out custom, unique infrastructure to support them, at least until an infrastructure is deployed that can seamlessly handle physical, virtual, and container-based workloads.

Imagine the complexity for the IT department charged with supporting all of this and being required to use traditional infrastructure to support it. *Nightmare, expensive,* and *wow* are three words that accurately describe the situation. Each environment would need its own hardware and software and might even need separate staff to support it. Hardware and software can be expensive, and so are people.

Composable infrastructure provides an environment that supports the ability to run workloads on bare metal as well as virtual systems.

Any workload

Composable infrastructure eliminates the need for workload-specific environments and provides a fluid set of resources that can be dynamically combined to meet the unique needs of each application.

Do you have a legacy on-premises Exchange server that you have to keep running? Do you have an enterprise resource planning (ERP) system that currently powers your business but will take ten years to phase out? At the same time, do you have an emerging DevOps philosophy under which you'd like to empower developers with dynamic computing environments as a part of their development efforts?

All these things can be accomplished simultaneously on the right kind of infrastructure. Composable infrastructure enables any workload to operate as a part of the solution.

The right service level

Service levels — regardless of where an application or service is deployed — are critical, even when a particular application is assigned *low* priority! Service levels in a composable infrastructure environment are enabled by providing users with a fluid pool of resources, which include compute, storage, and networking. Different applications will require different combinations of these resources. Some will require very high-performance storage, while others may be able to work with lower levels of storage performance. By providing an infrastructure on which any workload can operate, the *right* service levels can be established for each workload. This helps IT move to on-demand resource management. Only when something unexpected happens — for example, a new application is deployed that exceeds the capability of the existing environment — will IT be required to act.

Programmable Infrastructure as a Business Enabler

To deploy infrastructure quickly, developers look to treat *infrastructure as code.* This allows them to deploy it, version-control it, and tear it down in the same way they manage the application software they've developed. This powerful common software layer then becomes a complete, and eminently configurable and programmable, abstraction layer for all resources in the data center.

Abstraction is similar to virtualization, so the ubiquitous compute hypervisor has an important role to play here. However, to achieve infrastructure as code, the abstraction must happen at the infrastructure level so all resources — compute, storage, and networking — are brought into the picture. With all resources being configured as software elements, practitioners gain control over the infrastructure and can actually use this control to accelerate the business in ways that were not possible just a few short years ago. The various infrastructure elements simply become an extension of the software and are themselves treated as code.

Chapter 3

Four Categories of Infrastructure

In This Chapter

- Understanding why traditional infrastructure is no longer meeting critical business needs
- Discovering emerging data center architectural opportunities
- Identifying the downsides to these new architectures
- Seeing how composable infrastructure can solve business workload needs

For years, IT leaders have been looking for data center architectures that can better meet the needs of the business. In general, data center architecture options fall into one of four categories, each of which is described in the following sections.

Traditional Infrastructure

First came the traditional data center architecture on which many, many organizations still operate. Today's traditional infrastructure solutions harken from the days before virtualization, in which data center operators were forced to toil away on physical servers. They shed tears of frustration as business units requested new applications that required standing up a few, or even dozens of new physical servers.

Although traditional infrastructure has served us well for a very long time, it does suffer from a number of weaknesses. First, deploying different kinds of architecture — physical, virtual, and containers — requires different kinds of hardware and software. In addition, it can require separate skill sets and can end up as a “cobbled together” infrastructure rather than one that is cohesive and easily maintained.

WARNING!

Traditional infrastructure results in a data center that becomes chock-full of silos. There is a team of people in place to manage storage, another team to manage servers, and yet another to manage the networking layer. There may be more teams managing cross-functions such as virtualization that combines the compute environment and the storage environment, too.

The result is a static environment that is not flexible. There are complex processes in place that often involve varying degrees of manual processes, engaging multiple teams, and all kinds of other inefficiencies.

Finally, it’s just a pain to manage it all. It requires a ton of coordination and a whole lot of skills, which can often be really hard and really expensive to acquire.

Converged Infrastructure

Having to individually procure and assemble all the pieces of a traditional infrastructure takes a lot of time, money, and knowledge. But even the best laid plans can still run into unforeseen challenges. When you try to assemble everything on your own, you may find that you’re missing a piece or that the pieces don’t quite fit together the way that you need.

In addition, all the various pieces are managed with separate tools, each of which requires a different kind of knowledge.

Converged infrastructure is intended to help address some of these challenges. With this type of environment, you’re buying preconfigured physical IT assets. By procuring the whole compute, storage, and network environment as a unit, you can be more assured that everything will interoperate as you expect. And, in some cases, converged infrastructure can be easier to manage.

But let’s pull the curtain back a bit. When you look at this kind of environment, you’re still buying the same kinds of hardware you’ve always bought, but you’re just buying it as a package. Converged infrastructure systems aren't built on new kinds of hardware. They consist of combinations of existing products that test well with one another.

There are some benefits to converged infrastructure that can't be overlooked:

- **Improved staff productivity:** When you don't have to worry about whether the various hardware silos will interoperate with one another, you can focus on maximizing your use of that environment instead of on trying to make it all work.
- **Masks some complexity with people and software:** Many converged infrastructure solutions ship with administration tools that can manage the full environment, which is far easier than managing everything separately. In that sense, this infrastructure solution is light-years ahead of traditional environments.
- **Massively simplified procurement:** When you buy converged infrastructure, you're buying it all at once, which makes procurement a breeze!

With that said, converged infrastructure is still defined by the hardware that runs the solution. It's still not as flexible as it needs to be to solve today's biggest business challenges, and it's suitable only for really targeted workload types. This, in turn, can create new silos of converged infrastructures for different workload types.

Hyperconverged Infrastructure

Storage area networks (SANs) removed the need to maintain distributed storage islands for each server. They can scale easily but bring their own challenges around maintaining and deploying new resources. The scalability is ideal for large implementations, but for small sites or organizations this may be too much to manage, both in terms of people and cost. And when an array for smaller instances requires a lower level of service, this would be overkill in both cost and management overhead.

What would you do if you could just get rid of it?

That's the primary thought behind what has become known as hyperconverged infrastructure. This rising form of data center architecture is removing complexity by eliminating the SAN. Instead of deploying a monolithic storage array, storage is distributed to the various nodes that comprise the hyperconverged infrastructure cluster.

Each node in this cluster manages its own local storage while also running a hypervisor. Don't overlook what I just said there. Each node in hyperconverged infrastructure operates as both a virtualization host and as a node in a storage cluster. That fact makes hyperconverged infrastructure unsuitable for supporting physical workloads because physical servers aren't able to access the storage resources trapped inside the hyperconverged environment. That is, perhaps, the most significant downside to running hyperconverged infrastructure.

Hyperconverged infrastructure leverages software-defined storage to work its magic. Software-defined storage is a concept also gaining traction in the marketplace today. In a software-defined storage environment, there is a piece of software — sometimes running on a virtual machine appliance and sometimes built right into the kernel of the hypervisor — that assumes responsibility for managing the storage on the local node. In the case of hyperconverged infrastructure, each of these storage management software layers coordinates with all its peers on other nodes, handily creating a completely distributed, scaled-out storage environment that doesn't need a monolithic SAN.

There are many reasons that people are looking at hyperconverged infrastructure today:

- **Ease of management:** Because the SAN is gone, there is no dedicated storage resource that needs managing, a fact that can really put a lot of companies — especially smaller ones that might have difficulty affording expensive storage administrators — at ease. All storage is managed via the hypervisor management software or by the integrated management tools provided by the hyperconverged infrastructure software vendor.

- **Scaling simplicity:** When you need more capacity — whether that's in the form of storage, processing power, RAM, or network uplinks — you just add another node to the cluster. It's that easy! You can also generally grow in increments that make sense for your company. No two companies are alike, and each will have a need to grow at different speeds. With hyperconverged infrastructure, you have the potential to begin your journey to an environment that supports fluid virtual IT.
- **Cost:** With the ability to deploy as few as two or three nodes — depending on the hyperconverged infrastructure vendor — it can be less expensive to jump into one of these solutions than it is to get into a traditional environment in which you need to buy a ton of storage upfront.

As I allude to, though, there are some serious challenges that you need to keep in mind when considering hyperconverged infrastructure:

- **Virtualization only:** Physical servers are not welcome in a hyperconverged infrastructure environment. Because most companies still have a mix of physical and virtual servers, this means that you'll probably be spending your time maintaining at least two environments — one is the physical server environment and the other is the new hyperconverged infrastructure environment.
- **No physical infrastructure support:** I'm saying it again because it's *that* important.
    - No SAN support for applications that require connectivity to a Fibre Channel SAN.
    - Because HC systems combine both compute and storage, it isn't possible to add more of one without also adding the other.

Composable Infrastructure

Now that you have a broad understanding of the pros and cons behind traditional infrastructure, converged infrastructure, and hyperconverged infrastructure, I want to give you a quick overview of how composable infrastructure can help you solve the challenges introduced in those architectures (also see Table 3-1 for a quick view):

- **Hardware and software architected as one:** Unlike many other data center architectures, composable infrastructure systems are built right alongside the software that will manage the environment. This tight coupling ensures that the two sides of the house cooperate to make sure that business workloads are well supported.
- **Fluid IT:** With the right hardware, composable infrastructure makes it a breeze to manage resources, including compute, storage, and fabric.
- **Software-defined everything:** In general, hardware-bound architectures do not enjoy the kinds of flexibility and agility that are so critical to today's businesses. Composable infrastructure, however, puts all the enterprise brains into software, making it very easy for the system to manage the abstracted resources and ensure that they are used to the best possible effect.
- **Physical, virtual, and containerized workloads:** With composable infrastructure, you don't need to compromise on the kinds of workloads you need to run. Bring it on!

Table 3-1 Data Center Architecture Spectrum

	Traditional	*Converged*	*Hyperconverged*	*Composable*
Complexity	High	Moderate	Moderate	Low
Time to value	Days, weeks, month	Days, weeks	Hours, minutes	Minutes, seconds
Flexibility	Moderate, but very complex	Moderate	Moderate	High
Scaling	Difficult	Moderate	Simple	Simple
Workloads supported	Physical, virtual, containers	Physical, virtual, containers	Virtual, containers	Physical, virtual, containers

Chapter 4

Fluid Resource Pools

In This Chapter

- Getting background information on composable infrastructure
- Discovering the importance of disaggregating resources
- Identifying the various workload types supported in a composable infrastructure environment
- Finding out how simple it is to scale a composable environment

In the next three chapters, you learn all about the three characteristics — fluid resource pools, software-defined intelligence, and a unified application programming interface (API) — that comprise composable infrastructure. But before we jump right in, let's take a look at the overall architecture.

An Introduction to Composable Infrastructure

We've talked a bit about composable infrastructure so far in this book, but in this section, I go into a little more depth. You've already learned about the ways in which traditional, converged, and hyperconverged architectures may introduce challenges in helping organizations seek to leverage the idea economy, but what does the supporting composable infrastruture architecture really look like?

Composable infrastructure has three primary characteristics that make it perfectly suited to the needs of the modern enterprise. Figure 4-1 provides you with a look at these three characteristics. This chapter, as well as Chapters 5 and 6, expands on each of these.

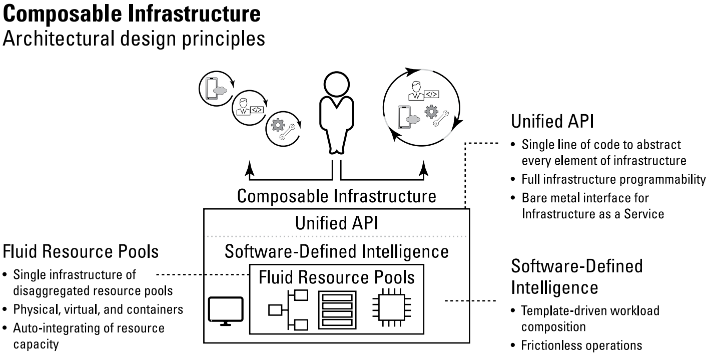

Composable Infrastructure
Architectural design principles
Unified API
• Single line of code to abstract every element of infrastructure
• Full infrastructure programmability
• Bare metal interface for Infrastructure as a Service
Composable Infrastructure
Unified API
Software-Defined Intelligence
Fluid Resource Pools
Fluid Resource Pools
• Single infrastructure of disaggregated resource pools
• Physical, virtual, and containers
• Auto-integrating of resource capacity
Software-Defined Intelligence
• Template-driven workload composition
• Frictionless operations

Figure 4-1: HPE's vision of composable infrastructure.

A Fluid Resource Pool

In Chapter 3, you learn about a number of different data center architecture options that you have at your disposal. Each of those options carries with it very different capabilities when it comes to how resources align with one another, particularly as you try to expand your environment.

The primary problem with traditional, converged, and hyperconverged infrastructure revolves around the resources that make up the environment. In order to be able to support different kinds of workloads, you often need to build out silos of infrastructure, a situation that forces you to increase the cost and complexity of the data center environment.

Furthermore, with some system architectures — most notably converged and hyperconverged infrastructure — administrators often need to scale resources in lockstep with one another. For example, suppose you're running a hyperconverged infrastructure environment and you need to add a few terabytes of storage. To do so, you also have to add more compute and RAM because you have to add resources in increments of full server nodes.

Composable infrastructure effectively eliminates these problems by enabling administrators to build the environment in a way that disaggregates the underlying compute, storage, and fabric resources. In this context, disaggregation basically means that you're able to scale each individual resource independently. You are not forced to add unnecessary resources in order to get the resources you actually need.

Better yet, with composable infrastructure, even while the underlying resources are disaggregated for scaling needs, they operate as a single cohesive infrastructure for management and workload purposes. Workloads are able to pull resources from the single pool of resources as needs dictate. This resource assignment process can be a manual one initiated by an administrator, or it can be handled via a powerful application programming interface (API) that enables developers to treat the data center architecture as a code element, thereby bringing into their development efforts ways to automatically assign resources for use by their applications.

So, what does this all mean from a practical standpoint? Simply put, it can save you a whole lot of money. In traditional environments, there can be major resource overlap between different silos of infrastructure, a situation that can massively increase both capital expenditure (CapEx) and operational expenditure (OpEx). By moving to a single pool of fluid resources, you effectively eliminate silos. It's kind of like what happened when you initially adopted virtualization. No longer did you have to stand up a bunch of redundant resources to support your workloads. Today, though, rather than standing up single servers, many organizations are deploying entire environments to support multiple applications, so the potential efficiency gains are incredible.

Workload Support

The workloads you run in your data center will always come in all kinds of different shapes and sizes — physical, virtual, and container based. Attempting to provide a common platform for these workloads using traditional tools would be difficult and expensive. Composable infrastructure provides you with a single pool of resources that will enable you to run any kind of workload that you need any time of day.

Composable infrastructure includes the ability to maintain physical workloads inside the exact same environment that supports virtual and container-based workloads.

Physical

Let's dispel the myth that physical servers don't know what they're doing. They know *exactly* what they're doing, and they're not going anywhere anytime soon. Lest you think that physical workloads have been eliminated, think again. Even though most companies now take a "virtual first" approach to new workloads, that doesn't mean that there isn't a need for physical workloads anymore.

In fact, for a variety of reasons, physical workloads are often preferable. Here's why:

- **Performance demands:** Other applications often need a lot of horsepower and operate best when they can simply consume everything that a server has to offer.
- **Licensing:** For some applications, licensing in a virtual environment can open up a rat's nest of risk and legalese and result in massively increased licensing costs. In fact, some vendors have been known to sue their own customers over such implementations if careful attention is not paid to what can be onerous licensing restrictions.

You may be wondering how this sounds any different from typical physical infrastructure. The main difference revolves around a single word: stateless. By providing a centrally driven stateless infrastructure environment, IT can seamlessly move workloads to new locations as needs demand.

Composable infrastructure replaces your traditional environment with fluid pools of compute, storage, and fabric. It takes the essence of the server, storage, and networking resources and reduces it down to its bare elements. In this environment, compute, networking, and storage start their lives as stateless and anonymous resources that can then be easily combined and configured to deliver to the needs of an application almost instantaneously. With these kinds of capabilities, you can provision bare-metal workloads in the same way that you deploy virtual workloads today.

Virtual

Even though there remain really good reasons to run physical systems, the fact is that more than 80 percent of new workloads run inside virtual environments. With that in mind, it becomes glaringly obvious that there needs to be comprehensive support for virtualization in any data center architecture.

With composable infrastructure, support for virtualization ships "as standard." These workloads exist in the same infrastructure environment as their physical and container-based brethren and are managed alongside those platforms.

Container-based

Containers are becoming a really popular way to implement workloads, particularly in DevOps-centric organizations (see Chapter 3). Containers bring abstraction to the operation system level and run atop services.

Containers wrap up a piece of software in a complete file system that contains everything it needs to run: code, runtime, system tools, system libraries — anything that can be installed on a server. This guarantees that it will always run the same, regardless of the environment it runs in. It gives programmers, development teams, and operations engineers the common toolbox they need to take advantage of the distributed and networked nature of modern applications.

Keep the virtualization management tools you already have

A whole lot of people have become intimately familiar with virtualization tools, using them day in and day out. Remembering that composable infrastructure is all about efficiency and leverage, and because more than 80 percent of traditional IT infrastructure is virtualized, composable infrastructure allows you to continue to use familiar tools to manage virtualized resources.

Containerized applications are packaged with their configurations and dependencies, making it easier to share apps from machine to machine. This simplifies collaboration within development teams and between developers and testers. Because developers don't need to worry about setting up and maintaining composable infrastructure environments, they can put their full focus on creating new features, fixing issues, and shipping software.

Simple Scalability in Both Directions

As more infrastructure is added in, it's auto-integrated with the existing infrastructure so it's ready to go and just becomes part of the pool of capacity. Because it's so easy to combine resources on the fly, it eliminates the need to so dramatically overprovision infrastructure, and instead allows infrastructure to be provisioned right sized and easily grown or shrunk as needed.

REMEMBER

Resource disaggregation allows IT to deploy just those resources that are necessary. There is no need to deploy, for example, more compute resources just because more storage is being added.

For both of these scenarios, there is a clear financial benefit. IT is able to grow and shrink as necessary and in whatever increments make sense, and there is no need to deploy resources that would simply go to waste.

Traditional as Well as Cloudlike

A composable environment allows organizations to run both kinds of applications covered in Chapter 1. You're able to run those traditional applications that demand traditional resources. At the same time, though — and in the same environment — you can run more modern cloudlike applications that your business demands.

By being able to support both modes of IT, you help to move IT into the business driver's seat.

Chapter 5

Software-Defined Intelligence

In This Chapter

- Seeing how a template-driven infrastructure environment streamlines IT operations as a whole
- Understanding the importance of frictionless IT and how it plays into the idea economy
- Seeing how composable infrastructure brings together hardware and software in a way that enables IT to become a driver of the business

In Chapter 4, you learn all about fluid resource pools and how they can support all the different workload needs in your data center. In this chapter, I introduce you to the software that brings together your entire composable infrastructure environment.

The Software-Defined Data Center

You're likely familiar with the variety of vendor initiatives around the software-defined data center (SDDC). For many, these endeavors have been fractured, resulting in multiple software layers, application programming interfaces (APIs), and administrative paradigms. What is needed is a fast, common, policy-based automation of applications and infrastructure across development, testing, and production.

To deploy infrastructure quickly, more and more organizations are seeking to treat infrastructure as software. This allows them to deploy it, version-control it, and bring it down in the same way they manage the application software they've developed. This powerful, common software layer then becomes a complete, configurable, and programmable abstraction layer for all resources in the data center.

With all resources controlled virtually as software elements, practitioners gain control over their infrastructure and can actually accelerate business in ways that were not possible just a few years ago. The various infrastructure elements simply become an extension of the software layer.

Template-Driven Infrastructure

It's become commonplace in some environments to create templates for new virtual machines that need to be deployed. What if you could do this for every workload in your environment, regardless of the underlying platform that the workload needs?

The HPE composable infrastructure API (see Chapter 6) lets IT administrators compose and manage physical, virtual, and cloud infrastructure essentially on demand, via automated templates, giving them the ability to request, flex, update, and heal resources quickly, more efficiently, and with fewer errors. The interface can be used for high-level orchestration, making for easier alignment with DevOps workflows as opposed to forcing workflows to align with multiple APIs. This helps administrators and software developers be more productive. Composable resources are provisioned together with their state (BIOS settings, firmware, drivers, protocols, and so on) and the operating system image using repeatable templates. This is ideal for traditional IT as well as the DevOps approach because it eliminates time-consuming provisioning processes across operational silos that often delay projects for weeks or months. Automated life cycle operations reduce cost, save time, and increase time-to-value for your business.

Templates go far beyond just initial deployment. With them, you can also simplify system updates and enforce compliance to ensure infrastructure stability. You're able to manage deployment plans and create bootable images from capturing, cloning, or customizing golden images. Furthermore, you can enforce compliance using templates to provision, update, or rollback images quickly to minimize maintenance windows.

This software-driven data center architectural model imbues IT with eminent flexibility that simply isn't possible with legacy architectures. In fact, it's easy to equate these kinds of capabilities with those that are present in public cloud environments. With those services, you're not required to physically deploy a bunch of servers and storage to run your workloads. You simply consume the resources provided by the cloud provider.

REMEMBER

Of course, in a composable infrastructure environment, you — as IT — still need to deploy hardware, but for your users, you essentially become a cloud provider making available on-demand template-driven resources.

Frictionless IT

Under traditional computing environments, there is a lot of friction and angst inside the IT department, too. Different management silos carry responsibility for different aspects of the environment; they don't always align and sometimes lead to turf battles. These kinds of issues do nothing but introduce delay to user requests.

Composable infrastructure also provides the capability for frictionless operations. No longer do you need to task your IT staff with manually maintaining a bunch of different firmware systems across a bunch of different device types. Change operations such as updating firmware, adding additional storage to a service, or modifying network connectivity are automatically implemented via a template, significantly reducing manual interaction and human error. This empowers IT to configure the entire infrastructure for development, testing, and production environments using one interface and in one step with precision, accuracy, and speed.

Composable infrastructure helps to remove the friction from the IT equation by providing a more generalist approach to resource management. Instead of needing teams of resource-focused subject matter experts, organizations can hire individuals with a wider breadth of data center knowledge and with skills that help them better align IT infrastructure with business goals.

Hardware and Software Architected as One

Composable infrastructure uses flexible pools of compute, storage, and fabric, and a template-based approach to facilitate the move to continuous delivery. By using an open and unified RESTful API (see Chapter 6) together with repeatable templates, composable infrastructure provides a programmatic interface for higher-level orchestration tools and paves the way to the idea economy. This continuous delivery approach provides speed, agility, and a competitive advantage for the business.

With composable infrastructure, the infrastructure elements, both physical and virtual, consist of fluid resource pools that enable composition, decommissioning, and rebuilding of the granular resource elements. Resource elements include compute, storage, and networking.

In a composable infrastructure environment, there is one place to go to manage each and every element of the infrastructure and the workload environment. The software intelligence and single pool of resources enable a number of key business outcomes:

- **Reduction in capital expenditure (CapEx):** Because you don't have to deploy workload-specific resources to run different kinds of workloads, you're not in a position where you have "trapped" resources or resources in separate inaccessible silos.
- **Reduction in operational expenditure (OpEx):** By moving to a workload-centric architecture and collapsing disparate administration tools into a single tool, operational effort and time is reduced, freeing up resources for other initiatives.
- **Improvement in agility:** Perhaps even more important than reducing CapEx and OpEx costs, improving agility is another outcome that can be enjoyed thanks to composable infrastructure. The reason: Costs can only be managed to a certain point, but increasing agility can have a multiplier effect, which can be limitless.

Chapter 6

Unified Application Programming Interface

In This Chapter

- Understanding why an API is good, but API proliferation is bad
- Bringing everything together in the composable data center
- Helping IT to be seen as a revenue generator, not just a cost center
- Overhauling your software development practices with composable infrastructure

Even though I saved the application programming interface (API) chapter for last, it's just as critical of a game changer of composable infrastructure as a fluid pool of resources and software-defined intelligence. The API is native in composable infrastructure and enables infrastructure administrators and developers to treat the entire infrastructure as code.

Identifying the Problem with API Proliferation

Over the years, just about every hardware and software provider has implemented some kind of API to enable programmatic access to its product. With these APIs, infrastructure administrators and developers can write code to manipulate the environment. Do you need a new virtual machine? No problem! Write a few lines of code, and you've built yourself a brand-new one.

Imagine the mess that is created when you find yourself writing to multiple — sometimes even dozens of — different APIs, all from different providers. The complexity and potential for error is enormous. Now, what happens if you replace one component for a similar component from another vendor? Now you need to rewrite your code to leverage the new vendor's API.

It's an unsustainable reality. API proliferation is a real problem.

Composable as the Glue

Composable infrastructure provides administrators with a single, unified API that can manipulate any part of the environment, from compute to storage to networking and even to individual workloads because they are based on software-defined templates.

The unified API increases productivity and control across the data center by integrating and automating infrastructure operations and applications. It provides a single interface to discover, search, inventory, configure, provision, update, and diagnose the composable infrastructure. A single line of code fully describes and can provision the infrastructure required for an application, eliminating time-consuming scripting of hundreds of calls to low-level tools and interfaces.

With a unified API, you get a lot of benefits:

- You can write a single line of code to abstract every element of infrastructure.
- You get full infrastructure programmability.
- You get a bare-metal interface to replicate Infrastructure-as-a-Service (IaaS) outcomes.

IT: Cost Center or Revenue Generator?

In reality, IT will always be a cost center to some degree. After all, those general line of business applications aren't going to maintain themselves! But remember that there are two modes of IT and both are supported in the world of composable infrastructure.

For some applications, IT may be a cost center, and that's largely unavoidable, but by providing the right infrastructure, IT can become a revenue generator, even if it's indirectly.

The composable infrastructure API helps to support both sides of this coin. In traditional environments, IT can now automate its IT operational processes and design its workflow around enterprise needs. For the new breed of applications, DevOps can now automate applications through infrastructure deployment, scaling, and updates. The unified API aggregates physical resources in the same way as virtual and public cloud resources, so developers can code without needing a detailed understanding of the underlying physical elements.

A developer focus

By eliminating the need to manually rebuild environments after writing new code and performing testing, development time is significantly reduced. In fact, simplification is becoming a mega trend across most areas of IT because it lowers costs and enables agility.

For example, with composable infrastructure, if developers have an idea for a new application at lunch, they can have a new development environment (even a clone of production, if desired) up and running when they get back to their desks. They can immediately start developing their new application.

A multitiered and complex environment can potentially be created on demand by executing a single line of code. This infrastructure environment is not just made up of a few virtual machines, but real server, network, and storage hardware that allows developers to leverage a fluid pool of resources that can be quickly composed, decommissioned, and then recomposed back into different pools, when needed. The composable pool of infrastructure can be formed and reformed, as many times as needed based on business priorities.

Transforming IT

What does it take to transition IT from a support service into a new line of business focused on time-to-value and run as a profit center?

Without question, composable infrastructure is one direct path for achieving that goal. As you know, technology innovation comes from all corners of the enterprise. With API-driven infrastructure programmability, IT can expose the infrastructure to developers across the organization.

But let's think bigger than just allowing these developers to build out a couple of test environments and jump feet first right into what "infrastructure as code" *really* means. For this scenario, consider an organization that builds a lot of software.

Development requires constant builds and consistent configuration in order for testing to be effective. As organizations perform development, there is a need to continuously build and rebuild the underlying operational environment for development, testing, and production. Further, most applications require multiple underlying infrastructure elements in order to function. These elements may include database servers, web servers, networking devices, load balancers, and more. HPE composable infrastructure allows DevOps teams to fully automate the creation of all these items, thereby enabling focus on the code, not the infrastructure.

The concept of infrastructure as code can be summed up like this: Provision bare-metal infrastructure with one line of code — in the same way as virtual machines.

With composable infrastructure, costly and complex development cycles can be reduced thanks to the dynamic, adaptable nature of the underlying infrastructure. No longer will infrastructure be the barrier to development progress or innovation.

Accelerated and automated testing

Quality assurance and testing teams should always work with the latest code so they can have the most impact.

With composable infrastructure, testing can be done using the same infrastructure as production. Plus, that infrastructure can dynamically allocate to testing when testing occurs and de-allocate when testing is complete.

Integrate and automate across the data center

Infrastructure as code is a centerpiece of HPE's composable infrastructure strategy.

This fully programmable interface integrates into the management tools that data center administrators use to do their jobs. It is also future-proofed by integrating into open-source automation and DevOps tools. This integration extends the power of the infrastructure to everyone in the data center:

- Virtualization administrators can automatically provision hypervisor clusters and nondisruptively update infrastructure through the same interface used to manage the virtual machines.
- Facilities operators can visualize power consumption and thermal infrastructure through their Data Center Infrastructure Management (DCIM) interface and make workload placement recommendations.
- IT administrators can easily construct a cloud infrastructure, enabling them to be a service provider to the business.
- Application developers leveraging DevOps methodologies can rapidly provision infrastructure and applications together in a single recipe because infrastructure becomes code through the unified API.

The API-Driven Composable Promise

Composable infrastructure uses flexible pools of compute, storage, and fabric, and a template-based approach to facilitate the move to continuous delivery. By using an open and unified RESTful API together with repeatable templates, composable infrastructure provides a programmatic interface for higher-level orchestration tools and paves the way for DevOps.

The core of the approach is the unified API, which provides the ability to abstract any infrastructure element with just a single line of code. When coupled with the right infrastructure, the unified API enables abstraction and automation of any physical or virtual resource. This continuous delivery model provides speed, agility, and a competitive advantage for the business.

Chapter 7

Your Ten Composable Infrastructure Rights

As you look to develop your own strategy, you should have a certain set of expectations to which you can hold your provider accountable. These are the ten rights HPE believes should be expected in any composable infrastructure:

- **The right to support any workload:** Composability should provide a universal infrastructure for all workload types and the ability to provision and run any workload, whether on virtual machines, bare-metal deployment, containers, or cloud-native applications.
- **The right to use all resources:** A composable infrastructure should provide fluid pools of compute, storage area network (SAN), local storage, and network fabric resources that can be continually aggregated, disaggregated, and composed based on the needs of the application.
- **The right to a single unified application programming interface (API):** True composability provides one simple and open RESTful API that allows you to abstract and control every element of infrastructure — compute, storage, and fabric — and easily plugs into other programming elements.
- **The right to software-defined intelligence:** Composability should remove complexity from infrastructure provisioning and maintenance by providing programmable and template-driven software intelligence all included in a single management platform. It should have the ability to self-discover and auto-integrate while working with the infrastructure or the application.

- **The right to use any tool:** Composable infrastructure should deliver native integration with tools like Ansible, Chef, Docker, OpenStack, Puppet, and VMware, among others.
- **The right to true infrastructure as code:** A composable infrastructure should be able to deploy private cloud on bare metal, allowing the provisioning and control of physical resources from their applications.
- **The right to products architected for composability:** Your solution should be designed for composability from the ground up. Compute, storage, fabric, and management should work together to provision the right resource at the right time to run any workload.
- **The right to a return on your investment:** Composability should eliminate over-provisioning and stranded resources. Each workload should use only the resources it needs, and return those resources to the pool when they are no longer needed. This aligns processes and services around a single delivery model, reducing complexity and cost.
- **The right to future-proof your business:** There should be no limits to scalability or flexibility. With a composable infrastructure, your infrastructure should get out of the way and work harmoniously with any data center.
- **The right to start on the path to composability now:** Your solution should allow the deployment of next-generation infrastructure in incremental steps, delivering the benefits of composability where they're most needed today without disrupting critical core business applications.

Turn your data center into a revenue generator with composable infrastructure

IT and business alignment has been a dreaded phrase for many years, but misalignment is often no one's fault. It's a function of an IT department doing its best to provide an infrastructure that is solid, stable, and reliable. The business however, wants more flexibility and agility from IT and the IT infrastructure. To meet these sometimes competing demands, IT needs to implement an infrastructure environment that is rock solid and reliable while also providing the flexibility and speed to run a new style of business based on the concept of the idea economy.

- ***Data center architecture spectrum* — identify where composable infrastructure fits in your data center options.**
- ***The idea economy* — discover why IT always seems to be challenged by a need to provide stability while also providing flexibility to support new apps.**
- ***Two modes of IT* — learn why IT needs a single infrastructure that can support legacy apps while also accelerating the development of new apps and services.**
- ***Composable infrastructure* — find out how composable infrastructure provides the ultimate in flexibility and agility for the business.**

Scott D. Lowe has been in the IT field since 1994. After spending time in the trenches, Scott spent ten years as a CIO. Today, he's a partner in ActualTech Media, as well as a consultant providing insight and solutions to his higher-education clients.

Open the book and find:

- **How we got to where we are**
- **How the idea economy applies to IT**
- **How composable infrastructure enables the idea economy**
- **The pillars of composable infrastructure**
- **Business outcomes possible only with composable infrastructure**

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