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**HPE Special Edition**

# **HPE Synergy**

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**Learn to:**

- Apply Composable Infrastructure concepts to support both traditional and cloud native applications
- Deploy HPE Synergy Infrastructure to revolutionize workload support in the data center
- Analyze HPE Synergy infrastructure elements to maximize outcomes

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 **Hewlett Packard  
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**Scott D. Lowe**



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**by Scott D. Lowe**

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## HPE Synergy For Dummies®, HPE Special Edition

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# Introduction

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**C**omposable Infrastructure is the embodiment of HPE's Idea Economy vision and is intended to help organizations transform their IT function into one that is cutting-edge and business friendly. The goals are to infuse the IT architecture with the ability to enable business agility, flexibility, and speed.

HPE Synergy, the first platform built from the ground up for Composable Infrastructure, is a single infrastructure that reduces operational complexity for traditional workloads and increases operational velocity for the new breed of applications and services. It's the physical representation of HPE's Idea Economy outlook. The era of Composable Infrastructure is upon us!

## *About This Book*

In this 72-page book, I explain what makes HPE Synergy tick. After reading this book, you'll know what comprises an HPE Synergy environment, how it all fits together, and how it integrates with your existing data center.

Even if you choose to ignore everything else you read in this book, never forget that, no matter how much money is saved, if 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.

## *Foolish Assumptions*

In writing this book, I made a few assumptions about you, the reader:

- ✓ You have at least a basic understanding of data center computing, virtualization, and storage.

- ✓ You work in IT and want to learn more about data center architectures in general and composable infrastructure and Synergy in particular.
- ✓ You may be a member of your organization's technical staff, managerial staff, or executive staff.

## *Icons Used in This Book*

Throughout this book, I use icons to help you better spot key concepts. Here's a guide to those icons:



When I tell you something so important that you need to commit it to memory, I mark it with the Remember icon.



When I offer especially useful advice that you'll want to keep in mind as you analyze your own data center environment, I mark it with the Tip icon.



Throughout this book, when I tell you about potential pitfalls, I mark those paragraphs with the Warning icon. Make sure to pay attention to save yourself time, money, or at least a big headache.

## *Where to Go from Here*

There's only so much I can cover in 72 pages. To learn even more about Synergy, visit [www.hpe.com/info/synergy](http://www.hpe.com/info/synergy) for more information.



## Chapter 1

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# The Idea Economy and Composable Infrastructure

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### *In This Chapter*

- ▶ Reviewing the key ideas that comprise the Idea Economy
  - ▶ Discovering what makes an environment Composable
  - ▶ Establishing a baseline of Composable Infrastructure expectations
- 

**T**he 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 of these reasons revolve around continued challenges with the way that IT has traditionally done business.

This is not to say that IT has been doing everything 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.

Although IT is hard at work building out its current data centers, the world is changing. “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 — known as the *Idea Economy* — requires a different mindset and a different kind of infrastructure. It also results in critical outcomes, including the following:

- ✓ Energized growth
- ✓ Strengthened profitability
- ✓ Boosted productivity
- ✓ Enhanced innovation
- ✓ Increased organizational agility
- ✓ Improved customer experience
- ✓ Reduced risk

## Introducing Composable Infrastructure

Supporting the Idea Economy requires rethinking IT. A key way to achieve the goals of the Idea Economy is to move to a technology environment known as *Composable Infrastructure*. Composable Infrastructure helps organizations achieve important objectives related to infrastructure, objectives that are difficult — if not impossible — to achieve via traditional means, such as the ability to do the following:

- ✓ Deploy quickly with simple flexing, scaling, and updating
- ✓ Run workloads anywhere — on physical servers, on virtual servers, or in containers
- ✓ Operate any workload upon which the business depends, without worrying about infrastructure resources or compatibility
- ✓ Ensure the infrastructure is able to provide the right service levels so the business can stay in business

## 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 situation has led to the rise of the DevOps culture 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 required at the rate at which it is demanded, enterprise IT must increase its speed, agility, and flexibility to enable people anytime composition and re-composition 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.

You may be charged with supporting all this and still be required to use traditional infrastructure approaches. *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 its own staff members supporting it. Hardware and software can be expensive, but people are *really* expensive!



Composable Infrastructure provides an environment that supports the ability to run physical, virtual, or containerized workloads.

## *Any workload*

Do you have a legacy on-premises application that you have to keep running? Do you have enterprise resource planning (ERP) software that currently powers your business but that 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 to dynamically create 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 architecture.

## *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* criticality. 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.

## Chapter 2

# HPE Synergy Overview

### *In This Chapter*

- ▶ Understanding the components that comprise an HPE Synergy environment
- ▶ Identifying the key design principles that underlie the HPE Synergy environment
- ▶ Seeing how a stateless infrastructure enables eminent workload mobility and agility

If you read Chapter 1, you know how Composable Infrastructure can help you to accelerate your business, but you may be wondering just how you can embrace this architectural paradigm and shift your business into high gear.

That's where HPE Synergy comes in. As a next-generation data center architectural option, Composable Infrastructure embraces and extends key concepts and traits from the architectures that have come before it, including converged and hyperconverged systems.

Simply trying to “bolt” Composable onto one of these less-inclusive architectures wouldn't have resulted in a complete, tightly integrated solution. With that in mind, HPE has developed the first platform architected for composability focused solely on helping you achieve the key outcomes behind the Idea Economy.

In this chapter, I fill you in on the primary characteristics of HPE Synergy and how it meets the demands imposed by the Idea Economy. Here, I stay in overview mode and touch on how each of these characteristics contributes to HPE Synergy as a whole. In subsequent chapters, I dive right into the

deep end and go in-depth on what makes each of these items actually tick.

## ***HPE Synergy Design Principles***

HPE Synergy is a new category of infrastructure designed to bridge traditional and cloud-native applications through the implementation of composable infrastructure. The HPE Synergy product line delivers on a series of key architectural principles, each of which is described in the following sections.

### ***Fluid resource pools***

Composable Infrastructure starts with fluid resource pools. Composable pools of compute, storage, and fabric work as a single structure, ready to boot up for any workload. Such pools can also be instantly turned on and flexed to meet the needs of any business application.

The fluid nature of this architecture effectively eliminates stranded resources 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 resource individually. You aren't forced to add resources that aren't required in order to get the resources you need.

### ***Software-defined intelligence***

Software-defined intelligence means that HPE Synergy bakes intelligence right into the infrastructure and uses workload templates to tell the infrastructure how to compose, recompose, and update on-the-fly in a very repeatable, frictionless manner.

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.

## Statelessness is a virtue

Perhaps one of the biggest challenges in today's data center is the fact that so many workloads have a "state" associated with them in a number of ways. In traditional environments, workloads are closely linked to the specific underlying hardware — physical or virtual — upon which they run. For example, every network adapter in a system has a unique MAC address. Server firmware and BIOS have revision levels that are not always kept in sync in a traditional environment. The problem here is that workloads may end up tethered to these states. For example, you may have a workload with licensing that is tied to a network adapter's MAC address.

This makes workload mobility and recovery very difficult because when hardware fails — and it will fail from time to time — all the state information that was tied to the failed hardware then needs to be re-created at a new location before the workload can be brought back into service. In short, this statefulness increases downtime.

In a stateless architecture, such as that provided by HPE Synergy, state information is independent of hardware and can be easily shifted to a new location, along with any workloads that are dependent upon that state.

## *Unified application programming interface*

As organizations seek to implement infrastructure that is less hands on and far more automated, it's important to have the tools — such as application programming interfaces (APIs) — to accomplish this automation. With these tools, the infrastructure can be programmed like code, bringing powerful Infrastructure-as-a-Service (IaaS) capabilities to the private data center.



The unified API can be served up to people who just want to update existing apps or code new apps and be able to drive infrastructure directly as code.

## *Architecture Overview*

The HPE Synergy platform is composed of a number of elements, which, when brought together, bring numerous benefits.

## Composable frame

The HPE Synergy 12000 Frame is the hardware foundation for HPE's Composable vision and provides a location in which compute, storage, fabric, and management are all aggregated.

The HPE Synergy 12000 Frame is optimized to include all elements to run any workload. It includes embedded management and is designed to support a wide range of compute modules and storage options. The back of the frame includes fabric interconnects, enabling flexibility with regard to storage and other interconnectivity needs.



The frame is designed to be optimized for longevity. HPE has taken into consideration ongoing requirements from a power, cooling, and bandwidth standpoint that may occur over the next decade. You'll be able to protect your investment even while you go through multiple generations of compute, storage, and fabric resources. Plus, as technology moves from copper connectivity to fiber optics, you'll be able to upgrade your environment to leverage this paradigm shift. The frame is plumbed to allow you to grow from a bandwidth perspective, from 10 to 25, 40, and 100 GbE and beyond.



For more on the HPE Synergy 12000 Frame, turn to Chapter 3.

## Composable management



HPE Synergy features two management components that administrators use to administer workloads running in the environment:

- ✓ **HPE Synergy Composer:** HPE Synergy Composer, powered by HPE OneView, enables you to deploy, monitor, update, and manage infrastructure through its life cycle from one interface.

As the window into HPE Synergy, the Composer provisions compute, storage, and fabric resources using a template process. This allows infrastructure to be deployed and consistently updated with the right configuration parameters and firmware versions — streamlining the delivery of IT services.



✓ **HPE Synergy Image Streamer:** Deploying a typical operating system or hypervisor can be time consuming because it requires customizing and/or copying each image for each compute module. HPE Synergy Image Streamer accelerates these processes through tight integration with HPE Synergy Composer templates.

The image payload consists of your compute module's profile (from HPE Synergy Composer), your golden image (the operating environment with a bootable operating system and application and the I/O driver version) and the personality (the operating system and application configuration). Through the template, bootable images are deployed across stateless compute modules using a simple, consistent process.

For more information on HPE Synergy management modules and capabilities, turn to Chapters 4 and 5.

## *Composable compute*

Running multiple workloads requires the use of compute modules with a wide, unrestricted choice of CPU and RAM. In an HPE Synergy environment, compute modules provide the performance, scalability, CPU and memory density optimization, storage simplicity, and configuration flexibility that enable a variety of workload support.

Beyond CPU and RAM, HPE Synergy compute modules can optionally provide many local storage choices, converged networking, as well as specialized graphics capabilities for workloads that require such resources.

For more information on HPE Synergy compute modules, turn to Chapter 6.

## *Composable storage*

HPE Synergy provides support for file, block, and object-based storage systems and supports a variety of both internal and external storage modules and arrays. For example, Synergy direct attached storage modules support everything from traditional applications such as Microsoft Exchange or database applications to Hadoop Analytics.

Administrators can also choose HPE StoreVirtual VSA to create virtualized clusters supported by HPE Synergy storage modules allowing you to take advantage of tiering for performance on a highly dense, scalable storage platform with the flexibility required for their VMs and VDI solutions.



If you need high-powered, highly scalable storage, HPE Synergy offers a fully composable Tier 1 flash storage option, leveraging the proven HPE 3PAR platform. It's a great performance storage option that scales easily to support data-intensive and mission-critical applications.

The world of storage in an HPE Synergy environment is discussed in much more depth in Chapter 7.

### *Composable fabric*

Fabric is a critical component in any environment and has often been a difficult resource to integrate and manage. HPE Synergy effectively eliminates these challenges by enabling rack-scale multifabric connectivity, which eliminates the need for standalone top-of-rack switches, improves performance, provides cost efficient scaling, and simplifies life-cycle management.

HPE Synergy fabric provides workloads with high-performance connectivity that easily integrates with existing SAN/LAN infrastructure. The fabric allows you to create a pool of capacity that can be configured to rapidly provision infrastructure. With wire-once, change-ready templates, you can move workloads and make updates without having to modify the network.

With support for native Fibre Channel, Fibre Channel over Ethernet (FCoE), and Flat SAN storage connectivity, the composable fabric has the ability to support any storage that your workloads demand.

Fabric is a key interconnect resource; for more information, turn to Chapter 8.

# Chapter 3

## HPE Synergy Frame

### *In This Chapter*

- ▶ Looking at the general architectural design of the HPE Synergy frame
- ▶ Seeing how the frame provides an ultra-high-speed, highly available design and experience
- ▶ Finding out about all the future-proofing engineered into the HPE Synergy frame

**T**he HPE Synergy 12000 frame is the foundation of HPE Synergy and accommodates compute, storage, fabric, and management in a single infrastructure.

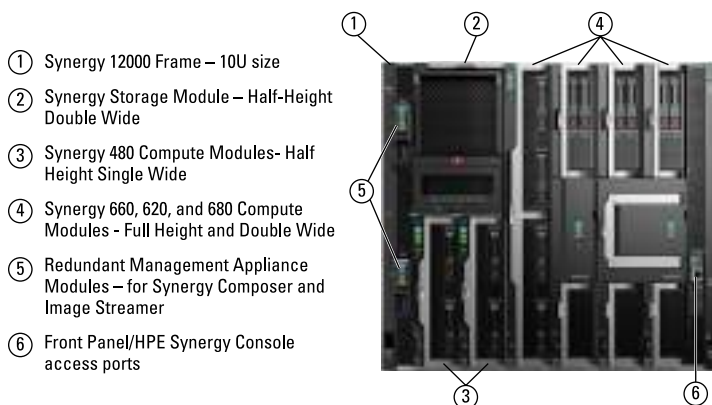
In your journey to Synergy-based composable goodness, you can start an environment with just a single frame, or you can start with a rack or racks of frames. And then, simply through a single Composer appliance, you can connect multiple frames with overarching management.

Just like you wouldn't buy a brand-new sports car without understanding what it can do, you shouldn't buy new data center infrastructure without a bit of a speeds-and-feeds assessment. In this chapter, I'm going to provide you with enough information about the HPE Synergy frame so you have a very clear idea of what it can do for you.

## *General Architecture*

Physically, each of your new HPE Synergy 12000 frames consumes just 10U of rack space in a standard 19-inch rack, making it easy to deploy in any current data center environment. Like any good expandable and scalable data center element, your frame sports module bays that you use to extend

its capabilities. The frame's front module bays offer flexibility to integrate a broad portfolio of compute and storage modules of different types and sizes, while also providing bays for management appliances. But you're not just buying for today. You have tomorrow to think about, too. To that end, the Synergy 12000 frame incorporates future-proofing designs to support the components and new technologies of tomorrow. In Figure 3-1, you can see the front of the enclosure and where each component fits.



**Figure 3-1:** The front of the HPE Synergy frame.

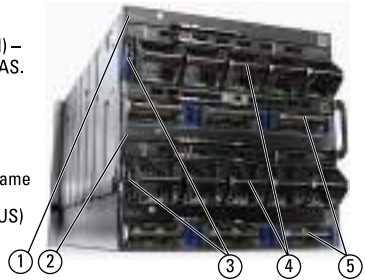
Before we jump into workload support, let's take a peek at what keeps the electricity and cool air flowing through each of your frames. First, in order to make installation as easy as possible, the frame uses standard 8.2kW power feeds. Each frame supports up to six 2,650-watt power supplies that are 96 percent efficient with 80PLUS Titanium certification. More efficient power supplies translate to lower electrical usage, which reduces your electric bill each month.



Even today's power-sipping solid-state disks and other components will get hot if not properly cooled. As such, each Synergy frame provides an efficient cooling system, with ten built-in fans included. No more having to guess how much cooling you need now or in the future.

All of this — and more — slots into the rear of the frame. Figure 3-2 shows you what the back of the frame looks like.

- ① Three primary InterConnect Modules (ICM) – Virtual Connect Ethernet, Fiber Channel, SAS.
- ② Three Redundant Interconnect Modules
- ③ Two Redundant Frame Link Modules
- ④ Ten System Fan Modules standard with Frame
- ⑤ Six Titanium 2650W Power Supplies (80PLUS)



**Figure 3-2:** The rear of the HPE frame.

I go into much more depth about the individual frame components throughout this book.

## ***Appliance bays: Embedded management***

Every HPE Synergy 12000 frame features two bays that are designed to house management appliances, including HPE Synergy Composer and Image Streamer. With two appliance bays in every frame, full redundancy of the management infrastructure is built in while leaving room for future appliances in multi-frame environments. To make things even more reliable, redundant appliances may be placed in different frames in a group of linked multi-frames.

The frame's design physically embeds HPE Synergy Composer with HPE OneView management software to compose compute, storage, and fabric resources in any configuration. HPE Synergy frames may be linked into larger groups or domains of frames to form a dedicated management network, increasing resources available to the business and IT efficiency as the size of the infrastructure grows — achieving both CapEx and OpEx economies of scale.

Appliance bays link directly to the frame Link Modules in the rear to provide detailed information regarding compute, storage, and fabric resources.



Currently, there are two management appliances available for the Synergy appliance bays:

- ✓ HPE Synergy Composer
- ✓ HPE Synergy Image Streamer

## *Device module bays*

HPE Synergy module bays accept a variety of compute and storage modules. The frame's flexible design supports half-height, full-height, and full-height double-wide compute modules, and a half-height double-wide storage module.

## *Front panel*

The front panel on every frame offers a direct connection to the Synergy console or KVM connection point to the Composer. On multiple linked frames, it provides a single management connection point to HPE OneView for all frames in the management ring.

## *Interconnect bays*

The back of the frame sports a number of bays to enable connection of HPE Synergy frames with a whole neighborhood of components, including frames, networking, and power, while also providing efficient cooling with ten built-in fans.

I'll focus here on the frame connectivity side of things. Let me start by quickly mentioning that you're not stuck with just a single frame. You can operate a Synergy environment with multiple racks of frames in a single management ring, all managed by the Composer. Frames connect to each other via a frame link module and a simple cable.



Each frame also supports up to three fully redundant fabric bays for many fabric Interconnect Module combinations.

## *The management ring and frame Link Modules*

Frame Link Modules provide the link from the management appliances to the resources in each frame. Each frame has two slots for full redundancy. The frame Link Module (shown in Figure 3-3) is the key point for providing resource and health information of the frame to the management appliances. On each frame Link Module, there is a management port for access to the Composer management appliance by the admin and link ports for multi-frame linking and setup. In addition, this new frame link topology or ring option for linked systems offers debug and diagnostics benefits to the systems.



**Figure 3-3:** The HPE Synergy frame Link Module.



The management ring operates on a highly available isolated 10 GbE infrastructure network, providing more than sufficient management bandwidth for today and tomorrow. Traversing this link is all the Synergy resource information and telemetry for each frame connected in the ring.



In a multi-frame infrastructure, you don't need to buy Composer or Image Streamer appliances for each and every frame. Instead, you get to enjoy economies of scale! You need to deploy just a single pair of Composers and/or Image

Streamer appliances, which can support multiple racks of frames with full redundancy.

Figure 3-4 shows multiple full racks of Synergy frames, all powered by a set of two management appliances deployed in a highly available, ring configuration.



**Figure 3-4:** Multi-frame Synergy environment.

## *The midplane and speeds and feeds*

The frame's direct-connect midplane delivers a whopping 16.128 Tb/s of bandwidth and is future-proofed with a photonic-ready design that will exceed bandwidth requirements for the next decade. In other words, you won't have to replace your frames anytime in the near future, and they'll support multiple generations of modules, ensuring that your infrastructure investment is well protected.



This high-bandwidth midplane means you don't need to compromise when it comes to the performance of interconnectivity in the frame.



## Photonics ready

As with everything in IT, seismic shifts often disrupt entire industries and have the potential to supplant existing equipment in favor of new designs. Today, most data center hardware — with the exception of networking — is based on copper interconnectivity. In the coming years, however, we should begin to see more of this copper-based connectivity transition to glass-based fiber optics.



With that will come entirely new server designs and many companies will be forced to re-create their entire product portfolios to accommodate the change. With Synergy, HPE has designed a solution that is able to easily transition to photonics as copper use declines. As such, you won't need to rip and replace your Synergy frames and modules.

## Ensuring Reliability, Availability, and Flexibility

Although we've already covered a whole lot regarding the reliability, availability, and flexibility of the frame, the power of these characteristics can't be overstated. In the HPE Synergy frame, these characteristics are brought to life thanks to the midplane, which provides massive levels of growth potential.

The HPE Synergy 12000 frame includes a number of features that improve the overall reliability, availability, and flexibility of the platform:

- ✓ **Three redundant fabrics:** HPE Synergy Composable Fabric module bays support up to three *redundant fabrics* per frame, and the QSFP unified ports can be configured for either Ethernet or Fibre Channel.
- ✓ **Redundant management modules.**
- ✓ **Ring-based management architecture.**

Table 3-1 provides you with a high-level summary of the characteristics and capabilities of each HPE Synergy 12000 frame.

Table 3-1 The HPE Synergy 12000 Frame in a Nutshell	
Model	12000 frame
Rack units	10U per frame
Compute bays	12 half-height, 6 full-height, 3 full-height double-wide
Module types	Half-height, full-height, double-wide full-height compute modules, double-wide half-height storage module
Fabrics supported	3+3 Redundant Fabric Modules Ethernet/FCoE, Fibre Channel, and SAS
Management	HPE Synergy Composer powered by HPE OneView
Total bandwidth	16.128 Tb
Cooling	10 fans (included)
Power	6x 2650 W, 96% efficiency, –48 V dc, 277 V ac, 380 V dc

# Chapter 4

## HPE Synergy Composer

### *In This Chapter*

- ▶ Simplifying deployment and configuration of resources in your environment
- ▶ Accelerating updates using templates
- ▶ Automating applications and workloads using the Unified API

**C**omposable Infrastructure allows flexible handling of resources to address both traditional environments and the cloud-like environments of the Idea Economy. HPE Synergy Composer is the management appliance that brings Composable Infrastructure to life (see Figure 4-1).

Manages Composable Infrastructure  
for compute, storage, and fabric resources

Powered by HPE OneView  
for infrastructure as code  
life-cycle management

Designed for High Availability  
using redundant physical appliances

Enables automation via Unified API  
using a programmable REST interface



**Figure 4-1:** HPE Synergy Composer management appliance.

HPE Synergy Composer is a hardware management appliance that is powered by HPE OneView. Composer provides a single interface for assembling and reassembling flexible compute, storage, and fabric resources to support business-critical applications and a variety of workloads, whether they are bare metal, virtualized, or containerized.

“Infrastructure as code” allows physical and virtual infrastructure elements to be programmed and treated like software

code. It provides on-demand delivery and support of applications and services with consistent governance, compliance, and integration. This approach accelerates the transformation to a hybrid infrastructure.

HPE Synergy Composer provides life-cycle management to deploy, monitor, and update your infrastructure using a single interface or the Unified API. IT departments can rapidly deploy infrastructure for traditional, virtualized, and cloud environments in just a few minutes — sometimes in a single step. Resources can be updated, expanded, flexed, and redeployed without service interruptions.

## *Deploy with Auto-Discovery*

Getting a Synergy environment up and running is very easy using Composer. First, a technician racks and connects the frame in the data center. Second, they ensure that the frame has power and network connectivity and is connected to all other frames in the ring.

Once powered on, Synergy Composer performs automatic out-of-the-box discovery and error checking for auto-assimilation of all resources. All linked frames and resources are discovered in minutes.

The technician can access an installation and startup wizard by connecting a laptop or crash cart to a display port on the front of the frame. This wizard allows the technician to have appropriate system access to do their job without having full control over the management environment. An installation screen shows the technician which hardware issues need to be corrected, such as poorly seated components or wiring errors. These issues are highlighted as red or yellow warnings. When all issues have been corrected and all the notifications are green, the technician knows that the hardware setup is complete and accurate (see Figure 4-2).

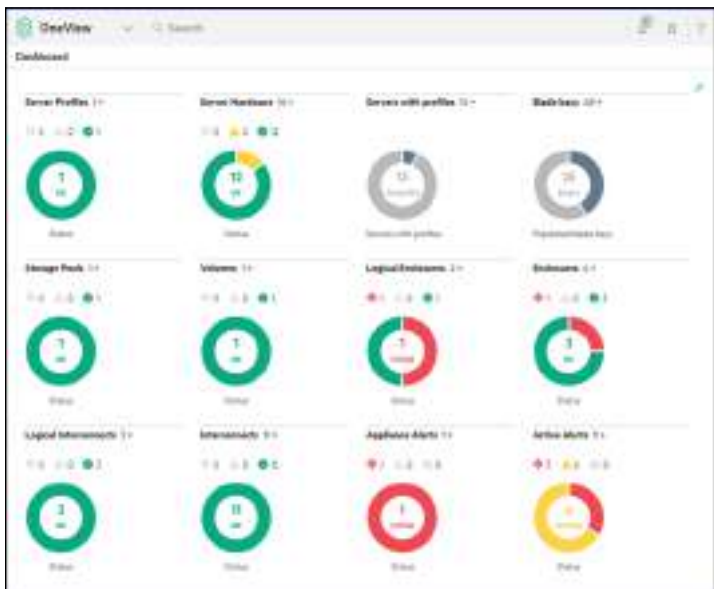


The Composer appliance can be accessed from any frame in the management ring. The startup wizard allows the technician to check that all components and connections are properly installed and compliant. Anything that would impair the ability of the devices to operate properly will be identified and corrected using this process.



**Figure 4-2:** Technician's guidance for initial configuration.

Composer also simplifies system health monitoring by providing a streamlined, modern alert management architecture. Resources are automatically discovered, inventoried, and set up for monitoring. This includes the automatic registration of traps and scheduling of health data collection, along with reports and a customizable dashboard (see Figure 4-3). Synergy compute modules are monitored immediately without requiring additional configuration or discovery steps.



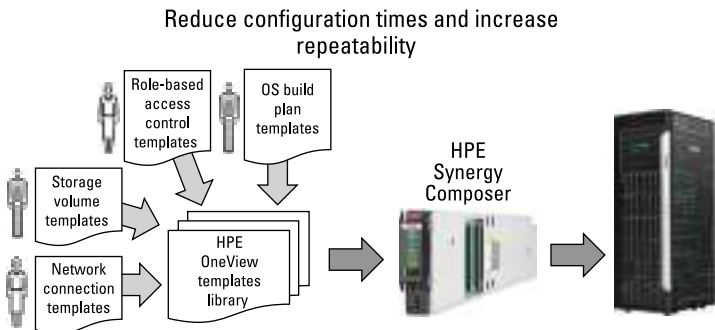
**Figure 4-3:** Dashboard for systems health and monitoring with customized alerts.

## Provision with Templates

Reduce, reuse, recycle! It's not just about saving the environment. You can apply similar concepts via templates in the world of composable. HPE Synergy Composer uses HPE OneView templates to provision compute, storage, and fabric resources.

Templates are the single point of control for defining compute module requirements with their associated storage and fabrics. They can also monitor, flag, and remediate the server profiles associated with them. Templates are key to delivering “infrastructure as code” capabilities.

As organizations seek to reduce IT costs while maintaining quality, templates become increasingly important. Users can quickly provision or update multiple servers in minutes using a single template for fast time-to-service. IT organizations can also capture their own best practices into templates for “infrastructure as code” consistency and repeatability, as shown in Figure 4-4. Templates give IT the agility they need to respond to changing business needs.



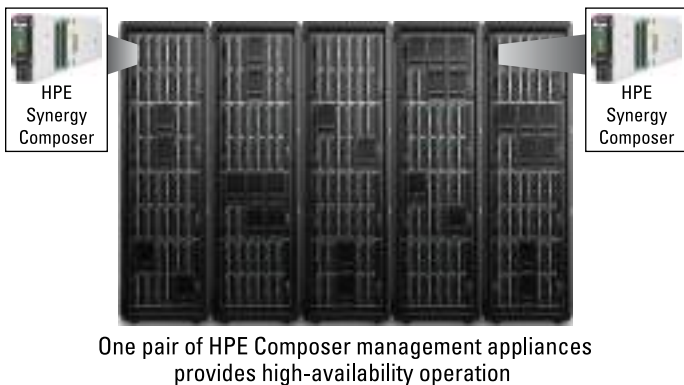
**Figure 4-4:** Templates build in your best practices to deliver consistent services.



Templates provision flexible blocks of composable compute, storage, and fabric resources together with their state — BIOS settings, firmware, drivers, and so on. IT can quickly create infrastructures specific to their application needs, and can eliminate time-consuming provisioning processes that cross organization and operational silos, which often delay projects for weeks or months.

## Grow Your Environment

You can easily grow your Synergy environment by adding more frames to support more workloads and add more storage, and you won't need to worry about scaling your management points at the same time. With a pair of HPE Synergy Composer appliances, you can manage racks of frames in a high-availability environment. In Figure 4-5, you can see that this set of racks is being managed by a single pair of Composer appliances.



**Figure 4-5:** HPE Synergy high-availability management with scaling.

Further scaling across multiple environments (and Synergy appliances) is possible using HPE OneView Global Dashboard.

## Accelerate Life-Cycle Operations

Perhaps one of the biggest challenges in IT these days is maintaining predictable infrastructure performance and availability. To this end, uptime and speed are key objectives of life-cycle operations.

Templates allow changes to be implemented automatically, reducing manual interactions and errors. Change operations — such as adding more storage to a service, modifying network connectivity, or updating firmware — are implemented via templates with ease and accuracy.

HPE Synergy lets you orchestrate firmware updates without impacting operations. With frictionless life-cycle operations, updates can automatically be implemented to compute modules without disruptive downtime. HPE Composer aids the frictionless updates by providing a single firmware/driver set in which all the firmware and system software are tested together as a single solution stack. The application owner has options on how to activate the update process, by launching it on demand or by aligning it to application maintenance windows.

Operational efficiency is increasingly important these days. HPE Synergy simplifies life-cycle operations so that IT can confidently change the infrastructure while dramatically reducing service interruptions, operational costs, and planned downtime.



HPE Synergy Composer templates also provide monitoring and flagging capabilities with remediation. Thus, profiles created from the template are monitored for configuration compliance. When inconsistencies are detected — sometimes referred to as “drifting from a baseline configuration” — an alert is generated indicating that the profile is out of compliance with its template. Or when a new update is made at the template level, all profiles derived from that template will be flagged as inconsistent. Once detected and flagged, the user has complete control over the remediation process for bringing individual modules or multiple systems back into compliance.

## Templates and statelessness

Server templates are a powerful way to quickly and reliably update and maintain existing infrastructure for the long term. HPE Synergy Composer uses templates to simplify one-to-many updates and manage compute module profiles. This feature adds inheritance to the process, meaning that updates can be made once in the template, and then propagated out to

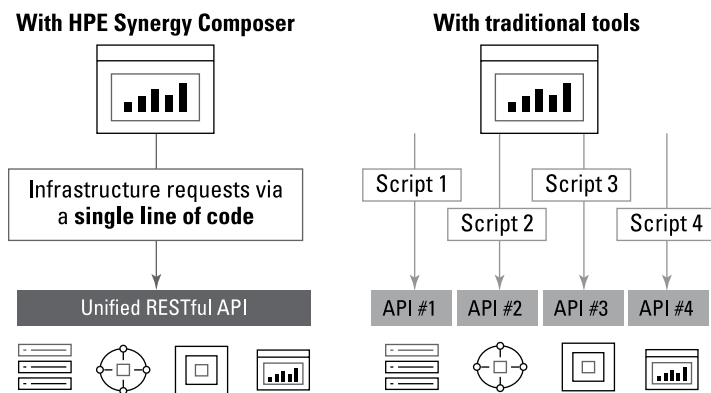
the server profiles created from that template. Elements such as firmware, BIOS settings, local RAID settings, boot order, network configuration, and shared storage configurations can be updated via a template to save time and energy. These template-driven processes deliver Synergy stateless operations in a way to keep from driving administrators crazy!



## Unified API

A business-friendly IT infrastructure needs to be able to quickly and easily automate infrastructure processes. The “infrastructure as code” mindset enables administrators and developers to program infrastructure to meet business needs.

The Unified API allows Synergy Composer users to programmatically access all the management functions that might be invoked through the HPE Synergy Composer user interface. The Unified API operates at a very high level of abstraction and makes actions repeatable, which saves time and reduces errors. For example, you can use an HPE Synergy template to “provision a server” using one line of code in the API (see Figure 4-6). You can also use this API to control other routine operational and maintenance tasks in your IT environment.



**Figure 4-6:** Unified API enables infrastructure requests using a single line of code.

The Unified API in HPE Synergy can be used for discovering, searching, inventorying, configuring, provisioning, updating, and diagnosing composable resources. This single API eliminates the need for multiple low-level programming interfaces, so administrators and software developers can be more productive.

HPE Synergy’s fully programmatic interface integrates into popular management tools for traditional management environments, such as Microsoft System Center and VMware

vCenter. It also integrates into popular open-source automation and configuration management tools like Chef, Puppet, Python, Powershell, Java, Ruby, OpenStack, and others. This capability of the Unified API to integrate into a variety of environments means composable infrastructure can support IT in both traditional applications and applications of the Idea Economy.



The Unified API uses modern REST protocols to create, aggregate, and host internal IT resources so automation tools can provision on-demand and pragmatically. Developers don't need to have a detailed understanding of the underlying physical elements. By connecting automation tools with HPE OneView, bare-metal infrastructure can be directed the same way as virtual and public cloud resources.

## *High-Availability Architecture*

The entire Synergy management architecture is designed with hardware redundancy for high availability (HA) operations.

Synergy Composer appliances can be deployed in pairs for hardware redundancy, as shown in Figure 4-5. Pairs of Composer appliances also operate in active-standby mode with failover so that the loss of a single appliance won't impact the ability to manage the environment.

Synergy Frame Link Modules link frames to form a management network and present appropriate device information to Composer for management. Frame Link Modules link frames into larger groups, or domains, to form a dedicated, highly available, multi-frame management network. This dedicated 10Gb air-gapped management network provides management security and enables automatic discovery and change detection.



Synergy's ring-based management architecture ensures that a Composer appliance is always available for use. If a link is compromised in one direction, traffic can flow in the other direction in the ring to maintain communication with a Composer appliance.

## Chapter 5

# HPE Synergy Image Streamer

### *In This Chapter*

- ▶ Streamlining and automating the workload provisioning process
- ▶ Getting a complete administrative experience
- ▶ Seeing why traditional workload deployment methods aren't enough

**T**he Idea Economy demands infrastructure that is fluid, flexible, and hyper-connected. But how can composable infrastructure rapidly deploy new operating systems, keep BIOS and firmware revisions in sync, and provision new compute modules with cloudlike speeds?

Magic!

But, if you're not an actual magician, you can act like one with HPE Synergy Image Streamer (shown in Figure 5-1).

- Manages physical servers like virtual machines
- Enables true stateless operation by capturing software state with hardware state
- Deploys, updates, and rolls back compute images rapidly for multiple compute modules
- Enables automation via Unified API



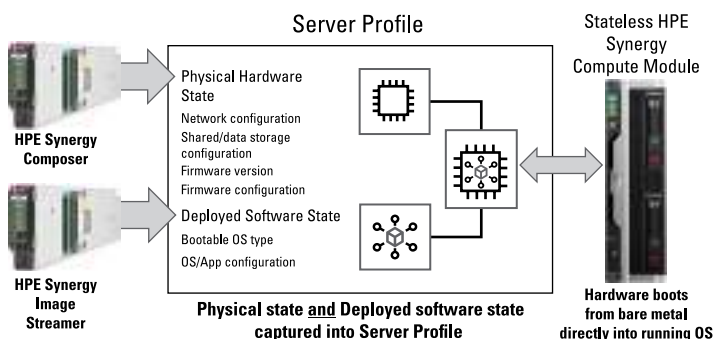
**Figure 5-1:** HPE Synergy Image Streamer management appliance.

HPE Synergy Image Streamer adds a powerful dimension to profiles and templates — the ability to manage physical servers like virtual machines. Image Streamer enables administrators to perform fast logical server deployments and updates to compute modules.

## Manage Servers like Virtual Machines

The Image Streamer works with HPE Synergy Composer to provision compute modules with bootable images created from your predefined set of golden images. With these golden images, you can deploy and update infrastructure with unmatched speed and agility.

Image Streamer creates bootable images for compute modules from your golden image. These bootable images are captured into an enhanced server profile as software structures (see Figure 5-2). These software structures, or “infrastructure as code,” can be constructed and/or updated in seconds.



**Figure 5-2:** Enhanced server profiles capture hardware state and software state.

The Image Streamer appliance maintains a physical appliance repository for all your software images. Golden images can be rapidly cloned to create unique bootable images for compute modules. This enables you to quickly boot new “bare metal”

compute modules directly into a running OS, or to update existing compute modules with software changes.

Image Streamer ensures high availability by providing redundant repositories of bootable images, which are securely stored so you don't have to worry about prying eyes. Single-frame configurations with a single Image Streamer appliance might be used for development, but multi-frame configurations with at least one pair of Image Streamers are required for production high-availability operations.



Image Streamer uses redundant appliances to provide high-availability operation (active-standby management) and to securely store your bootable images.

Image Streamers are tied to the fabric. Large environments may need multiple pairs of Image Streamer appliances to meet increasing needs.

## *Streamlined Deployment*

Let's compare the centralized, streamlined processes of Image Streamer with the traditional sequential processes for building new servers.

Traditional processes have a number of discrete steps, which are repeated for additional nodes:

- ✓ Provision a physical server.
- ✓ Deploy the operating system.
- ✓ Configure the various OS components.
- ✓ Install I/O drivers.
- ✓ Install your hypervisor.
- ✓ Deploy application stacks.
- ✓ Perform application configuration.

Administrators using HPE Image Streamer can create and deploy bootable images for multiple compute nodes in a single instance, with the OS and application stacks included.

These ready-to-run Image Streamer environments use a simple process:

- 1. Identify the image.**
- 2. Identify the deployment plan.**
- 3. Push the button.**

You'll find that Image Streamer is far faster than traditional processes. Perhaps more important, its processes are far less error prone than a traditional manual deployment.

Why? Because fewer moving parts and repetitions means there is less opportunity to introduce human error into the deployments.



If security is another source of sheer frustration, then Image Streamer provides even more good news: Unlike traditional deployments, Image Streamer doesn't rely on notoriously finicky and security-unfriendly PXE booting in order to operate. Image Streamer automatically creates and mounts its boot volumes as iSCSI devices for compute modules.

## ***Image Streamer Outcomes***

Image Streamer helps companies embrace the ideals of the Idea Economy by fully automating deployments, rapidly updating infrastructure, and centralizing compliance to infrastructure standards. By streamlining the deployment and update processes, organizations can gain tremendous flexibility and agility in their operations.

### ***Automating operations***

Image Streamer will enable you to automate deployments and updates of compute modules using software-defined intelligence and stateless infrastructure operation. When combined with the Unified API, you're also able to control all your processes programmatically.

This is a new paradigm for how to manage images in compute modules. You'll realize improved administrator control over images for multiple nodes while improving operating efficiencies and dramatically increasing agility. It's a win-win proposition.

HPE Image Streamer automates operations using similar processes for both initial deployments and image updates. Deployments are performed from your golden images, complete with operating environments and personalities, at extreme speed. Using Image Streamer, bare-metal compute modules can be booted directly into a running OS (or into a running application, if it's captured in your golden image)!



The operating image may include the full operating environment with a bootable OS and application stack, as well as the necessary I/O drivers. The personality includes the hostname, IP configuration, MAC address, and much more.

Updates are performed by capturing a currently running image, revising it to create a new golden image, creating new boot images, and then rapidly redeploying them. Each compute module is then rebooted to run on its new boot image. *Voilà!* HPE Image Streamer provides a simple user experience to accomplish compute boot/run provisioning and operating system deployment so that you can minimize any downtime related to ongoing maintenance tasks.



By leveraging Unified API access to HPE Image Streamer, you enable programmatic control of its functions. In other words, you can script against it. Provisioning can be controlled from the GUI or it can be seamlessly integrated into existing scripting processes to achieve a truly hands-off data center administration experience. This allows partners, developers, and users to integrate, automate, and customize HPE Image Streamer use for scaling across large infrastructure blocks.

## DevOps adopters

For those who have adopted DevOps, the Unified API can help you to create applications that can automatically deploy new infrastructure elements as necessary. For example, if you have an application that senses that the web server tier is becoming burdened, the application can simply

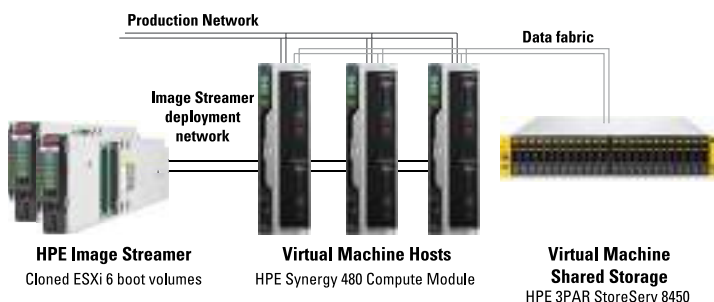
make an API call to Image Streamer and automatically deploy an additional web server to handle the increased demand and then, once the load has decreased, remove that new web server instance and return those resources back to the resource pool.

## Running stateless operations

Image Streamer enables true *stateless* operation by integrating your profiles with your golden images and your personalities for rapid implementation onto available hardware. Operations are performed in software for implementation onto hardware at a later point in time.

True stateless operation allows IP addresses to be assigned to software — for example, to operating systems (similar to the way IP addresses have been assigned to hardware). Stateless operation allows environment planning apart from hardware and for fast implementation onto hardware when it is available.

True stateless operation can simplify systems design and save you money. For example, you may be able to run diskless systems and save the cost of local hard drives and storage controllers (see Figure 5-3).



**Figure 5-3:** Stateless virtualization deployment architecture with Image Streamer.



With HPE Synergy Image Streamer, images can be created and then instantly cloned, personalized with a host name and IP addresses, and then booted as if they were from a SAN environment. Unlike booting from SAN environments, no additional setup or configuration is needed. Image Streamer can be set up faster and more efficiently than a boot-from-SAN environment, and it can deploy new images more quickly and at lower cost than traditional on-server boot disks.



## *Centralizing compliance*

Compliance is an increasing concern for IT organizations, whether it be regulations, security vulnerabilities, or simple “configuration drift.” HPE Image Streamer centralizes and automates image management to help address these concerns. Stateless operation separates the image profile from the hardware to make image updates and changes easy.

To update an image, IT administrators just revise the profile to associate with a new boot image. When the compute module is rebooted, the profile automatically updates to connect the module to the new image. Rollbacks are similarly accomplished by simply changing the profile back to the original boot image, followed by a reboot. This update process avoids complex and time-consuming patching processes across multiple nodes.



HPE Synergy Image Streamer automates the seamless configuration, provisioning, and updating of composable infrastructure. This unlocks the value of faster delivery of on-demand resources.

## *Operation with Composer*

Deploying a traditional OS or hypervisor can be time consuming because it requires customizing and/or copying each image for each server. HPE Synergy Image Streamer accelerates these processes by tightly integrating with HPE Synergy Composer. Together, these management appliances integrate processes to reduce complexity and provides infrastructure consistency.

One of the true advantages of this integration is the ability to rapidly deploy an entire application stack. The “deployed software image” is whatever you capture into your golden image. If you capture the application stack into your golden image, then this can also be rapidly deployed and updated!

How would this work in a real-life example? Suppose you have a web application that you need to deploy into the Synergy infrastructure. Composer will auto-discover and assimilate the resources in your Synergy infrastructure for your use. Image

Streamer will work with Composer to identify and create boot images for your compute nodes using your golden image. Image Streamer will deploy your golden image (including your web application, if it was included in your golden image) to the compute modules using your deployment plan. There is no need for you to provision specific resources in advance. Synergy will simply take what is needed and will return the unused resources back to the resource pool for use by other applications.

Figure 5-4 shows Synergy displaying its Image Streamer resources.



**Figure 5-4:** HPE Synergy displaying its Image Streamer resources.



The composable infrastructure process can be used for a wide variety of applications. It can be used for bare metal, virtualized, or containerized workloads. The infrastructure will identify and use whatever resources it needs to run. When the application is no longer needed, it will seamlessly return the resources to the pool. Try *that* with a traditional infrastructure!

## Chapter 6

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# HPE Synergy Composable Compute

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### *In This Chapter*

- ▶ Examining the breadth of the HPE Synergy compute module portfolio
  - ▶ Seeing the benefits of Intel's latest E5 v4 and E7 v4 series processors
  - ▶ Looking at the adapters available with HPE Synergy compute modules
- .....

**D**riving a truly agile and efficient IT infrastructure requires the transformation of traditionally rigid physical systems into flexible physical or virtual resource pools. HPE Synergy Composable Compute creates a pool of flexible compute capacity that can be configured almost instantly to rapidly provision infrastructure for a broad range of applications.

HPE Synergy compute modules are available in both two- and four-socket sizes, which provide significant levels of performance, scalability, density optimization, storage simplicity, and configuration flexibility. In this chapter, you'll be introduced to the HPE Synergy compute module lineup.

## *Systems Portfolio*

HPE Synergy compute modules come in a variety of shapes and sizes, with a wide variety of options to meet workload demands ranging from general purpose to mission critical. Table 6-1 gives you a look at an overview of the Synergy compute modules available from HPE.

**Table 6-1     HPE Synergy Compute Module Portfolio Overview**

<i><b>Model</b></i>	<i><b>Size</b></i>	<i><b>Sockets</b></i>	<i><b>Max RAM (64GB /128GB DIMMs)</b></i>	<i><b>Local Storage</b></i>	<i><b>Mezzanine Connectors</b></i>
HPE Synergy 480 Gen9 Compute Module	Half-height	1 or 2	1.5/3.0TB	2 SFF SAS/SATA, 2 SFF NVMe or 4 uFF drives	3
HPE Synergy 620 Gen9 Compute Module	Full-height	1 or 2	3TB	2 SFF SAS/SATA or 2 SFF NVMe or 4 uFF drives	5
HPE Synergy 660 Gen9 Compute Module	Full-height	2 or 4	3/6TB	4 SFF SAS/SATA or 4 SFF NVMe or 8 uFF drives	6
HPE Synergy 680 Gen9 Compute Module	Full-height, Double-width	4	6TB	4 SFF SAS/SATA or 8 uFF SATA or 4 SFF NVMe or 8 uFF drives	10

***Right-sizing compute***

Choose from any of the available Synergy compute modules to power many different types of workloads.

### ***HPE Synergy 480***

The HPE Synergy 480 Gen9 compute module (shown in Figure 6-1) delivers the capacity, efficiency, and flexibility to power demanding workloads and high levels of virtual machine density by providing a full range of processor choices, storage options, and a simplified I/O architecture. It's designed to optimize general-purpose enterprise workload performance including business processing, IT infrastructure, web infrastructure, and collaborative and high-performance computing in physical and virtualized environments.



**Figure 6-1:** HPE Synergy 480 compute module.

The HPE Synergy 480 Gen9 Compute Module delivers up to 24 DIMM slots (1.5 TB of RAM with 64GB/DIMM), and supports the entire Intel E5 v4 two-socket processor family without any DIMM slot restrictions. Increased memory footprint and performance support more demanding bare-metal workloads, and greater consolidation and efficiency are achieved through an increase in virtual machine density per compute module.



The Synergy 480 compute module is also uniquely suitable for virtual desktop environments thanks to its support for the NVIDIA Tesla M6 MXM Mezzanine Card. Additional MXM form factors and GPU options are available.

### ***HPE Synergy 660***

The HPE Synergy 660 Gen9 compute module (shown in Figure 6-2) easily handles data-intensive workloads. This is a full-height module sporting two or four sockets of Intel Xeon E5 goodness, 48 DIMM slots providing up to 3 TB of available memory, flexible I/O fabric connectivity, with six available mezzanine slots and a plethora of storage options. The HPE Synergy 660 offers a large memory footprint and powerful processors required to support more data-intensive workloads.



All HPE Synergy compute modules support a variety of different processors. They also have the same memory options and other similar architectural features for a seamless experience.



**Figure 6-2:** HPE Synergy 660 compute module.

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### ***HPE Synergy 620 and 680***

The HPE Synergy 620 (shown in Figure 6-3) sports one or two sockets, while the HPE Synergy 680 (shown in Figure 6-4) is a four-socket Gen 9 x86 compute module. These compute modules support E7 processors to give you the highest-performing, as well as the most reliable and resilient, options. You get maximum virtual machine density and choices that are perfect for IT projects such as in-memory workloads, high-availability requirements, and server consolidation.

These compute modules have almost 40 more RAS features than their EP counterparts, and support twice the RAM (24

DIMMs per processor), providing up to 1.5TB or 6TB maximum RAM with 64GB DIMMs in the two-socket and four-socket models, respectively. Ideal for financial, insurance, health-care, manufacturing, and retail enterprises, these compute modules are intended for any enterprise that requires very high levels of availability and memory, extended versatility, and real-time performance.



**Figure 6-3:** HPE Synergy 620 compute module.

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**Figure 6-4:** HPE Synergy 680 compute module.

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# Workloads

You can power any enterprise workload with the complete family of Synergy compute modules, as shown in Figure 6-5.



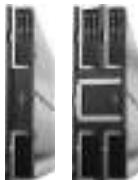
		
HPE Synergy 480 Gen9 v4	HPE Synergy 660 Gen9 v4	HPE Synergy 620/680 Gen9 v4
<ul style="list-style-type: none"> <li>• Collaborative Applications</li> <li>• Content Applications</li> <li>• Business Applications</li> <li>• IT/Web Infrastructure</li> <li>• GPU Computing/VDI</li> </ul>	<ul style="list-style-type: none"> <li>• Enterprise IT Consolidation</li> <li>• Virtualization</li> <li>• Structure database and large memory demands</li> <li>• Business processing</li> <li>• Decision support</li> </ul>	<ul style="list-style-type: none"> <li>• Workload and compute consolidation</li> <li>• Business processing</li> <li>• Decision support</li> <li>• IT infrastructure</li> <li>• Mission critical applications with large memory demands</li> </ul>
Intel® Xeon® E5-2600 v4 series 19 choices 4 to 22 cores	Intel® Xeon® E5-6600 v4 series 10 choices 10 to 22 cores	Intel® Xeon® E7-4800 v4 series 5 choices 8 to 16 cores Intel® Xeon® E7-8800 v4 series 6 choices 4 to 24 cores

Figure 6-5: Compute module workload comparison.

## Intel Xeon v4 processors drive Synergy compute modules

The features found in the Xeon v4 processors can be summarized into three general categories: orchestration, security, and performance.

### Orchestration

With Resource Director, the processor can more efficiently and dynamically manage resources like cache and memory.

- ✓ **Cache monitoring technology:** Provides additional insight by monitoring the last-level cache (LLC) utilization by individual threads, applications, or VMs. With this technology, the

system can more easily provide advanced real-time provisioning and resource-aware scheduling decisions.

- ✓ **Cache allocation technology:** Prioritizes important virtual machines, containers, or applications through software-guided redistribution of LLC capacity.
- ✓ **Memory bandwidth monitoring:** This feature extends what is available via cache monitoring technology by providing monitoring services for each and every running thread. This feature



helps to identify services that may be consuming excessive memory bandwidth, helping to ensure that memory resources are applied evenly.

- ✓ **Code and data prioritization:** Extends the cache allocation technology feature by enabling separate control over code and data placement in the last-level (L3) cache

### Security

Existing processor features have been augmented with new instructions, resulting in an encryption performance boost of up to 70 percent. The processors provide more secure key generation with non-deterministic key generation.

### Performance

Intel's processor lineup provides a number of performance enhancements, including the ability for scale-out workloads to achieve higher turbo speeds without being capped. Plus, with support for high-speed DDR4, systems can achieve up to an 8 percent increase in performance.

On the virtualization front, the Intel processors support the following:

- ✓ **Hosted interrupts:** Reduces latency when there is a lot of data access or I/O between virtual machines or between the processor and a virtual machine. This feature can reduce latency by up to 88 percent.
- ✓ **Page modification locking:** Keeps dirty guest pages in check. For example, if a guest VM is moving from host A to host B, some guest pages may remain on another server. This feature keeps these dirty pages in check, enabling more efficient VM migration performance.

In addition to all the capabilities mentioned above, the EX processors have almost 40 additional RAS (reliability, availability, and serviceability) features in the areas of CPU, QPI, Memory, System, and I/O. They also support twice the DIMMs per processor to fuel the quickest and most reliable data storage instantly retrievable from cache.

## Local Storage

HPE Synergy Composable Compute's flexible design optimizes internal storage choices to match workload requirements. If local drives are desired, each compute module has a flexible, front-bezel design that includes two or four HPE SmartDrive bays (two for two-socket systems and four for four-socket systems). Each individual SmartDrive bay supports one small form factor drive or two micro form factor drives with built-in RAID and a choice of SAS, SATA, HDD, and flash storage.

If internal storage is not required, such as environments using the HPE Synergy Image Streamer, you can order compute modules with no local storage hardware for a stateless configuration. For workload acceleration, PCIe NVMe SSDs from HPE combine the high throughput and low latency of a storage workload accelerator with the flexibility and convenience of a standard form factor drive, ideal for web scaling, cloud, OLTP, big data, or business intelligence.

With all the local options, you get a variety of choices for booting your operating system:

- ✓ Boot from management appliance (Image Streamer).
- ✓ Boot from DAS or SAN.
- ✓ Boot from USB, micro SD, or local drive.

This gives you flexibility in boot cost and high availability with dual boot capabilities.

## Adapters

The compute modules converge traffic over high-speed 10/20 Gb connections using HPE Converged Network Adapters (CNAs). When connected to an HPE Virtual Connect SE 40 Gb F8 module, each adapter provides multiple adjustable connections for data, storage, management, backup, and other uses to each 20Gb compute module port offering administrators unparalleled connectivity flexibility.



Internal Smart Array RAID controllers ensure that you receive superior reliability and increased compute module uptime by providing local fault-tolerance. These controllers also provide online sparing capability to enable automatic storage rebuilds after a drive failure, and fault prevention with predictive spare activation before a failure occurs.

## Graphics

Different workloads require access to different kinds of resources. For example, in server environments, supporting graphics is not generally all that important. However, when

you try to support virtual desktop infrastructure (VDI), graphics support takes on a new level of importance. In fact, poor graphics performance and storage performance have led to the downfall of many VDI projects.

With the HPE Synergy 480 compute module, HPE makes available an MXM form factor GPU to extend its graphics capabilities in order to better support applications that require a lot of graphics horsepower.



For example, the NVIDIA Tesla M6 MXM form factor GPU supports up to 16 users, running multiple displays/sessions, including 4K monitors at high frame rates. This is far more graphics capability than is available with typical Intel-based, bare metal CPU configurations. The HPE Synergy 480 with the Graphics Expansion Module can support up to six MXM GPUs paired with the compute module providing support for hundreds of 3D CAD users or thousands of task-oriented VDI sessions in a single rack.



## Chapter 7

# HPE Synergy Composable Storage

### *In This Chapter*

- ▶ Considering the breadth of the HPE Synergy storage portfolio
- ▶ Recognizing the advantage of internal-to-the-frame storage in a Synergy environment
- ▶ Finding out why HPE 3PAR StoreServ is a perfect fit for a Synergy deployment

In legacy environments, storage is a resource under assault from all angles:

- ✓ New companies and technologies challenge traditional methodologies but also introduce greater complexity and a sprawl of siloed storage pools.
- ✓ Hyperconverged infrastructure offerings are seeking to bring a semblance of simplicity to what is considered a complex market.
- ✓ Software-defined storage vendors are seeking ways to help organizations more easily scale storage capacity resources as the need for storage continues to explode in the enterprise.



Each storage approach has its own set of strengths and weaknesses. That's why it's so important to deploy an infrastructure that enables you to implement storage systems that make sense for your workloads and your organizational dynamics.

HPE Synergy Composable storage is flexible and agile. With Synergy's storage options, you can deploy any kind of storage into your environment, without having to compromise or settle for something that may not work in all instances. In this chapter, you learn about the primary types of storage available in a Synergy infrastructure.

HPE Synergy Composable Storage provides the ideal storage choices for every target workload. HPE Synergy Composable Storage offers high-density storage options that span from fully integrated internal storage modules and software-defined storage to Tier 1, quality of service assured all-flash arrays. No matter the data type, connectivity protocol, or service-level requirement, with HPE Synergy Composable Storage, you can respond to both planned and unplanned demand change.

As a key building block for many applications, the HPE Synergy Composable Storage Module is designed to store and share anything — file, block, and object data — with enterprise-class reliability. It delivers a new level of simplicity, density, and flexibility by eliminating the complexity and limitations of siloed resources and administration. Its high performance capabilities support I/O-intensive workloads like database, as well as email, file sharing, web scale applications, and media streaming. Each HPE Synergy Storage Module utilizes HPE Smart Array controllers in each compute module to accelerate performance, plus RAID protection and encryption to improve security and availability.



## Compute module local storage options

I briefly touch on the compute module local storage options in Chapter 6. Remember these key points from that discussion:

- ✓ Different compute modules have different maximums with regard to the number of local disks.
- ✓ You have a whole lot of options available to you: SAS SFF, NVMe SFF, Flash uFF, or diskless options.
- ✓ When you choose a diskless system, you're effectively able to avoid hardware-based state problems and enable eminent levels of workload portability.

## *HPE Synergy D3940 Storage Module*

Technology advances can be mind boggling when considered in a historical context. In 1956, IBM released a 5MB hard disk that weighed in at over a ton and required a forklift in order to move. Today, 5MB is considered paltry capacity and for those who deployed those 5MB behemoths back in the 1950s and 1960s, the HPE Synergy internal storage module would be the stuff of science fiction. With up to 40 drives per storage module, and support for up to four storage modules in a single frame, with no predefined ratio between storage modules and compute modules in the same frame, HPE Synergy can support up to 614TB of DAS storage in a 10U frame. As you can see in Figure 7-1, this module handily slots into the Synergy frame and consumes two half-height bays. HPE Synergy Composable storage is best optimized with all solid-state drives. According to industry analysts, SSDs provide for a compelling total cost of ownership. The benefits span five areas:

- ✔ Far fewer devices to meet performance requirements
- ✔ Much lower energy and floor space consumption
- ✔ Fewer application servers
- ✔ Lowered administration costs
- ✔ Higher average drive mean time between failure (MTBF)

The HPE Synergy Storage Module maximizes density and supports flash (SSD) and/or disk (HDD) storage in both SAS and SATA options so you can easily align storage resources with application needs. Its nonblocking SAS fabric allows full utilization of flash storage and up to two million IOPs when outfitted with all solid-state drives.

HPE has partnered with Intel to provide options around all-flash SATA arrays, configurable in the Synergy D3940 Storage Modules. The Intel SATA solid state drives provide for lasting integrity, reliable effective performance, and platform confidence you need in your data center. Intel drives were found to be more than 100 times more reliable at preventing Silent Data Corruption (SDC). They are validated on a massive scale

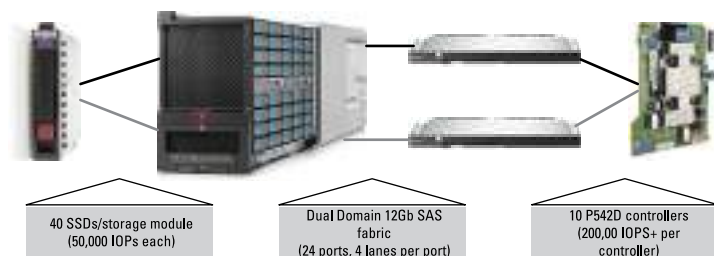
of over 5,000 workloads, and have up to 90 percent IOPs consistency on all product lines with less than 11 percent performance degradation.



**Figure 7-1:** HPE Synergy Storage Module.

With data center downtime costing, on average, \$8,850 a minute, selecting the right Intel SSD's for the Synergy Storage Module is essential. Intel makes three different tiers of SSD endurance drives: Read Intensive, Mixed Use, and Write Intensive. Selecting the right SSD for the right workload helps to ensure you receive the right performance and longevity of your drives.

#### Non-Blocking SAS Fabric delivers up to 2M IOPs\*



\*4KB Random Read Workload using SSD. 2M IOPs is for a single storage module connected to multiple compute modules.

**Figure 7-2:** HPE Synergy Storage Module nonblocking fabric architecture.





The HPE Synergy D3940 direct attached storage (DAS) module supports everything from traditional applications such as Exchange or database applications to I/O-intensive applications such as Hadoop Analytics. Finally, the Storage Module provides you with a choice of storage architectures for managing data. With the module and the right enabling software, you get support for file, block, and object storage types.

For a simple DAS array, the D3940 storage module carries with it a number of benefits:

- ✓ Easy to use (compose through the HPE Synergy Composer)
- ✓ Easy to deploy (just slide the module into a set of available frame bays)
- ✓ Highly scalable (up to 160 disks in a single frame; see Figure 7-3)
- ✓ Achieve up to 2 million IOPS when deployed with five storage modules, with no performance restrictions due to storage network constraints
- ✓ Can be composed in any ratio with any compute resources in frame



**Figure 7-3:** HPE Synergy Storage Modules in action.

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But wait, there's more!



The Synergy Storage Module does not have any native data services built in with it, but it is a great platform from which to leverage software-defined storage solutions such as HPE StoreVirtual VSA. As such, you're effectively able to use the storage module as a software defined storage array shared across multiple frames, and take advantage of data services such as thin provisioning, snapshots and clones, or adaptive optimization to maximize performance.

## *StoreVirtual Virtual Storage Appliance (VSA)*

What happens when you combine HPE Synergy D3940 Storage Modules with the software-defined storage goodness of HPE StoreVirtual VSA? You get a software defined storage powerhouse with these benefits:

- ✓ A highly scalable and flexible platform
- ✓ A solution that maps very well to VSA best practices
- ✓ Adaptive optimization for auto-tiering of data

In highly virtualized environments, virtual storage appliances (VSAs) have become a popular way to more easily manage and consume storage resources at the hypervisor level. VSAs are virtual machines that take responsibility for abstracting and pooling storage resources that are local to a host, including zoned drives from a Synergy storage module. When this aggregation process is complete, the VSA coordinates with other nodes in the cluster and creates a global, scalable pool of storage resources.



This is all about choice and having the ability to deploy resources that meet the unique needs of *your* workloads.

## Integration and interconnectivity

Many organizations have already made significant investments in their storage environments and may be hesitant to throw it all away. Never fear! Your HPE Synergy environment can easily connect to your third-party systems just as they always have. You may not enjoy the full breadth of composability — at least with

regard to storage resources — that is offered by solutions designed for HPE Synergy, but you can still connect to any iSCSI, Fibre Channel, NFS, or SMB storage system. The storage networking fabric available in the frame enables you to make such connections.

## *Composable All-Flash Storage Arrays*

Although DAS and software defined storage architectures are great for some workloads, there's a reason that external SAN- and NAS-based storage has remained a data center stalwart: It just works. Purpose-built arrays provide incredibly high levels of performance, scalability, flexibility, and reliability for Tier-1 storage requirements. With annual data growth rates in the double-digit percentage range, ensuring easy ongoing scalability is critically important. Additionally, Quality of Service (QoS) optimization means that your most mission-critical applications will receive the prioritization and protection they deserve.

Perhaps the biggest problem with external shared storage, however, is manageability. Fortunately, Synergy provides a solution to this vexing issue. For example, when you couple a Synergy deployment with HPE 3PAR StoreServ (see Figure 7-4) as an external-to-the-frame option, you're able to include that storage as a part of the composable management.

The HPE 3PAR StorServ system is a core part of the overall Synergy Storage family because it is a fully composable storage resource, much like the Synergy D3940 DAS module, but geared for a Tier 1 shared storage requirement. Under this scenario, you're able to carve up 3PAR-based LUNS using templates and profiles provided by Composer.



**Figure 7-4:** HPE 3PAR StoreServ 8450.

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This Fibre Channel–attached storage option includes the ability to leverage all-flash arrays that scale up to 24 petabytes of usable capacity per system, delivering massive performance, low latency, and extreme scalability. For workloads such as CRM, ERP or mission-critical databases requiring quality of service assured storage, and the most comprehensive native data protection and disaster recovery features, HPE 3PAR arrays offer composability and availability.

## Chapter 8

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# HPE Synergy Composable Fabric

### *In This Chapter*

- ▶ Looking at the full breadth of the HPE Synergy fabric module portfolio
- ▶ Adapting your Synergy environment to interoperate with your traditional networking infrastructure
- ▶ Reducing the amount of cabling in your data center infrastructure

**T**hroughout this book, I cover compute modules and storage modules, as well as interconnectivity with external systems. Have you wondered at all yet what brings all this stuff together in a Synergy world?

That's the role of the HPE Synergy Composable Fabric. HPE Synergy Composable Fabric delivers high performance and composability for the delivery of applications and services. It simplifies network connectivity using disaggregation in a cost-effective, highly available, and scalable architecture. HPE Synergy Composable Fabric creates a pool of flexible fabric capacity that can be configured almost instantly to rapidly provision infrastructure for a broad range of applications. The composable fabric, enabled by HPE Virtual Connect technology, helps you to eliminate up to 95 percent of network sprawl at the compute module edge. Virtual Connect liberates administrators from the constraints of a traditional infrastructure by bringing “wire-once” simplified management between network and compute resources.

## *A Single Disaggregated Pool of Flexible Resources*

HPE Synergy Composable Fabric's disaggregated, rack-scale design uses a master/satellite architecture (see Figure 8-1) to consolidate data center network connections, reduce hardware and management complexity, and scale network bandwidth across multiple frames.



**Figure 8-1:** Extending the fabric.

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HPE Synergy Composable Fabric employs a flat, east/west architecture to maximize data throughput and minimize latency with only a single hop within large domains of virtual machines or compute modules. This single-hop architecture goes a long way toward reducing fabric-imposed latency.

The intelligence is in the master module, which handles all the data forwarding decisions. The satellite only passes data packets from the compute module to the master, and vice versa. With the master/satellite architecture, the fabric resource can be extended up to five frames without a need for additional top-of-rack switches.

## *Reducing Networking Footprint*

Networking is an expensive data center resource and carries with it a great deal of complexity. By providing a fully converged environment, Synergy has the potential to help you reduce your networking footprint, lower costs, and make this resource vastly easier to manage.

### *Eliminate top-of-rack switching*

The master module contains intelligent networking capabilities that extend connectivity to satellite frames through the HPE Synergy 10/20Gb Interconnect Link Module, which can eliminate the need for top-of-rack switches and substantially reduce infrastructure cost.

### *Rack-scale fabric*

The reduction in components also simplifies fabric management at scale while consuming fewer ports at the data center aggregation layer, which further reduces costs. HPE Synergy Composable Fabric modules support up to three redundant fabrics per frame, and the quad small form-factor Pluggable (QSFP) unified uplink ports can be configured for either Ethernet or Fibre Channel to allow you flexibility in deployment options.

Further, scaling is fast and simple and nonimpactful from a performance perspective. When adding a new frame using HPE Synergy's Interconnect Link Module, the new frame is an extension of the existing fabric, and the east/west design scales so the performance of the existing workload is not negatively impacted. The solution also features ultra-low latency for east-west traffic with 3.84Tb/s throughput in any configuration.



Compare this to a legacy hierarchical architecture that uses a north/south design. Such a design has the potential to create an oversubscription bottleneck and adds latency caused by multiple hops, both of which negatively impact performance.

## Predictable performance

Perhaps one of the biggest challenges in historical data center architectures has been a lack of predictable performance, particularly as you extend and scale the architecture. With so many shared components, it's extremely difficult to predict what impact scaling might have on these shared components. Will it result in a bottleneck? Will it increase latency and impact the business?

Modern data center infrastructure designs — especially those supported by HPE Synergy — are striving to provide IT administrators and the business with ways to

grow the environment while retaining expected levels of performance. Being able to “go really fast” with a new infrastructure is great, but if you can't maintain that level of performance as you grow, it's almost worse to start out by going really fast and then, over time, slowing down.

The ability to achieve predictable levels of performance is even more important as you move to rack-scale infrastructure. Fortunately, HPE Synergy's fabric is well-suited to the needs of these kinds of environments and can easily grow with you without creating new performance-related headaches.

## Cable reduction

You've probably seen terrible data center cabling disaster photos on the Internet. In these cringe-inducing pictures, you see cabling plants that look like spaghetti and you probably think to yourself, “I'm glad I don't have to figure out that mess!”

Now, ask yourself this question: How many dozens of cables do you have strung around your data center? Perhaps you closely identify with those poor souls who have to dig through a mess of cabling every time something goes wrong. Or perhaps you've done an outstanding job at keeping your cabling color coded and perfectly neat.



Way back in the year 2001, I was hired as a systems engineer to build out a 40+ server farm with each and every server having connectivity to any of six different physical networks. Bearing in mind that this was in the pre-virtualization days, each of these 40 physical servers had six network connections, necessitating use of 240 switch ports. Let's say it was not an inexpensive build-out.



Between cabling rat's nests and expensive switch ports, maintenance of this kind of environment can be pretty challenging. Today, with HPE Synergy fabric modules, I'd be building a very different kind of architecture. In fact, each system would, in theory, be able to operate with just one set of cables connecting it to the fabric. These Synergy fabric modules enable abstraction and virtualization of network traffic that greatly increases overall efficiency.

## Composable Fabric Resources

HPE Synergy Composable Fabric can precisely match workload performance needs using its low-latency, multispeed architecture. It accomplishes this goal by using one device that converges traffic across multiple frames — creating a rack scale architecture — and directly connects to external LANs.



The HPE Synergy 3820C 10/20 Gb Converged Network Adapter (CNA; see Figure 8-2) also includes features that help organizations get more from their infrastructure. With the adapter's Flex-20 Technology, it converges Ethernet and FCoE onto a single connection simplifying I/O hardware by 50 percent and significantly reducing costs.

### Flex-20 Technology powered by Virtual Connect

Using Flex-20 and Virtual Connect technology, each redundant pair of Virtual Connect modules provides four software-adjustable downlink connections (three FlexNICs and one FlexHBA or Four Flex NICs) to dual-port 10 Gb adapters and 20 Gb Converged Network Adapters on each compute module.

Why is this important? Let's take the case of a hypervisor-driven environment. In such an environment, you may need to connect a host to a multitude of different networks. For

example, you need to have a network on which your virtual machines can communicate with users. You need a workload migration network and a management network.

With Virtual Connect capability, you can do all this with just a pair of adapters. By creating these networks virtually (hence the name Virtual Connect), all this traffic can share the same converged network route, helping you to reduce administrative burden and deploy far simpler environments.

The CNA (shown in Figure 8-2) is a mezzanine card that slots into a compute module. This mezzanine slot is electrically connected directly to the frame mid-plane where it attaches to a fabric module. The fabric modules can consist of either HPE Virtual Connect modules — Composable Fabric — or traditional switch modules for interconnectivity with traditional environments.



**Figure 8-2:** HPE Synergy 3820C 10/20 Gb Converged Network Adapter.

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I talk about the Virtual Connect modules here and integration with traditional environments later in this chapter.

There are three primary Virtual Connect fabric modules available for HPE Synergy frames:

- ✓ HPE Synergy 10 Gb Interconnect Link Module (see Figure 8-3, top)
- ✓ HPE Synergy 20 Gb Interconnect Link Module (see Figure 8-3, middle)
- ✓ HPE VC SE 40 Gb F8 Module (see Figure 8-3, bottom)



**Figure 8-3:** HPE Virtual Connect and Interconnect link fabric modules for HPE Synergy.

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Beyond networking, there are additional fabric modules available as well. Earlier in this book, you learned that compute modules could connect to internal storage via SAS connectivity. That is accomplished via the use of the HPE Synergy 12Gb SAS Connection Module (see Figure 8-4).



**Figure 8-4:** HPE Synergy SAS fabric module.

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## *Integration with Traditional Environments*

You probably have an existing data center environment and you may want traditional switch functionality at the edge. If you fall into this category, HPE offers a broad portfolio of switches for Ethernet and Fibre Channel networking, connecting the frame and compute modules.

HPE Synergy offers a complete end-to-end solution for customers who require traditional network-managed switches with Fibre Channel or Fibre Channel over Ethernet (FCoE) support. The HPE Synergy 40Gb F8 Switch is an Ethernet switch that gives full manual control to network administrators who want to manage their interconnects from a command-line interface (CLI). This fabric solution provides high-speed layer 2 and layer 3 switching capabilities, and allows the network administrator to independently manage the switch within the frame. The switch design uses the same master/satellite architecture as the HPE Virtual Connect SE 40 Gb F8 module to consolidate data center network connections, reduce hardware complexity, and scale network bandwidth across multiple frames.

In addition to the composable fabric and traditional switch options discussed thus far, you can install other interconnects such as a pass-through module or a SAN switch.



If you want to maintain your existing network, you can use the Synergy pass-through module (see Figure 8-5), which provides full compute module connectivity to an existing network switch. The HPE Synergy 10 Gb pass-through module allows for one-to-one connectivity between a compute module's network adapters and a top-of-rack Ethernet switch. It's an alternative to managing the switch outside the frame with the operating system of your choice. Bear in mind, however, that you'll need a switch port for every network connection from the frame.



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**Figure 8-5:** Pass-through module.

The HPE Virtual Connect SE 16Gb FC Module for HPE Synergy is a Storage Area Network (SAN) interconnect with a wire-once change-ready technology. The Fibre Channel (FC) module, in conjunction with Synergy Composer powered by HPE OneView, allows workloads to be moved or managed without modifying the network.

The Brocade 16Gb Fibre Channel SAN Switch Module (see Figure 8-6) for HPE Synergy provides high-performance, low-latency networking with cut-through mode FC SAN capabilities. This switch is ideal for financial services, trading applications, medical imaging, and rendering.



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**Figure 8-6:** Brocade Fiber Channel module.

## Chapter 9

# Ten Key Tips about Synergy

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**Y**ou're a newly minted Composable Infrastructure and HPE Synergy guru! Here are the ten most important tips to keep in mind as you begin your journey into the new Idea Economy–driven data center:

- ✓ **The journey is about the business, not IT.** IT exists to support the business, but complex, outdated infrastructure environments are often putting the focus on technology, and not always in a positive way. With Composable Infrastructure and HPE Synergy, the goal is to shift the focus to the business by enabling the infrastructure to be as invisible as possible to the business.
- ✓ **Fluid pools of resources should be the norm.** With HPE Synergy, IT administrators no longer have to statically provision resources and then waste those resources when they aren't used as fully as possible. Synergy allows administrators to flex their resource use depending on the current demands of the business.
- ✓ **Software-defined intelligence enables agility.** Modern businesses are all about speed of execution. By bringing into software those functions that used to be defined by hardware, HPE Synergy enables you to bring new solutions to market far more quickly than was possible before. On the application front, deployments can now take minutes or hours rather than days or weeks.
- ✓ **The unified API is a boon for DevOps.** If you've adopted DevOps, the unified API can help you create applications that can automatically deploy new infrastructure elements as necessary. For example, if you have an application that senses that the web server tier is becoming burdened, you can simply make an API call to HPE OneView and automatically deploy an additional web server to handle the increased demand. After the load has decreased, you can decommission that new web server instance as you return those resources back to the resource pool.

- ✓ **The infrastructure is designed for today and for tomorrow.** The HPE Synergy Frame is designed to accept multiple generations of compute, storage, fabric, and management modules. The direct-connect midplane delivers 16.128 Tb/s of bandwidth and is future-proofed with a photonic-ready design that will exceed bandwidth requirements for the next decade.
- ✓ **Templates can help you reinvent your IT processes.** With workload-driven templates supported by the HPE Synergy Composer, flexible blocks of composable compute, storage, and fabric resources can be provisioned together with the state — BIOS settings, firmware, drivers, and so on — and operating environment images. Templates eliminate time-consuming provisioning processes across operational silos that often delay projects for weeks or months.
- ✓ **Image Streamer crushes traditional infrastructure deployment models.** With the traditional process, a number of discrete steps are involved with multiple reboots. HPE Synergy utilizes the Image Streamer, a repository of bootable images that can be streamed across multiple compute modules in a matter of seconds. This unique capability enables HPE Synergy to set up and update infrastructure with unmatched speed and consistency.
- ✓ **Compute module options abound.** With four Composable compute module options powered by Intel Xeon processors in the HPE Synergy portfolio, you can mix-and-match compute devices to meet just about any workload need. The compute modules provide the performance, scalability, density optimization, storage simplicity, and configuration flexibility to power a variety of workloads, including business processing, IT infrastructure, web infrastructure, collaborative, and high-performance computing.
- ✓ **Utilize integrated storage without compromises.** HPE Synergy Composable Storage's complete integration into the frame drives simplicity and reliability. Each storage module has 40 drives, and HPE Synergy can support up to four storage modules per frame.
- ✓ **The Fabric grows with your company and reduces hardware spend.** HPE Synergy Composable Fabric's disaggregated rack-scale design uses an intelligent master/satellite architecture to consolidate data center network connections, significantly reduce hardware and management complexity, and simplify network bandwidth scaling across multiple frames.

## Appendix

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# HPE Services for Synergy

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**H**ewlett Packard Enterprise (HPE) can help you transform to a hybrid infrastructure with HPE Synergy as the foundation. With transformation expertise, HPE can help you design the right solution, integrate your solution into your existing environment, proactively support your environment ongoing, further automate your infrastructure, and help you flexibly finance your investment.

Your journey to Composable Infrastructure is unique. HPE helps you to evolve your organization's culture, people, processes, and technology.

## *Transform to a Hybrid Infrastructure Workshop*

Gain clarity on hybrid IT concepts and infrastructure (including composable, software-defined, and converged), identify the initiatives that can work for your business, and create a high-level plan that defines your steps forward. During this one-day workshop, senior HPE consultants use informative visual displays in an interactive session to share their knowledge with your C-level, IT&O manager and business key decision-makers. Transformation workshops bring business and IT organizations together to collaborate, define the topline hybrid infrastructure strategy, and kick-start your projects confidently. For more information and scheduling a workshop visit us at [www.hpe.com/info/transformhybrid](http://www.hpe.com/info/transformhybrid)

## ***The HPE Synergy Rapid Advisory Service***

Ensure that your key personnel understand the imperative of a composable infrastructure and HPE Synergy and have an executable deployment plan that addresses your organization's needs.

Working from the physical infrastructure and technologies of your datacenter through to the tools and processes used to manage your organization's IT, HPE's consultants and your experts will plan the integration of Synergy into each level of your datacenter and operations focusing on your people and processes.

## ***Modernization and Migration Services***

HPE experts help you choose the right platform for the right workload at the right cost and evolve your IT infrastructure, processes, and organization, taking advantage of “on-hybrid infrastructure” innovations such as composable, converged, and software-defined technologies. HPE experts advise, transform, integrate, and implement for platform refresh, data center consolidation virtualization, migration, and automation projects.

HPE also offers additional education, implementation, and support services for your devices, to help you prevent incidents and operate your environment without disruption. More information at [www.hpe.com/us/en/services/consulting/it-infrastructure.html](http://www.hpe.com/us/en/services/consulting/it-infrastructure.html).

## ***HPE Flexible Capacity***

HPE Flexible Capacity is a pay-per-use model for on-premises infrastructure, giving you the needed HPE Synergy capacity



in your data center with a buffer of additional capacity to use when you need it. HPE Synergy delivers a more dynamic IT environment, and Flexible Capacity provides the needed room to grow your environment, but you only pay for actual metered use. Technology transitions with refresh can be built in, and infrastructure and services are billed monthly, enabling you to align costs to business use. With Flexible Capacity, your organization can gain cloudlike OPEX-based economics, while continuing to maintain your own private data center. For more information, visit [www.hpe.com/services/fc](http://www.hpe.com/services/fc).

## ***HPE Datacenter Care— Infrastructure Automation***

HPE Datacenter Care—Infrastructure Automation (DC-IA) is an extension to HPE Datacenter Care and delivers advice, best practices, and coaching for infrastructure automation. HPE Synergy with OneView embedded helps enable infrastructure automation and is integrated with tools such as those from Chef, Puppet, and Docker, to enable rapid bare-metal provisioning. With DC-IA, HPE service experts provide advice, support, and best practices for these tools that work with OneView to help create a fast, agile, and reliable automated IT environment. DC-IA delivers support to customers to enable infrastructure as code and agile processes as part of the service. Customers schedule quarterly reviews and reports with the HPE Center of Expertise, as well as having access to these experts when needed, for automation development and code coaching. The benefits include the following:

- ✓ Help no matter where you are on the journey to composable
- ✓ A personalized plan for exactly what you need
- ✓ Global access to experts to help you evolve your culture, people, processes, and technology

- ✓ Help maintaining business stability and growth while transforming
- ✓ The flexibility to grow quickly and align costs to the business

The Technology Services portfolio is enabled for HPE Synergy. Accelerate time to business value with HPE Synergy and Technology Services. For additional information, ask your HPE Sales Representative or Channel Partner.



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## Discover how HPE Synergy delivers on the vision of Composable Infrastructure

HPE Synergy is a new platform that brings to life the architectural principles of Composable Infrastructure. Discover how HPE can help IT meet the demands of the Idea Economy through a single, purpose-built platform that reduces operational complexity for traditional workloads and increases operational velocity for the new breed of cloud native applications and services.

- **HPE Synergy design principles** — discover the principles behind the HPE Synergy platform and how they make it a programmable infrastructure
- **Single infrastructure** — explore the highly available, natively intelligent infrastructure that can easily scale to meet the demands of tomorrow
- **Fluid resources** — compute, storage and fabric are now always available and can be instantly configured according to the specific needs of each application

**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:

- Key innovations that make HPE Synergy the first platform built from the ground up for Composable Infrastructure
- Detailed explanations of all the components that comprise the HPE Synergy environment
- The critical role played by the single management interface in the HPE Synergy environment

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