HPE Synergy
Management Infrastructure
Managing Composable Infrastructure
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Introduction

In today’s Idea Economy, businesses need to turn ideas into services faster. Every new business and established enterprise is at risk of missing a market opportunity and being disrupted by a new idea or business model. It has never been easier, or more crucial, to turn ideas into new products, services, or applications—and quickly drive them to market. But IT needs an infrastructure that enables them to partner with the business to speed the delivery of services.

HPE Synergy is a single composable infrastructure that can help IT simplify operational complexity in traditional IT environments and accelerate service velocity in the Idea Economy. New classes of applications exist in the Idea Economy which bring ideas to market faster and more efficiently. Implementing composable infrastructure provides IT organizations with an agile environment to increase the pace of innovation while driving profitability. At the same time, IT environments must sustain traditional business applications that run core business operations. Examples of these traditional applications include large prepackaged databases and enterprise resource planning (ERP) applications. A recent Gartner article describes this type of IT environment as “bimodal computing.” Companies are expected to adopt a strategy that maintains existing infrastructure for traditional applications, and creates a different infrastructure and tools for the new cloud-native and mobile applications (Figure 1). HPE Synergy is the ideal architectural and management solution that addresses both traditional business applications and the emerging Idea Economy applications for current IT environments.

Figure 1. Maintaining existing infrastructure for traditional applications, and creating a new infrastructure for cloud and mobile apps.

Pursuing a bimodal strategy means that IT organizations create and maintain two IT infrastructures, which increases complexity and cost. Because to date there has been no single solution that meets these different needs, companies are investing in separate environments, which results in higher capital expenses and operating costs.

There are fundamental differences in the tools and technologies required to run traditional and new Idea Economy application workloads. HPE believes that it is not sustainable to maintain two different sets of infrastructure, one designed for traditional apps and another designed for the new cloud-native apps that require a continuous and efficient DevOps-to-production process. HPE Composable Infrastructure is a single infrastructure that sustains traditional applications and also delivers the new Idea Economy applications that epitomize agility and fluidity.

This document describes HPE Synergy management, methods, and tools. You can find a brief description of the HPE Synergy physical infrastructure in the Appendix of this document. For detailed information about the physical infrastructure, see the companion technical white paper, “HPE Synergy: the first composable infrastructure” at hpe.com/V2/GetDocument.aspx?docname=4AA6-3257ENW&cc=us&lc=en

1 You can read an abstract of Gartner’s article on Bimodal IT here: gartner.com/doc/2798217/bimodal-it-digitally-agile-making
HPE Synergy is Composable Infrastructure

HPE Synergy is the engine for the Idea Economy. It is the first platform built from the ground up for Composable Infrastructure that offers an experience which empowers IT to create and deliver new value instantly and continuously. It uses a single management interface and unified API to reduce operational complexity for traditional workloads and to increase operational velocity for the new breed of applications and services (Figure 2). Through a single interface, HPE Synergy composes physical and virtual compute, storage, and fabric pools into any configuration for any application. As an extensible platform, it easily enables a broad range of applications and operational models such as virtualization, hybrid cloud, and DevOps. With HPE Synergy, IT can be more than just an internal service provider; but rather, IT can be the business partner which rapidly launches new applications that become the business.

HPE Synergy allows IT organizations to create and deliver new value instantly and continuously, enabling IT to:

- **Run anything**—HPE Synergy optimizes any application and service level through a single infrastructure with fluid pools of compute, storage, and fabric. All resources are continuously available to you and can be instantly configured according to the specific needs of each application.
  - Compute capacity can be configured for physical, virtual, or container-based workloads.
  - Internal storage can be presented as direct-attached or remote block, file, or object. HPE Synergy can be extended with 3PAR storage as part of the resource pools.
  - Fabric bandwidth is dynamically adjustable and can be configured for multiple protocols.

- **Move faster**—HPE Synergy enables IT organizations to accelerate application and service delivery through a single interface that precisely composes and recomposes logical infrastructures into any combination at near-instant speeds. Composable resources are provisioned together with their state (determined by variables such as BIOS settings, firmware, drivers, and protocols) and their OS image using repeatable templates. This is ideal for traditional IT applications, as well as newer DevOps approach, because it eliminates time-consuming provisioning processes across operational silos that often delay projects for weeks or months.

- **Work efficiently and unlock value**—HPE Synergy reduces operational effort and cost by using template-driven frictionless processes that define infrastructure functions and internal software-defined intelligence to implement programmatic changes. HPE Synergy increases productivity and control across the data center by integrating and automating infrastructure operations and applications through a unified API. The unified API provides a single interface that allows administrators and developers to interact with the infrastructure programmatically and to integrate efficiently with existing management tools.
HPE Synergy architecture

HPE Synergy has three key architectural principles: fluid resource pools, software-defined intelligence, and a unified API (Figure 3). These elements give administrators efficient GUI-based control of the entire infrastructure from one place, and enable DevOps team members to automate applications. These capabilities are available to both those who want to write code for existing apps, as well as those who want to code new applications and derive infrastructure directly as code.

![Figure 3. The three key architectural principles of HPE Synergy composable infrastructure.](image)

**Fluid resource pools**

HPE Synergy allows the transformation of traditionally rigid physical systems into flexible virtual resource pools. HPE Synergy creates resource pools of “stateless” (available resources with no identity) compute, storage, and fabric capacity that can be configured almost instantly to rapidly provision infrastructure for a broad range of applications. These fluid resources can easily scale memory, processing power, and persistent storage up or down depending on changing business demands and the IT tier or workload. A disaggregated virtual pool of flexible resources has the capacity to handle a broad range of applications with the ability to drive a variety of workloads including business processing, IT infrastructure, web infrastructure, collaborative, and high-performance computing.

When you increase resource capacity, HPE Synergy auto-integrates that capacity into existing resource pools, making scaling simple and automated. As the pool grows larger, the hardware and operational demands stay simple, ensuring IT can achieve economies of scale and efficiency. Your IT team is able to effortlessly assemble infrastructure building blocks of the size needed for the enterprise and to flexibly adjust resource composition based on application-based demand. By maximizing resource utilization, IT can eliminate overprovisioning and stranded capacity while ensuring right-sized resource allocation for applications. This significantly lowers your organization’s capital expenditures.

**Software-defined intelligence**

The software-defined intelligence in HPE Synergy reduces operational complexity and enables IT organizations to make needed programmatic changes quickly and confidently, without human intervention. This fundamentally changes the way infrastructure is managed. Historically, change operations required coordination across multiple teams, multiple tools and complex interdependent processes that could often take weeks to complete. HPE Synergy abstracts operational details and replaces them with high-level, automated operations. HPE Synergy uses templates to automatically implement change operations such as updating firmware, adding additional storage to a service, or modifying network

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2 HPE defines true “stateless” operation as allowing IP addresses to be assigned to software such as operating systems (similar to the way IP addresses are assigned to hardware). This allows environment planning apart from hardware and enables fast implementation when hardware is available.
connectivity, significantly reducing manual interaction and human error. This capability enables IT teams to configure the entire infrastructure for development, testing, and production environments using one interface, in one step, with speed and accuracy.

**Unified API**

HPE Synergy delivers automation through a unified API that provides a single interface to discover, inventory, configure, provision, update, and diagnose the composable infrastructure in a heterogeneous environment. In traditional environments, IT organizations can now automate operational processes and design workflow around enterprise requirements. For example, IT can leverage the integration with HPE Operations Analytics to find the root cause of problems faster and more proactively.

With HPE Synergy, a single line of code fully describes and can provision the infrastructure required for an application workload, eliminating time-consuming scripting of more than 500 calls to multiple low-level tools and interfaces. For the new breed of applications, DevOps can now automate applications from initial infrastructure deployment to updates. The unified API aggregates and hosts internal IT infrastructure to present physical resources in the same way as virtual and public cloud resources, so DevOps tools can provision instantly and programmatically, without needing a detailed understanding of the underlying physical elements.

This fully programmable interface integrates into dozens of popular management tools such as Microsoft System Center and VMware vCenter™. It is also future-proofed by integrating into open source automation and DevOps tools such as Chef, Docker, and OpenStack. (See the Third party and customizable integration section later in this document.)

This integration extends the power of the infrastructure to everyone in the data center:

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

The three key architectural elements of fluid resource pools, software-defined intelligence, and a unified API work together in the management solution for HPE Synergy systems. HPE Synergy manages physical infrastructure like software code. The “infrastructure-as-code” approach allows users to assemble infrastructure-on-demand for the set of workloads being deployed. This architecture provides users with the most powerful profiles and templates in the industry to manage infrastructure-as-code. Infrastructure-as-code structures in HPE Synergy can capture resources for compute, storage, fabrics, and OS images. The underlying hardware infrastructure enables these key architectural elements of composable infrastructure.

The hardware infrastructure for HPE Synergy manages the resources of the HPE Synergy Frame using three major management subsystems: HPE Synergy Composer, HPE Synergy Frame Link Module, and HPE Synergy Image Streamer (See Figure 4).

HPE Synergy Composer, powered by HPE OneView, is the primary management appliance in the HPE Synergy hardware infrastructure. It enables self-discovery, composition, and re-composition of resources. It provides intelligent mapping of the hardware to software operations with easy management access using the unified API. HPE Synergy Frame Link Modules link single or multiple frames to form a management network and present appropriate device information that enables management by HPE Composer. HPE Synergy Image Streamer is an optional management appliance, which works with HPE Composer to provide fast logical server deployment and updates. HPE Image Streamer provides easy manipulation of OS images, which are connected to profiles for powerful infrastructure-as-code control.

The HPE Synergy Frame is a basic unit of hardware infrastructure on which the management systems build. These frames are designed with hardware redundancy for high availability (HA) operations. There is also significant redundancy built into the management fabric, which connects the HPE Synergy Frames. Each HPE Synergy Frame has two dedicated management appliance bays, which are available for use by either HPE Composer or HPE Image Streamer. Management systems are 100% redundant when the management components are installed in pairs. Deployed pairs provide HA, and active-active operation is recommended.
HPE Synergy Composer

HPE Synergy Composer is the management heart of HPE Synergy. This hardware management appliance is powered by HPE OneView and enables on-demand creation and delivery of application-ready and workload-ready infrastructure with consistent governance. The HPE Synergy Composer appliance automatically installs itself. Just power it on and all components of HPE Synergy are accessible to Composer through the management network. In addition, HPE Synergy automatically creates HA operation with pairs of Composers. HPE Synergy Composer allows you to:

• Automatically discover resources (auto-discovery)
• Instantly compose resources into logical infrastructures from stateless resource pools to meet application needs
• Simplify operations with self-discovery and online/staged OS driver and firmware updates
• Use software-defined intelligence for template-driven, frictionless operations
• Automatically self-assemble new Synergy frames with existing frames into the single managed environment (auto-integration)

HPE Synergy Composer, powered by HPE OneView, manages single or multiple frames with their compute, storage, and fabric resources. This allows you to compose and recompose logical infrastructures into any combination at near-instant speeds. You can deploy, monitor, and update infrastructure for traditional, virtualized, and cloud environments in just a few minutes. Resources can be updated, flexed, and redeployed without service interruptions. Templates define how the infrastructure functions, and the internal software-defined intelligence of HPE Composer implements all changes programmatically.

The HPE Synergy Composer consolidates management of the entire system domain (HPE Synergy Frames, HPE Synergy Compute modules, HPE Synergy Storage modules, HPE Image Streamer, and HPE Fabric modules) to provide:

• One programmable interface with a unified API
• Simplified lifecycle management experience
• High availability operation from paired appliances
• Easy management access from any frame, including capabilities for hardware diagnosis, error reporting, and frictionless firmware management
• Visualization and control of resource pools
  - Auto-discovery of all linked Synergy Frames and their resources
  - Auto-integration of existing and new resources, allowing effortless scaling from racks to rows
  - Templates, profiles, port mapping to interconnects, network configurations, and topology
  - Zoning for up to 200 storage drives to any compute module
• Scaling for multiple HPE Synergy Frames using highly-available, high-performance management rings
• Management across multiple subnets of the same management LAN connectivity
• RESTful API for programmatic access and control through PowerShell and python scripting

HPE Composer provides a user interface (UI) with a single view into the HPE Synergy composable infrastructure. The HPE OneView technology delivers automation through OneView’s UI and the unified API. The single UI allows you to discover, inventory, configure, provision, update, and diagnose the composable infrastructure in a heterogeneous environment. By connecting the HPE OneView UI with automation tools through the Unified API, you can create, aggregate, and host IT infrastructure to present physical resources in the same way as virtual and public cloud resources. Traditional and DevOps automation tools can provision on-demand and programmatically.

You can deploy the exact compute and storage resources for your application needs and the fabric resources to scale to your application requirements using HPE Composer. See the Third party and customizable integration section of this document for more information about the applications and tools with which HPE Synergy Composer integrates.

Server profile templates

HPE server profile templates are the most powerful in the industry. They define how the HPE Synergy infrastructure needs to be configured, and then the infrastructure’s software-defined intelligence implements the needed changes programmatically without human intervention. This
significantly reduces operational complexity and cost, while increasing service availability. Detailed configuration information can be saved as templates and then re-applied, enabling the physical infrastructure to be managed like software. This approach is also described as “infrastructure as code”.

In traditional enterprise IT environments, infrastructure is managed one functional area at a time, also described as silos. Every device (whether it is server, storage, or networking) is associated with a specific manager. If templates are used to configure those devices, the templates are associated with a specific hardware device and IT teams must configure each device. Provisioning an application across these multiple devices involves a complex process of configuring a variety of different products with different tools. This is a time consuming and costly undertaking which is also error prone because of the complexity.

In contrast, HPE Synergy server profile templates bring intelligence into the infrastructure with a single interface that allows end-to-end control of the entire infrastructure. These built-in workload templates allow users to provision, configure, and update infrastructure according to the needs of the workload rather than the needs of a particular device. HPE Synergy Composer, powered by HPE OneView, provisions workloads with a template that describes the workload. The template-based approach can be used to provision multiple servers automatically without additional manual operations. These templates provide significant “infrastructure as code” capabilities that speed provisioning and accelerate your time-to-service.

HPE Synergy server profile templates also enable frictionless change as a powerful way to update and maintain your existing infrastructure. Embedded HPE OneView uses templates with a “one-to-many” model to update and manage server profiles (Figure 5). Templates have inheritance properties, which associate settings from a single server template with multiple server profiles.

![Figure 5. Use server profile templates to update/maintain infrastructure and enforce configuration compliance.](image)

You can configure settings (such as BIOS, firmware, and drivers) once in the template and then propagate them to the multiple servers using the profiles created from that template. You can use templates to automate infrastructure updates and maintenance, and to control settings like:

- Firmware baselines
- BIOS settings
- Local RAID settings
- Boot order
- Network configurations
- Shared storage configurations

Templates also provide “monitor, flag, and remediate” capabilities which can be used to enforce configuration compliance. Profiles created from the template can be monitored for compliance to the desired configuration. When inconsistencies are detected, the profile is flagged as no longer being compliant with the template. When updates occur at the template level, all profiles parented to that template are flagged as not being
consistent. Once flagged, the user has control over the remediation process, which can be used to bring individual nodes into compliance with the template or can be used for selecting multiple systems for update to the template. Templates can be implemented using the embedded HPE OneView user interface or using PowerShell or Python scripting through the unified API.

**Firmware updates without impacting operations**

HPE Synergy lets you orchestrate firmware updates without impacting operations. Infrastructure changes, like firmware updates for both fabric interconnects and compute, can be implemented automatically through template-based operations to reduce downtime, manual operations, and errors. Firmware updates for fabric interconnects are addressed later in this document (see the Frictionless Updates for Interconnects section). Firmware and OS driver updates for HPE Synergy compute can be orchestrated using online staged updates (Figure 6).

![Figure 6. Shared-infrastructure processes let you transparently manage firmware updates across the infrastructure](image)

HPE Synergy Composer aids compute updates by providing a single firmware and OS driver set (Service Pack for ProLiant, or SPP), in which all the firmware and system software are tested together as a single solution stack. Application owners also have options on how to activate the update process. Updates can be applied instantly for initial set up or staged to automatically take effect later. However, in typical firmware/driver update scenarios, administrators cannot update firmware/drivers/software all at once because the targeted updates have different maintenance windows, which control when it is appropriate to take the application or server offline. Coordinating all these maintenance windows can be extremely difficult. Therefore, staged updates copy the new firmware to compute modules, where they are stored while waiting for a convenient maintenance window, at which time they are applied.

HPE Synergy Composer automates this process and allows users to perform an orchestrated (rolling) update using logical enclosures throughout the entire managed environment without disrupting any applications. For example, multi-frame firmware updates across a logical enclosure can include the Frame Link Manager and components, logical interconnects, and server profiles. Update processes do not impact operations and include automated dashboard-based compliance reporting. HPE Synergy Composer also allows use of the high-level unified API to automate the update tasks.

HPE Synergy Composer manages the firmware update processes to significantly reduce manual interactions and errors, ensure real-time compliance, and minimize downtime.

**Health and Maintenance**

HPE Composer provides a streamlined, modern alert management architecture that simplifies monitoring. When managed resources are added to the appliance, they are automatically discovered, inventoried, and set up for monitoring, including the automatic registration of SNMP traps and scheduling of health data collection. HPE Synergy compute modules are monitored immediately without requiring additional configuration or discovery steps.

All monitoring and management of data center devices is agentless and out-of-band for increased security and reliability. No OS software is required, no open SNMP ports on the host OS are required, and zero downtime updates can be performed for these embedded agents. HPE Composer also provides proactive alert notifications via email. Administrators can configure alert filters and email identifications to match new alerts to filter criteria and then send an email to the identified contact. You can also view all alerts, filter your alerts, and search your alerts using
HPE Smart Search. Alerts can be assigned to specific users and annotated with notes from administrators. Notifications or traps can be automatically forwarded to enterprise monitoring consoles or to centralized SNMP trap collectors.

Customized dashboard capabilities also allow you to select and display important inventory, health, or configuration information. This can also be used to define custom queries for new dashboard displays.

Self-diagnostic capabilities allow HPE Synergy Composer to be aware if a hardware component is misconfigured or failing. The Synergy management infrastructure itself knows what has failed. For example, if a module is not properly seated or a component fails, HPE Synergy acknowledges the event and notifies administrators.

**HPE Synergy Management Network**

HPE Synergy Frame Link Modules link single or multiple frames to form a management network and present appropriate device information that enables management by HPE Composer. Using HPE Synergy Frame Link Modules, the HPE Synergy Frames can be linked into larger groups for frames, or domains, to form a dedicated highly-available multiframe management network (Figure 7). This dedicated 10Gb air-gapped management network provides management security, and it enables automatic discovery and change detection. The use of HPE Synergy Frame Link Modules increases the security of the overall environment and its available resource efficiency as the infrastructure grows.

![HPE Synergy Frame Link Module](Image)

**Figure 7.** HPE Synergy Frame Link Module management ring and management network

The multi-frame network creates a management ring and provides management network functions for each frame. Frame link modules connect the management network only. Interconnect modules provide the production network connection. Interconnect modules (Virtual Connect or otherwise) are independent from Frame Link Modules and have dedicated slots on the frame. Frame link modules provide 10Gb of throughput between the frames in a dedicated private network. This also provides 10Gb uplinks to the customer's management LAN. The internal management ring links the frame, and the management LAN traffic traverses on a specific vLAN. There are also private vLANs on the management ring, which are isolated.

Each frame has a pair of frame link modules, so there is no impact from a single module failure. The 10Gb management network is redundant within the frame, and across many frames, for network fault tolerance. The traffic will continue to traverse the network even in the presence of a single failure (for example, if one module fails or if a cable is disconnected).

**HPE Synergy Image Streamer**

HPE Synergy Image Streamer adds a powerful dimension to profiles and templates—the ability to manage physical servers like virtual machines. HPE Image Streamer enables HPE Synergy to perform fast logical server deployments and updates to compute modules. Its repository of bootable images can be used to setup and update infrastructure with unmatched speed and consistency, which accelerates workload deployment and changes. HPE Image Streamer is also significantly faster than the traditional, sequential process of physically provisioning servers with a subsequent OS or hypervisor installation.

HPE Synergy Frame appliance bays accept the HPE Image Streamer management appliance. This image repository contains a library of bootable images that are streamed to multiple compute modules in seconds, allowing you to setup and update infrastructure in a process that is simple,
repeatable, and scalable. HPE Synergy Image Streamer is ideal for use in tasks such as web scale deployments, in which IT needs to provision a software golden image across a large number of infrastructure blocks. Automated setup and infrastructure-as-code control provide significant timesavings for environments where similar images are deployed to multiple compute modules.

HPE Synergy Image Streamer makes it simple to automate server boot/run specifications, including boot/run storage, provisioning, and OS deployment. In traditional environments, deploying an OS or hypervisor is time consuming because it requires building or copying the software image onto individual servers, possibly with multiple reboot cycles. The HPE Synergy Image Streamer is tightly integrated with the HPE Synergy Composer. Together, these management appliances consistently deploy your golden images across compute modules. This deep integration reduces complexity, provides consistency across infrastructure, and saves significant time and resources.

The timesavings occurs after initiating provisioning and deployment from the HPE Synergy Composer. HPE Composer makes a REST call to the HPE Synergy Image Streamer appliance. HPE Image Streamer quickly clones your selected golden image to a boot volume personalized per the deployment plan (in this case with a host name and IP addresses), and then it automatically configures the compute module’s UEFI to perform an iSCSI boot from the volume. Unlike traditional boot-from-SAN environments, no additional manual setup or configuration is required. HPE Image Streamer sets up and deploys new boot volumes much faster than traditional direct attach boot disks or boot-from-SAN environments.

Simplify lifecycle operations and integration
HPE Synergy Image Streamer works in conjunction with HPE Synergy Composer to enhance server profiles with the deployed software state for "infrastructure-as-code" use in HP Synergy systems (Figure 8). HPE Composer, powered by HPE OneView, captures the physical state of the server in the server profile. HPE Image Streamer enhances this profile and its desired configuration by capturing your golden image as the deployed software state in the form of bootable image volumes. These bootable OS images are stored on the HPE Image Streamer appliance. Note that the enhanced server profile and bootable OS images are software structures—no compute module hardware is required for these operations. These software structures can be constructed and/or updated in seconds. When the compute module boots, it will boot from the bootable image volumes (residing on the Image Streamer appliance) directly into its running configuration.

3 In a typical SAN environment these requirements can include multipath support, adapter configuration, access control, FC SAN if it's fabric-attached, and possibly SAN array configuration.
Your compute module configurations can be greatly simplified when using HPE Synergy Image Streamer. Compute modules required by these operations can be stateless, allowing you to remove any local storage.

Lifecycle operations can also be simplified using HPE Synergy Image Streamer. Your golden images can be quickly provisioned/deployed, updated, or rolled back to minimize maintenance windows. Initial provisioning and deployment of compute modules are shown in Figure 8. Updates simply require you to capture and edit a known golden image that is in use. HPE Image Streamer will create new boot volumes from your revised golden image in seconds. When you reboot your servers using the new boot volumes, your update is complete. Rollbacks are even simpler. A rollback is performed by re-deploying older bootable OS images.

HPE Synergy Image Streamer uses server profiles to capture all workload configuration information. By keeping customer-defined workload requirements in the server profile, any physical compute module can be replaced or updated while retaining the original configuration. This separation of the image from the hardware makes it easy to update using a custom image, and it allows hardware to be replaced without losing workload requirement information to reduce downtime. Also, to the extent that your golden image captures your application stack, that application stack can also be a part of the deployed software state in HPE Image Streamer.

Tools for Images
A variety of tools is provided in HPE Image Streamer to assist you in creating and manipulating images:

- Golden image capture
- Deployment plan, build plan, capture plan, and plan script creation and modification
- Import and export of the above artifacts
- Personalization environment (software image configuration)

HPE will enable a variety of images for use on HPE Image Streamer with reference implementations. Examples include images based on current versions of ESXi, Red Hat® Enterprise Linux (RHEL), and a Docker-enabled Linux®. In addition, you can enable your own specific images and image types using the tools provided with HPE Image Streamer.
Storage Management

HPE Synergy architecture employs a variety of internal and external storage options to provide fluid pools of resources for any workload, from traditional applications to cloud-native applications. HPE Synergy Composer enables local and zoned direct attach storage (DAS), software defined storage (SDS) solutions – featuring HPE StoreVirtual virtual storage array (VSA) software - and System-defined tier-1 flash HPE 3PAR StoreServ storage area networks (SAN) solutions (Figure 9).

Local and zoned direct attach

Local direct attached storage is handled by the HPE P542D Controller and drives are located directly on the compute module, including boot volumes and any Unique HPC requirements.

HPE Synergy zoned DAS storage includes the HPE D3940 Storage Module, which completely integrates into the Synergy Frame. Each storage module has 40 drives, and HPE Synergy Composer can zone up to 200 storage drives to any compute module. For DAS-centric workloads, the non-blocking SAS fabric allows full utilization of flash storage performance for local applications. You can directly compose HPE Synergy Storage Modules as DAS for use with everything from traditional applications, such as Microsoft Exchange or database applications, to Hadoop Analytics.


Software-defined intelligence for storage management

Using HPE StoreVirtual VSA to create virtualized clusters compliant with HPE Synergy storage modules allows you to take advantage of tiering for performance on a highly dense, scalable storage platform with the flexibility required for their VMs and virtual desktop infrastructure (VDI) solutions.

HPE StoreVirtual VSA lets you use storage virtualization on HPE Synergy’s internal storage. It uses scale-out, distributed clustering to provide a pool of storage with enterprise storage features and simple management. This storage virtualization allows businesses to lower their IT infrastructure costs and protect business critical systems without the purchase of additional hardware. The scale-out storage architecture allows the consolidation of internal and external disks into a pool of shared storage. All available capacity and performance is aggregated and accessible to every volume in the cluster. Multiple HPE StoreVirtual VSAs running on multiple servers create a clustered pool of storage with highly-available data volumes protected using Network RAID. Adding more StoreVirtual VSAs to the cluster grows the storage pool.

Direct attached storage (DAS)

Software-defined intelligence for DAS integrates storage with server profiles to save you time and make you more productive. This software-defined nature in HPE Composer enables you to:
• Attach storage to server profiles
• View and manage your storage system and storage pools
• Add existing volumes and create new volumes
• Create volume templates to provision multiple volumes with the same configuration, and automate zoning of Fiber Channel SANs

In addition, server profile templates can specify which server profile should boot from managed HPE StoreVirtual (iSCSI) volumes. Resulting server profiles generated from the template will indicate which volume is the boot target. And, compliance checks are included.

Flexible SAN topologies and automatic SAN zoning
HPE 3PAR StoreServ is positioned as an external-to-the-frame option, but is still a part of the overall HPE Composable Storage family and continues to deliver the same value for accelerated and assured service-levels for virtualization, IT as a Service, or more traditional use cases around applications such as SAP® or Oracle®.

Using HPE Composer, the HPE 3PAR StoreServ Storage System can be created, grown, and recycled on demand for use in compute composition, as defined by profiles and templates. Storage changes are implemented quickly and non-disruptively through these template-based operations. HPE Composer allows 3PAR storage resources to be aggregated and disaggregated in a fluid manner, and with flexible ratios. Both of these storage solutions are managed through the HPE Synergy Composer software-defined intelligence.

HPE Synergy Composer SAN management is compatible with switched fabric, direct attach (FlatSAN) topologies, providing dynamic connectivity between HPE Synergy systems and HPE 3PAR StoreServ Storage Systems. HPE Synergy Composer allows you to bring a SAN Manager, and the SAN infrastructure associated with that SAN Manager, under management of the HPE Synergy Composer appliance, which can then discover SAN-connected servers and HPE 3PAR storage systems. You can then attach server profiles to SAN volumes on that 3PAR storage system through existing SAN connections or through the HPE Synergy Composer’s automated SAN zoning services. The HPE Synergy Composer enables connectivity across FC, FCoE, and mixed FC/FCoE SAN topologies.

Boot-from-SAN
HPE Composer allows users to select a managed volume as the boot target using a simplified server profile boot configuration. This action enables the software-defined intelligence in HPE OneView to internally perform the “cut and paste” functions. The user configures the connections as bootable, and then selects a managed volume from which to boot.

Storage monitoring, connectivity, and synchronization
HPE Composer monitors storage systems and issues alerts when there is a change in health or connectivity status of storage systems. Storage systems are also monitored by HPE Synergy Composer to ensure synchronization with changes to hardware and configuration settings. Should the appliance lose connectivity with a storage system, an alert is displayed until connectivity is restored. Storage topology is also displayed in Map View.

You can attach private or shared storage volumes from 3PAR to server profiles to enable automated boot target configuration and to move direct attach (FlatSAN) profiles across frames. This software-defined intelligence provides automated, policy-driven provisioning of storage resources, which is fully integrated with server profiles so you can manage your HPE 3PAR storage infrastructure.

Fabric Management
HPE Synergy simplifies next-generation fabric management with software-defined intelligence. Software-defined intelligence (such as profiles, templates, groups, and sets) allows HPE Synergy Composer to manage fabric by simplifying management, capturing best practices, and extending HPE Virtual Connect features. The HPE Synergy architecture includes three fabric interconnect types; HPE Virtual Connect modules, switches, and pass thru modules. The Virtual Connect modules are managed through the HPE Synergy Composer. The switches and pass through modules can be managed through a command-line interface (CLI) and can be monitored through the HPE Intelligent Management Center (IMC).

Virtual Connect
HPE Virtual Connect provides a wire-once, edge-safe, and change-ready environment that makes it easy for administrators to manage dynamic network environments at the server edge. HPE Synergy Composer manages HPE Virtual Connect to deliver simple, composable bandwidth resources with no fixed ratios, using a high performance cost-effective architecture. This simplified management experience uses HPE Virtual Connect technologies with rich telemetry MLAG on uplinks.
HPE Synergy Composable Fabrics enhance the familiar Virtual Connect ‘wire-once’ experience by adding:

- Fabric disaggregation—HPE Synergy Composable fabric is based on disaggregated, rack-scale design and uses a master/satellite architecture\(^4\) to consolidate data center network connections, reduce hardware and scales network bandwidth across multiple HPE Synergy Frames. This architecture reduces costs and simplifies networking.

- Frictionless scaling—As HPE Synergy satellite frames are added, they consume ports on master frames instead of a top-of-rack (ToR) switch. In the HPE Synergy Fabric, all satellite modules ports terminate onto master modules. In Non-HPE Synergy environments, ports are consumed on the ToR switch and these ToR switch ports are connected to an end-of-row (EoR) switch.

- Flexible bandwidth pools, and multi-module link aggregation—The master module contains intelligent networking capabilities that extend connectivity to satellite frames through Interconnect Link Modules. The result being elimination of top of rack switch need, as any addition of new satellite frames are connected to the master module instead of ToR switch, and substantially reduces cost. The reduction in components also simplifies fabric management at scale while consuming fewer ports at the data center aggregation layer.

- HPE OneView fabric management—Template based Software Defined Infrastructure (SDI) offers a rich set of interconnect features:
  - SDI-based management with HPE OneView
  - Server administrator compatibility with Virtual Connect solutions
  - Wire-Once, providing the easiest way to move, add, and change HPE OneView based server profiles
  - Simplest, most flexible infrastructure
  - Flat SAN with 3PAR storage
  - Minimal impact on existing SAN/LAN infrastructure

**Frictionless scaling**

Frictionless scaling is about composing resources on-demand to meet your business needs. When you need to add frames or grow your environment, the unique HPE Synergy scaling makes multi-frame deployment simple. HPE Synergy Composer uses the software-defined intelligence of “logical enclosures” to add frames to the master/satellite architecture, using hot-pluggable link extensions when adding satellite frames with the HPE Synergy Interconnect Frame Link module. This capability reduces the number of required management touch points. This enables frictionless scaling without adding hops and additional management steps.

**Frictionless updates for interconnects**

The goal of frictionless updates is to seamlessly deliver firmware and driver updates without impacting operations. Frictionless lifecycle operations automatically implement the desired changes without disruptive downtime.

Frictionless updates for interconnects are available when fabric updates only affect interconnect management of components, and where there is no data path outage. These updates are non-disruptive, with no dependency on the compute module or top-of-rack (ToR) configurations, and the interconnect modules continue to forward traffic, HPE Composer aids the frictionless updates by providing a single firmware/driver set (Service Pack for ProLiant, or SPP), in which all the firmware and system software are tested together as a single solution stack. In addition, the application owner has options on how to activate the update process, by launching it on-demand or by aligning it to maintenance windows.

HPE Synergy’s simplified lifecycle operations allows you to confidently change your infrastructure while significantly reducing service interruption, operational costs, and planned downtime. HPE Synergy is the first architecture that lets you quickly and accurately configure the entire infrastructure in one step, using one interface.

**Advantages of satellite architecture**

The master module contains intelligent networking capabilities that extend connectivity to satellite Frames through HPE Synergy Interconnect Link Modules. The result is elimination of ToR switches since any addition of satellite frames are connected to the master module instead of a ToR switch, substantially reducing cost. The reduction in components also simplifies fabric management at scale while consuming fewer ports at the data center aggregation layer. In addition, this architecture provides:

\(^4\) The HPE Synergy “master/satellite architecture refers to a ‘master’ interconnect module which contains management and intelligent networking capabilities, and to “satellite” interconnect link modules which extend the HPE composable fabric to additional satellite frames. This architecture replaces the fixed ratio of interconnects in each frame by extending the fluid pool of network resources from the master module.
• 40% or more lower fabric hardware costs
• 10Gb, 20Gb bandwidth with future path to 40Gb/100Gb to compute modules
• Flexible bandwidth allocation in 100Mb increments
• Ethernet, FC/FCoE, and iSCSI capability
• Frictionless scaling for “zero-touch” change management
• Frictionless firmware updates to upgrade with minimum downtime

The satellite module also extends HPE composable fabric to additional satellite frames and replaces fixed ratio of interconnects in each frame by extending the fluid pool of network resources from the master module.

HPE Synergy fabric interconnects
The HPE Synergy architecture includes three fabric interconnect types; HPE Virtual Connect modules, switches, and pass thru modules. The Virtual Connect modules are managed through the HPE Synergy Composer. The switches and pass through modules can be managed through a command-line interface (CLI), and monitored through the HPE Intelligent Management Center (IMC).

HPE Virtual Connect modules
The HPE Virtual Connect SE 40Gb F8 Module operates as the master module. It has 8xQSFP+ uplinks; six are unified (FC and Ethernet) and dedicated for the upstream switches. The last two being exclusively reserved for ICM Cluster ports that enable M-LAG between two VC modules and cannot be used as Ethernet uplink ports. An FC license is needed to leverage FC interface on uplinks. Once FC uplinks are activated, they can be used for either NPIV or Flat SAN. It has 12 downlinks ports. Each downlink port can operate at 10/20Gb and 40Gb. The 40Gb downlinks will be enabled with 40Gb adapter availability, and a 40Gb license will be needed to activate 40Gb downlinks on Virtual Connect. You can read more in the QuickSpec document at hp.com/h20195/v2/GetPDF.aspx/c04815258.pdf.

The HPE VC SE 16Gb FC Module is the first Virtual Connect with quad Small form-factor pluggable (QSFP) uplinks and complements the HPE Virtual Connect SE 40Gb F8 module for fibre channel based SAN networks. This is the ideal module for higher bandwidth applications in FC-based SAN networks. The module is compliant with templates and software-defined infrastructure based on HPE OneView. This complements the disaggregated rack-scale based HP SE 40Gb F8 module. You can read more in the QuickSpec document at hp.com/h20195/v2/GetPDF.aspx/c04815256.pdf.

HPE Synergy switches
The HPE Synergy System offers a number of options for traditional switched network environments. The HPE Synergy 20Gb and 10Gb Interconnect Link Module, satellite modules are designed for composable infrastructure. Based on disaggregated, rack-scale design, it uses a master/satellite architecture to consolidate data center network connections, reduce hardware and scale network bandwidth across multiple HPE Synergy Frames. HPE composable fabric extends up to two additional satellite frames with 20Gb connectivity to Synergy Compute Modules and replaces fixed ratio of interconnects in each frame by extending fluid pool of network resources from master module.

HPE pass thru modules
Customers that require a nonblocking, one-to-one connection between each HPE Synergy Compute Module and the network can use pass thru modules. Customers needing this functionality with the HPE Synergy 12000 Frame can use the HPE Synergy 10/40Gb Pass-Thru Module. This pass-thru module provides 12 uplink ports that can accept QSFP+ connectors and SFP+ connectors using a QSFP+ to SFP+ adapter.

The HPE Synergy 10/40Gb Pass-Thru Module can accommodate 10Gb and 40Gb connections on a port-by-port basis. Optical as well as Direct Attach Copper (DAC) cables are also available. Both standard Ethernet as well as Converged Enhanced Ethernet (CEE) traffic to an FCoE capable switch is possible when using the appropriate HPE Synergy Converged Network Adapter. You can read more in the QuickSpec document at hp.com/h20195/v2/GetPDF.aspx/c04815108.pdf.
Driving HPE Synergy management with the unified API

The HPE Synergy architecture enables the infrastructure-as-code paradigm for compute, storage, fabric, and OS image management. You can access HPE Synergy Composer through the unified API, which allows all management functions that might be invoked through the HPE OneView user interface to also be executed programmatically through the API.

The HPE Unified API operates at a very high level of abstraction—at a “whole machine” level. HPE Composer can implement ‘infrastructure-as-code’ to abstract complex actions into single lines of code. This 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 (Figure 10). You can also use this API to control other routine operational and maintenance tasks in your IT environment.

HPE Synergy increases productivity and control across the data center by integrating and automating infrastructure operations and applications through the unified API. The unified API provides a single interface to discover, search, inventory, configure, provision, update, and diagnose the composable infrastructure. A single line of code fully describes and can provision the infrastructure required for an application, eliminating time-consuming scripting of more than 500 calls to low-level tools and interfaces.

In traditional environments, IT can now automate their IT operational processes and design their workflow around enterprise needs. For example, IT can leverage the integration with HPE Operations Analytics to find the root cause of problems faster and more proactively. For the new Idea Economy applications, DevOps can automate applications through infrastructure deployment, scaling, and updates. The unified API aggregates physical resources in the same way as virtual and public cloud resources, so developers can code without needing a detailed understanding of the underlying physical elements.

**Figure 10. Transform infrastructure into a single line of code.**
Third party and customizable integration

In HPE Synergy Composer, the fully-programmable HPE OneView interface integrates over a dozen popular management tools such as Microsoft System Center, Chef, Docker, Puppet, Ansible, PowerShell, Python, and VMware vCenter (Figure 11).

The power of software-defined datacenter management
Enabling a broad ecosystem

Your developers can programmatically control the infrastructure to create a hyper-connected data center. Some of the possibilities include:

- Automating every operation
- Automating workload placement based on facilities’ power and cooling constraints
- Creating a DevOps-ready infrastructure
- Constructing a cloud infrastructure with a single command
- Deploying containerized micro-service apps

HPE Synergy is also future-proofed by integrating into popular open source automation and configuration management tools, such as Chef, Docker™, Puppet, Python, PowerShell, and OpenStack, to enable an “infrastructure-as-code” environment. The unified API’s ability to integrate into both environments means composable infrastructure can bridge both traditional and new Idea Economy IT.

The HPE Synergy unified API powered by HPE OneView creates, aggregates, and hosts internal IT resources so automation tools can provision on-demand and programmatically, without needing a detailed understanding of the underlying physical elements. By connecting automation tools with HPE OneView, bare metal infrastructure can be directed the same way that virtual and public cloud resources can.
Integrated Remote Support

HPE Synergy Composer provides integrated remote support from the management appliance. Remote support unlocks the benefits of your HPE Synergy technology investment by connecting to Hewlett Packard Enterprise. This relationship helps you reduce down time, increase diagnostic accuracy, and get a single consolidated view of your environment in the HPE Support Center portal. By connecting, you will experience 24x7 monitoring, automatic support case creation, and automatic parts dispatch. Customers of HPE Proactive Care service and HPE Datacenter Care will additionally benefit from proactive reports and issue prevention activities.

HPE Synergy Composer provides remote support through embedded HPE OneView with capabilities to:

- Enable remote support through settings in the HPE OneView interface
- Manage HPE Synergy 12000 frames and HPE Synergy Gen9 compute modules
- Check a single box to enable remote support for all eligible devices
- Quickly register your data center contacts, designated service partners, and reseller partners
- Automatically trigger creation of a support case with display of the case ID from service events associated with hardware failures
- Sign in to Hewlett Packard Enterprise Support Center to view case details, contract and warranty details, and a dashboard of all your connected devices, which is also available through the HPESC mobile application
- Display a single consolidated view of devices connected through Insight Remote Support in HPE Support Center along with your HPE OneView Remote Support connected devices.

Remote Support is available at no additional cost and securely connects your HPE Synergy frames and compute modules to Hewlett Packard Enterprise support.

Summary

HPE Synergy addresses the challenge of “bimodal” computing environments through compatibility with traditional applications as well as cloud-native applications that are required by the new Idea Economy to bring applications to market faster and more efficiently. The implementation of a composable infrastructure provides your IT organization with the agility to increase the pace of innovation while driving increased profitability.

HPE Synergy composable infrastructure simplifies lifecycle operations to allow your IT teams to confidently change the infrastructure while dramatically reducing service interruption, operational costs, and planned downtime. It is the first architecture that lets you quickly and accurately configure the entire infrastructure in one step, using one interface. HPE Synergy Composer provides a single interface for assembling and re-assembling flexible compute, storage, and fabric resources in any configuration. The infrastructure-as-code capability accelerates transformation to a hybrid infrastructure and provides on-demand creation and delivery of applications and services with consistent governance, compliance, and integration. The Unified API powered by HPE OneView creates, aggregates, and hosts internal IT resources so automation tools can provision on-demand and pragmatically, without needing a detailed understanding of the underlying physical elements. By connecting automation tools with HPE OneView, you can direct bare metal infrastructure in the same manner as virtual and public cloud resources.

HPE Synergy server profile templates are a powerful new way to quickly and reliably update and maintain existing infrastructure. HPE Synergy Composer uses templates to simplify one-to-many updates and manage compute module profiles. Change operations such as adding additional storage to a service, modifying network connectivity, or updating firmware are implemented through server profile templates. These templates allow changes to be implemented automatically, significantly reducing manual interactions and errors. Continuous lifecycle operations cost less, save time, and are less disruptive, all of which help ensure real-time compliance with less effort. This feature adds inheritance to the process, meaning updates can be made once in the template and then propagated out to the profiles created from that template. Elements that can be updated via a template include firmware, BIOS settings, local RAID settings, boot order, network configuration, shared storage configuration, and many others. HPE Synergy Image Streamer is a repository for unique bootable images, which it creates directly from your golden image in seconds. HPE Image Streamer enables HPE Synergy to quickly deploy new compute modules or update existing ones by booting them directly into their desired running OS.

HPE Synergy's fully programmatic interface integrates into popular management tools, such as Microsoft SystemCenter and VMware vCenter. It is also future-proofed by integrating into popular open source automation and configuration management tools, such as Chef, Puppet, Python, PowerShell, and OpenStack. The unified API's ability to integrate into both environments means composable infrastructure can bridge both traditional and new Idea Economy IT.
HPE Synergy deploys, monitors, and updates all elements of the solution from the embedded HPE OneView UI and the unified API. It allows IT departments to fluidly deploy infrastructure for traditional, virtualized, and cloud environments in just a few minutes. Resources can be updated, flexed, and redeployed without service interruptions. HPE Synergy provisions compute, storage, and networking resources using template processes. This allows you to deploy infrastructure that is consistently updated with the right configuration parameters and firmware versions, streamlining the delivery of IT services and the transition to a hybrid cloud. Reduced complexity and faster service delivery times achievable with HPE Synergy ultimately enable your IT infrastructure to better respond to changing business needs by bringing applications, services, and products to market faster.
Appendix A: HPE Synergy hardware architecture

The HPE Synergy 12000 Frame (Figure A1) provides the basic building block for an HPE Synergy infrastructure. Each frame includes two appliance bays for Synergy Composer Modules (two for redundancy), three zones of two full-height bays each for Synergy Compute and Synergy Storage Modules, and two Frame Link Modules. A Synergy Console panel provides local access to installation, setup, updates, and diagnostic functions. Fabric modules, fan modules, and power supply units are all accessible from the rear for servicing. In-server and external storage options (not shown in Figure A1 but described later) give HPE Synergy the scalability needed for business growth and extraordinary flexibility for changing application needs.

Figure A1. Figures, charts, tables, or screenshots can appear anywhere on the page and can span the entire width of the page.

Four 10U HPE Synergy 12000 frames can fit in a standard 42U rack. Multiple HPE Synergy Frames can be linked with an air-gapped frame management ring using Frame Link Modules, and this infrastructure can be managed by a single HPE Synergy Composer management appliance.

Compute
HPE Synergy compute modules are designed to take full advantage of processing, memory, and storage capabilities. The uncompromised choice of EP and EX Intel® processor-based modules allow you to run a variety of workloads with right-sized memory and in-server storage options. A half-height single-width compute module accommodates two processors (CPUs), two SFF drives, and three mezzanine cards. These modules use a new direct-connect I/O architecture offering more performance, efficiency, and growth.

Storage
HPE Synergy storage solutions include in-server, in-frame, and external storage options (SAN, NAS, and direct-attached storage systems) for a very flexible approach to right-sizing your storage resources.

Fabric
Unlike traditional IT fabrics that use a top-of-rack switch topology, HPE Synergy implements a disaggregation strategy that offers a fluid pool of networking resources and is more cost efficient. Using Virtual Connect technology, Synergy’s composable fabric offers a wire-once installation that is edge-safe. With Synergy’s low-latency, multi-path, and multi-speed architecture, you can precisely compose the fabric to match workload needs without being forced to used fixed ratios. HPE Synergy uses a master/satellite fabric architecture to scale with multiple frames and accommodates fully redundant (A-side/B-side) fabrics.
Resources

HPE Synergy

HPE Synergy: The first platform architected for composability to bridge Traditional and Cloud Native apps

HPE Synergy Composer QuickSpecs
hp.com/h20195/v2/GetDocument.aspx?docname=c04815139

HPE Synergy Image Streamer QuickSpecs

A compelling on-premises alternative to public cloud
The benefits of a composable infrastructure
hp.com/h20195/v2/GetPDF.aspx/4AA6-2194ENW.pdf

A compelling on-premises alternative to public cloud
Synergy for collaboration and database
hp.com/h20195/v2/GetPDF.aspx/4AA6-3161ENW.pdf

Five steps to building a Composable Infrastructure with HPE Synergy
hp.com/h20195/v2/GetPDF.aspx/4AA6-3322ENW.pdf

HPE Technology Services for HPE Synergy
hp.com/h20195/v2/GetPDF.aspx/4AA6-2753ENN.pdf

HPE Technology Whitepapers
hpe.com/docs/servertechnology