Hewlett Packard Enterprise

HPE Reference Configuration for Docker Enterprise Edition (EE) Standard on HPE Synergy with HPE Synergy Image Streamer

HPE Synergy rapid image based deployment of Docker EE Standard on virtual and bare metal hosts

Technical white paper

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Executive summary

Organizations looking to deploy containers at scale are looking for an environment that optimizes container resource efficiency while providing ease of scalability and high availability. This paper provides architectural guidance for deploying, scaling, and managing a Docker Enterprise Edition (EE) Standard environment on Hewlett Packard Enterprise Synergy Composable Infrastructure. It describes:

- How to leverage HPE Synergy strengths in rapid provisioning using HPE Synergy Image Streamer to scale a highly available Dockerized platform
- How to use a hybrid virtualized and bare metal strategy to optimize Docker managers and worker node deployment

Docker Enterprise Edition Standard provides an integrated enterprise container management solution that enables development and IT operations teams to build, ship, and run distributed applications. Docker Enterprise Edition Standard brings application portability, security and efficiency to enterprises with a production-ready Containers-as-a-Service (CaaS) platform. The combination of Docker Enterprise Edition Standard with HPE Composable Infrastructure allows organizations to build a high-performance and resource-efficient platform that supports large scale deployment of diverse container workloads. The composable nature of HPE Synergy enables IT operators to easily assign and re-assign physical, virtual, or container resources based on workload types and utilization demands. Using the composability and fluid resource pools features from HPE Synergy, organizations can minimize over-provisioning of underlying infrastructure resources and consequently reduce capital expenditure (capex) in the process.

Target audience: This document is intended for IT architects, systems integrators, and partners who are planning to deploy and manage containers on a large scale running on Hewlett Packard Enterprise Synergy Composable Infrastructure with Docker Enterprise Edition Standard.

Document purpose: The purpose of this document is to describe a best practice scenario for deploying Docker to a mix of bare metal and virtualized environment on HPE Synergy. Readers can use this document to achieve the following goals:

- Gain insight into the value proposition for running Docker container workloads in a hybrid virtual and bare metal environment leveraging the strengths of the HPE Composable Infrastructure.
- Learn how to rapidly deploy Docker using HPE Synergy Image Streamer technology.

Introduction

This Reference Configuration describes a Docker Enterprise Edition Standard deployment on HPE Composable Infrastructure and includes best practices to allow IT teams to bring up new services in minutes.

The HPE Synergy platform is designed to bridge traditional and cloud-native applications with the implementation of composable infrastructure. Composable infrastructure combines the use of fluid resource pools, made up of compute, storage, and fabric with software-defined intelligence. Composable pools of compute, storage and fabric can be intelligently and automatically combined to support any workload. The resource pools can be flexed to meet the needs of any business application. The use of HPE Synergy Image streamer in the solution allows for rapid image and application changes to multiple compute nodes in an automated process.

IT organizations are looking to deploy Docker containers on bare metal to optimize performance and resource efficiency of server hosts. By running bare metal intelligently provisioned by the HPE Synergy Image Streamer and not relying on the hypervisor, the container stack needs fewer compute and storage resources than running in VMs. Consequently, more containers can run on a host[1] than would be possible if these containers are running inside VMs. This consolidation can lead to reduced capex costs by minimizing virtualization and operating system instances licensing costs. Applications built using microservices and requiring high performance data stores are highly suitable to run on bare metal because they are highly distributed, scale horizontally, need quick instantiation, and don't need hypervisor level features to be highly available. Deploying them on bare metal allows efficient usage of existing capacities on demand, higher server density, and more reactive systems.

While the cost and performance advantages of bare metal hosts are quite attractive for running application workloads, the Docker Enterprise Edition Standard container management layer, Universal Control Plane (UCP), Docker Trusted Registry (DTR), and other management tools (see Figure 1) can be deployed as VMs instead of individual physical instances to optimize resource usage, enable high availability of load balancers, and simplify maintenance. This provides a single, on-premises, infrastructure solution for organizations adopting containers for existing

[1] HPE and Docker Reference Configuration for infrastructure optimization using Docker containers on HPE infrastructure

applications or new microservices, allowing them to compose and scale applications where some tiers or services can be running as VMs while others are running as containers.

HPE Synergy provides the ideal platform to allow for rapid deployment of additional UCP swarm workers to meet changing workload demands. The introduction of HPE Synergy Image Streamer provides the capability to automatically deploy new compute servers immediately with true stateless images which integrate server hardware configuration with operating environment images. This allows for seamless expansion and contraction of physical resource utilization providing optimal use of data center infrastructure.

Solution overview

This Reference Configuration provides a solution architected for Docker Enterprise Edition Standard on hybrid bare metal and virtualized HPE Composable Infrastructure and integrations to provide automated server provisioning and container management as shown in Figure 1. This creates a scalable and highly available platform for a Docker Enterprise Edition Standard deployment.

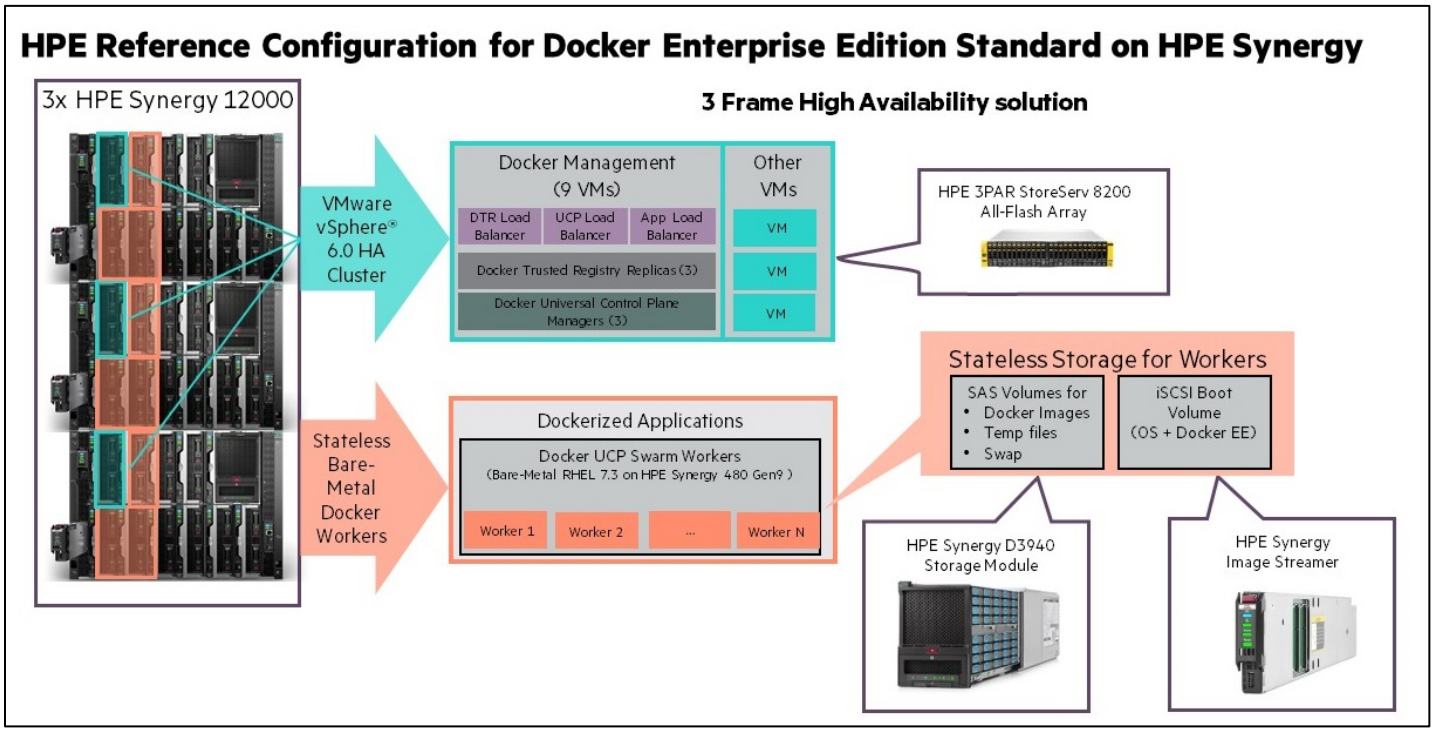

Figure 1: Solution overview: Docker Enterprise Edition Standard on HPE Synergy

This solution uses a Docker Enterprise Edition Standard deployment consisting of Docker Universal Control Plane (UCP), Docker Trusted Registry (DTR), and Docker Engine. The Docker management nodes will be running as virtual machines on a VMware® vSphere cluster as shown in Figure 1. For high availability (HA) and load balancing purposes, Docker recommends multiple hosts for Docker UCP, DTR, and load balancers. Running these components initially in virtual instead of physical hosts reduces overall hardware requirements and promotes better resource utilization. HPE Composable Infrastructure provides a scalable virtualization platform for the VMware vSphere environment. The VMware Distributed Resource Scheduler (DRS) clusters will provide resource management and additional high availability for the Docker management plane which is running on virtual machines. The Docker UCP worker nodes are running on bare metal HPE Synergy 480 Gen9 compute nodes and can be efficiently scaled out using HPE Synergy Image Streamer to rapidly deploy additional servers to the solution.

Golden images and automated deployment plans configured and stored in HPE Synergy Image Streamer enable rapid deployment of stateless bare metal Docker UCP swarm workers which immediately join the swarm cluster as the server is powered on. In order to efficiently utilize the limited amount of storage on the HPE Synergy Streamer, the Docker container images, when pulled from the Docker Trusted Registry, are deployed on HPE Synergy D3940 volumes which are presented as local storage to the compute servers.

Solution components

The solution hardware and software components used to build the HPE Reference Configuration for Docker Enterprise Edition Standard on HPE Composable Infrastructure are detailed in this section.

Solution hardware

The following hardware components were utilized in this Reference Configuration as listed in Table 1.

Table 1: Hardware components

Component	Purpose
HPE Synergy 12000 Frame	Infrastructure for compute, storage, fabric and management
HPE Synergy Composer	Infrastructure management
HPE Synergy Image Streamer	Infrastructure deployment
HPE Synergy 480 Gen9 Compute nodes	Docker virtualization and bare metal hosts
HPE Synergy D3940 Storage Module	Storage for Docker hosts
HPE FlexFabric 5900AF Switch	Top of Rack network connectivity
HPE 3PAR StoreServ 8200 All-Flash Array	Backing storage for ESXi shared datastore

HPE Synergy

HPE Synergy, the first Composable Infrastructure, empowers IT to create and deliver new value instantly and continuously. This single infrastructure reduces operational complexity for traditional workloads and increases operational velocity for the new breed of applications and services. Through a single interface, HPE Synergy composes compute, storage and fabric pools into any configuration for any application. It also enables a broad range of applications from bare metal to virtual machines to containers, and operational models like hybrid cloud and DevOps. HPE Synergy enables IT to rapidly react to new business demands.

HPE Synergy Frames contain a management appliance called the HPE Synergy Composer which hosts HPE OneView. HPE Synergy Composer manages the composable infrastructure and delivers:

- Fluid pools of resources, where a single infrastructure of compute, storage and fabric boots up ready for workloads and demonstrates self-assimilating capacity.
- Software-defined intelligence, with a single interface that precisely composes logical infrastructures at near-instant speeds; and demonstrates template-driven, frictionless operations.
- Unified API access, which enables simple line-of-code programming of every infrastructure element; easily automates IT operational processes; and effortlessly automates applications through infrastructure deployment.

HPE Synergy Composer

HPE Synergy Composer provides the enterprise-level management to compose and deploy system resources to your application needs. This management appliance uses software-defined intelligence with embedded HPE OneView to aggregate compute, storage, and fabric resources in a manner that scales to your application needs, instead of being restricted to the fixed ratios of traditional resource offerings. HPE Synergy template-based provisioning enables fast time to service with a single point for defining compute module state, pooled storage, network connectivity, and boot image.

HPE OneView is a comprehensive unifying platform designed from the ground up for converged infrastructure management. A unifying platform increases the productivity of every member of the internal IT team across servers, storage, and networking. By streamlining processes, incorporating best practices, and creating a new holistic way to work, HPE OneView provides organizations with a more efficient way to work. It is designed for open integration with existing tools and processes to extend these efficiencies.

HPE OneView is instrumental for the deployment and management of HPE servers and enclosure networking. It collapses infrastructure management tools into a single resource-oriented architecture that provides direct access to all logical and physical resources of the solution. Logical resources include server profiles and server profile templates, enclosures and enclosure groups, and logical interconnects and logical interconnect groups. Physical resources include server hardware blades and rack servers, networking interconnects, and computing resources.

The HPE OneView converged infrastructure platform offers a uniform way for administrators to interact with resources by providing a RESTful API foundation. The RESTful APIs enable administrators to utilize a growing ecosystem of integrations to further expand the advantages of the integrated resource model that removes the need for the administrator to enter and maintain the same configuration data more than once and keep all versions up to date. It encapsulates and abstracts many underlying tools behind the integrated resource model, so the administrator can operate with new levels of simplicity, speed, and agility to provision, monitor, and maintain the solution.

HPE Synergy Image Streamer

HPE Synergy Image Streamer is a new approach to deployment and updates for composable infrastructure. This management appliance works with HPE Synergy Composer for fast software-defined control over physical compute modules with operating system and application provisioning. HPE Synergy Image Streamer enables true stateless computing combined with the capability for image lifecycle management. This management appliance rapidly deploys and updates infrastructure.

HPE Synergy Image Streamer adds a powerful dimension to 'infrastructure as code'—the ability to manage physical servers like virtual machines. In traditional environments, deploying an OS and applications or hypervisor is time consuming because it requires building or copying the software image onto individual servers, possibly requiring multiple reboot cycles. In HPE Synergy, the tight integration of HPE Synergy Image Streamer with HPE Synergy Composer enhances server profiles with images and personalities for true stateless operation.

HPE Synergy Composer, powered by HPE OneView, captures the physical state of the server in the server profile. HPE Synergy Image Streamer enhances this server profile (and its desired configuration) by capturing your golden image as the 'deployed software state' in the form of bootable image volumes. These enhanced server profiles and bootable OS plus application images are software structures ('infrastructure as code')—no compute module hardware is required for these operations. The bootable images are stored on redundant HPE Synergy Image Streamer appliances, and they are available for fast implementation onto multiple compute nodes at any time. This enables bare metal compute modules to boot directly into a running OS with applications and multiple compute nodes to be quickly updated.

Figure 2 shows how a HPE OneView server profile is configured to deploy a compute server with Docker Enterprise Edition Standard installed. The Server Profile specifies the required networking, storage and firmware as well as the OS deployment plan from HPE Synergy Image Streamer. The physical state and deployed software state are maintained separate from the physical compute node. The physical compute node does not need to retain any state.

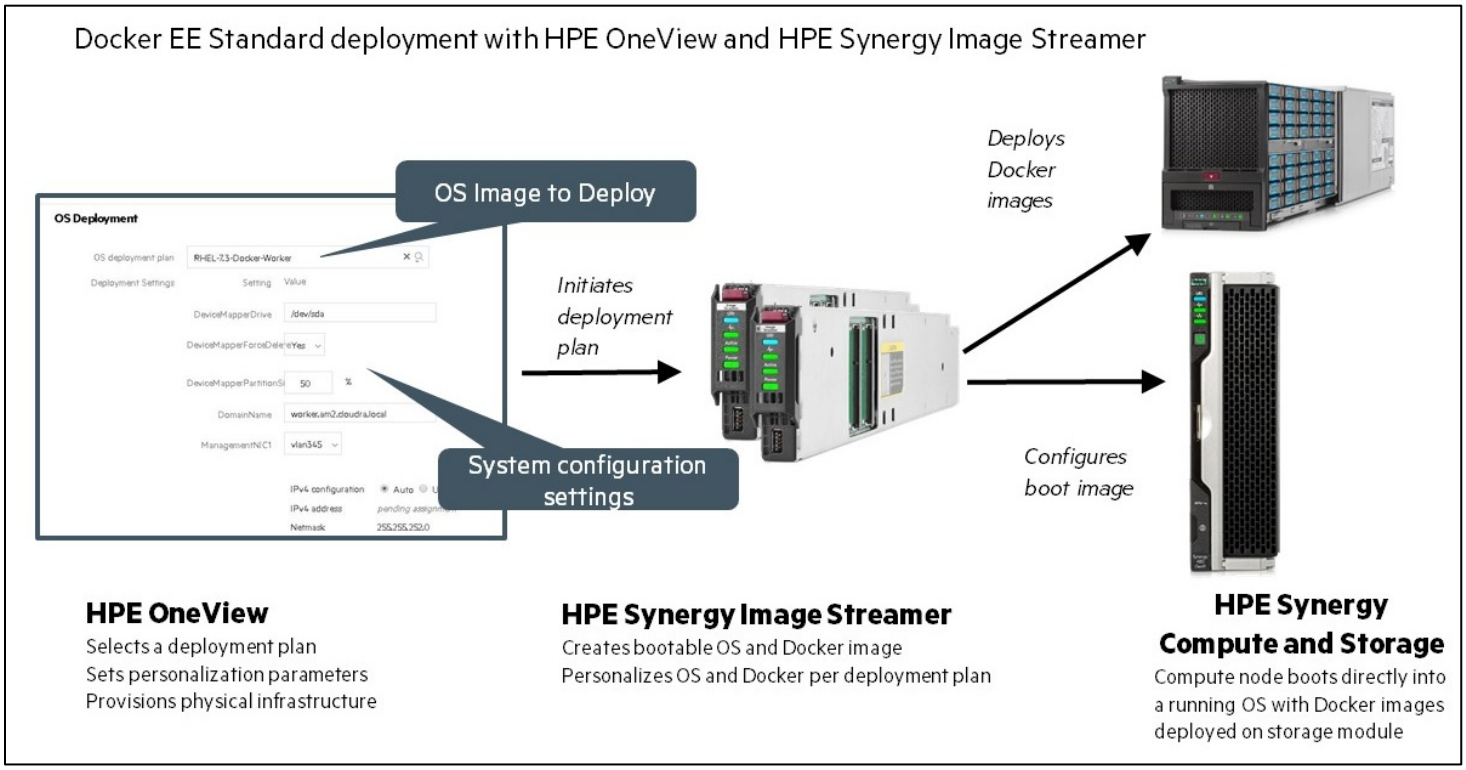

Figure 2: Deploying Docker workers with HPE OneView and HPE Synergy Image Streamer

HPE Synergy D3940 Storage Module

The HPE Synergy D3940 Storage Module provides a fluid pool of storage resources for the composable infrastructure. Additional capacity for compute modules is easily provisioned and intelligently managed with integrated data services for availability and protection. The 40 SFF drive bays per storage module can be populated with 12 G SAS or 6 G SATA drives.

The HPE Synergy D3940 Storage Module provides local storage to compute resources and can meet the demands of a wide range of data workloads. Pooled storage resources provide the flexibility and performance needed to accommodate a wide range of workloads. Changes such as updating firmware are automatically implemented with the infrastructure online significantly reducing errors and delivering real-time compliance.

For this Reference Configuration the HPE Synergy D3940 Storage Module was used for Docker images. The server profiles for Docker worker nodes include the configuration of local storage where the Docker volumes are mounted as shown in Figure 2. Configuring the storage in this manner minimizes the use of limited storage on the HPE Synergy Image Streamer.

HPE Synergy 480 Gen9 Compute Module

The HPE Synergy 480 Gen9 Compute Module delivers superior capacity, efficiency, and flexibility in a two-socket, half-height form factor to support demanding workloads. The HPE Synergy 480 Gen9 Compute Module provides a composable compute resource that can be self-discovered, quickly provisioned, easily managed, and seamlessly redeployed to deliver the right compute capacity for changing workload needs.

HPE 3PAR StoreServ 8200 All-Flash Array with iSCSI adapters

The HPE 3PAR StoreServ 8200 used for this Reference Configuration hosts the VMware vSphere clustered datastore used for the deployment of the Docker control plane virtual machines. The HPE 3PAR StoreServ 8200 All-Flash Array provides all-flash acceleration at entry-level price. The array was configured with 8 x 480GB SFF non-AFC SSD drives, the OS Suite, and Virtual Copy software. For this Reference Configuration, iSCSI adapters were added and utilized as the means of presenting the shared storage for the vSphere cluster hosting the Docker control plane.

HPE 3PAR is built on a modern architectural design that includes multi-controller scalability, a highly virtualized data layer, system-wide striping, a highly specialized ASIC and numerous flash innovations making it the only flash storage array to deliver speed, and enterprise data resiliency at an affordable price point.

The HPE 3PAR StoreServ 8200 used for this Reference Configuration hosts the VMware vSphere clustered datastore used for the deployment of Docker management control plane virtual machines.

HPE FlexFabric 5900AF 48XG 4QSFP+ Switch

The HPE FlexFabric 5900 switch series is a family of ultra-low-latency 1/10GbE data center top-of-rack (ToR) switches that is part of the Hewlett Packard Enterprise FlexNetwork architecture's HPE FlexFabric solution. Perfect for deployment at server access layer in large and medium-sized enterprises. These switches may also be used in campus core/distribution layers where higher performance 40GbE connectivity is required with 10GbE links. Virtualized applications and server-to-server traffic require ToR switches that meet the needs for higher-performance server connectivity, convergence, virtual environment support, and low-latency.

Solution management software

The following software components were utilized in this Reference Configuration as listed in Table 2 and Table 3.

Table 2: Docker Enterprise Edition Standard subscription components

Component	Version
Docker Universal Control Plane (UCP)	2.1.3
Docker Trusted Registry (DTR)	2.2.4
Docker Enterprise Edition Engine	17.03

Table 3. Hewlett Packard Enterprise solution management software

Component	Version
HPE Synergy Composer	3.00.07
HPE Synergy Image Streamer	3.00.05
HPE Synergy Image Streamer artifacts for Docker	HPE-RHEL-7.3-Docker-2017-04-18.zip

Docker Enterprise Edition Standard

Docker Enterprise Edition Standard provides Containers-as-a-Service (CaaS) to enterprises with a production-ready platform supported by Docker and hosted locally behind the firewall.

Docker Enterprise Edition Standard enables enterprises to containerize applications, and deploy them across the underlying infrastructure of choice, in a way that is efficient and secure. This enterprise container platform from Docker spans across the application lifecycle with tooling for both developers and IT operations and support from Docker or HPE. The platform is available in three different versions: Basic, Standard and Advanced. This Reference Configuration focuses on Docker Enterprise Edition Standard.

Docker Enterprise Edition Standard[2] features include:

- Built-in clustering and orchestration via Docker Swarm and Compose
- Integrated image and container management
- Cryptographic image signing enabled via Docker Content Trust to protect against man in the middle attacks
- Policy enforcement for image signing and run only signed images in production
- Integrated secrets management for a least privilege access strategy
- Granular role based access controls to manage users and teams access to all system components
- Flexible load balancing with built in routing mesh for L4 or L7 load balancing
- Application health checks configuration within GUI
- Support for all Docker API and commands
- GUI and CLI usability

Docker Enterprise Edition Standard delivers a universal, platform-agnostic container runtime with built-in orchestration, networking and volumes for container-based applications. It offers open APIs for automation, extensibility and integrations into existing systems like LDAP/AD, monitoring, logging and more. The solution comes with Hewlett Packard Enterprise technical product support if the license is procured through Hewlett Packard Enterprise.

[2] Additional image scanning via Docker Security Scanning is available as part of Docker Enterprise Edition Advanced

This Reference Configuration includes production grade deployments of the core components of the Docker Enterprise Edition Standard subscription which are listed in Table 2 above.

Universal Control Plane (UCP), the Docker management layer within Docker Enterprise Edition Standard, serves as the primary means of managing and monitoring the Docker Enterprise Edition Standard deployment described in this Reference Configuration. The dashboard shown in Figure 3, provides a high-level overview of the nodes, services and containers running in UCP cluster. Detailed information is available by exploring each area.

The UCP management interface controls actions through the use or roles and permissions. This enables a common interface for use by different teams.

The UCP management console enables operators to manage and configure the container environment and perform tasks such as:

- Manage worker node deployments
- Deploy services
- Manage service secrets
- Integrate with an external LDAP/AD service
- Manage container storage volumes and networks

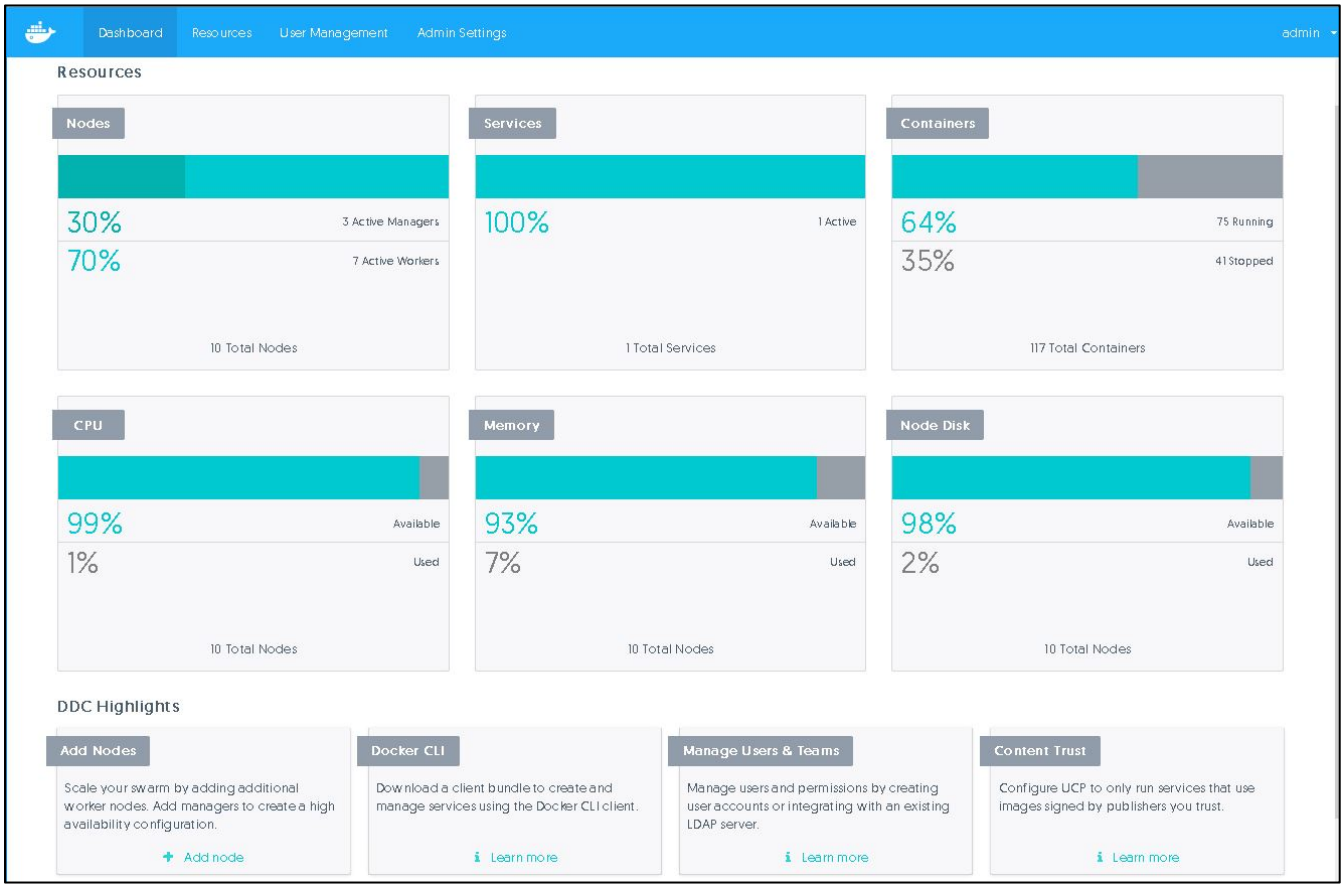

Figure 3: Docker UCP dashboard

The on-premises secure image registry that is part of Docker Enterprise Edition Standard is Docker Trusted Registry (DTR). DTR includes security features such as image signing to enable a secure container lifecycle and image scanning through Docker Security Scanning available as a part of the Docker Enterprise Advanced edition. It also allows for more efficient resource utilization by allowing for hard delete of orphaned images, as well as processes with image content cache and webhooks.

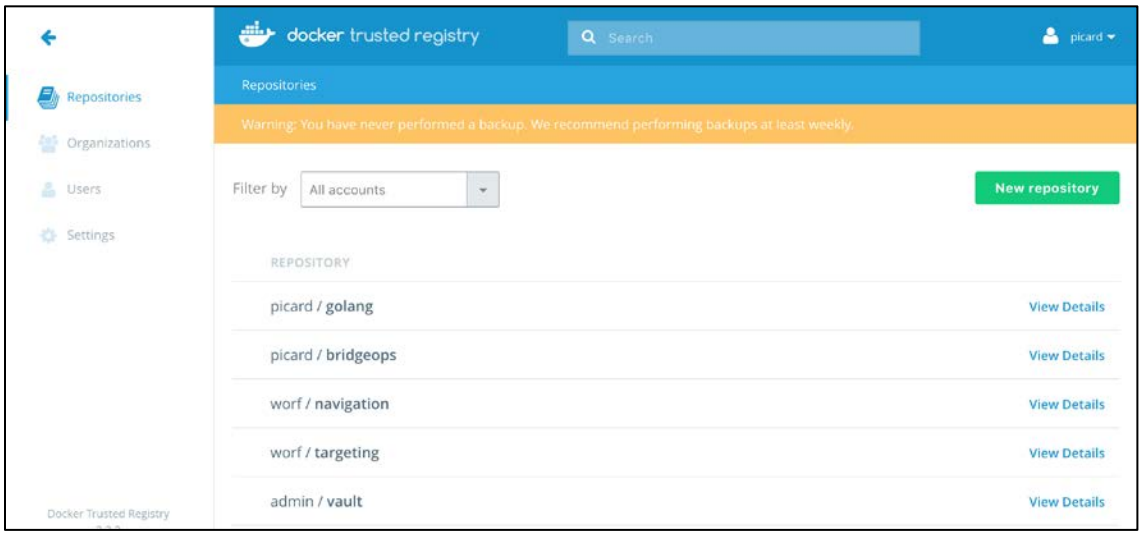

Figure 4: Docker Trusted Registry

For production deployments, Docker recommends running UCP managers and DTR in an HA configuration. These instances should be spread across multiple nodes (3 or more) fronted by a load balancer. The load balancer can direct traffic to the remaining instances should a failure occur. State is automatically synchronized between nodes and inherently part of the Enterprise Edition HA design. Design considerations can be found in the Docker Reference Architecture: Docker EE Best Practices and Design Considerations guide. A diagram of this deployment is shown in Figure 5.

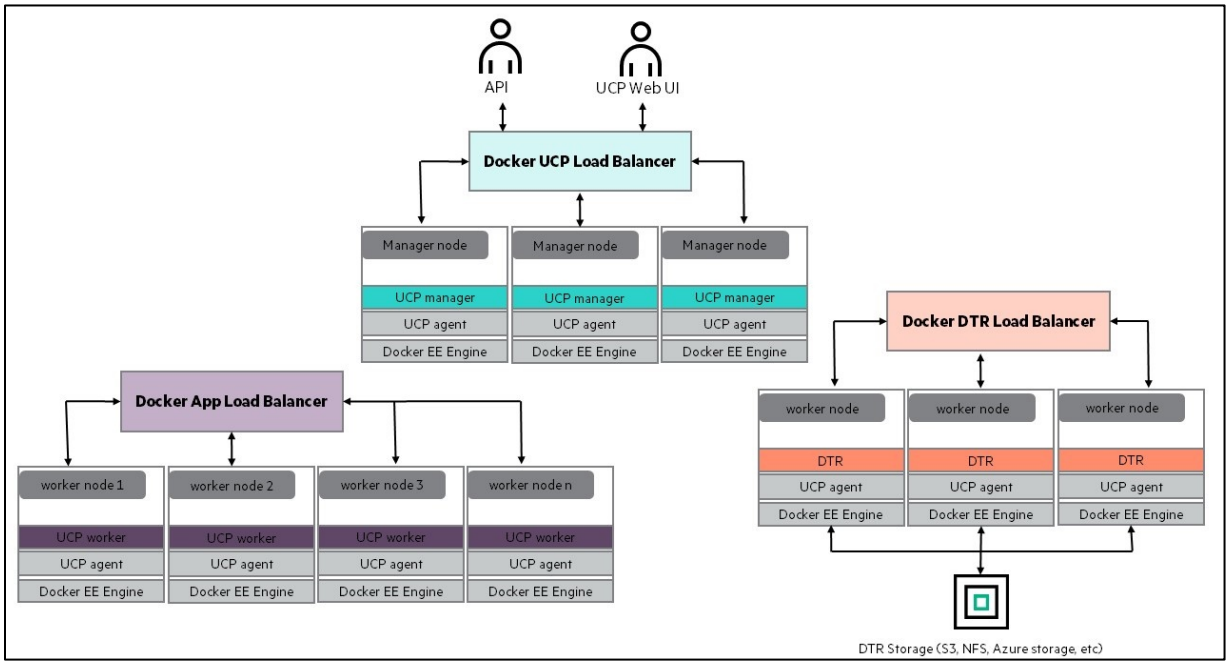

Figure 5: Docker Enterprise Edition Standard architecture

The Docker Enterprise Standard Edition installation for this Reference Configuration consists of three primary types of nodes that can be deployed on a mixture of virtual machines and physical servers:

- UCP manager nodes: The managers schedule container workloads to run on the cluster and maintains the workload requirements by spinning up containers that have gone down. It also provides a routing mesh enabling the traffic to be routed to the correct container node. UCP can be managed from a CLI or a UI.
- DTR worker nodes: Docker Trusted Registry nodes provide a highly available image repository including image scanning services with a management UI.
- UCP swarm worker nodes: These nodes run container workloads.

The Docker UCP swarm manager orchestrates and schedules containers on the entire cluster. Docker Enterprise Edition supports the use of three, five, or seven UCP swarm manager nodes for failover and state preservation.

Best practices for deployment and configuration guidance for the solution

Docker Enterprise Edition Standard deployment best practices utilizing HPE Synergy Image Streamer

This Reference Configuration outlines how to configure a hybrid deployment of Docker Enterprise Edition Standard using a combination of virtual machines and physical servers as shown in Figure 6. This hybrid configuration provides an optimized solution with a virtualized and highly available management plane as well as a highly efficient solution to host and scale Docker container applications on physical servers.

This solution is ideal for organizations who are developing cloud native applications or refactoring existing applications using containers and want to maximize resource, performance, and cost efficiencies[3]. The Docker UCP swarm workers can take advantage of the fluid pool of HPE Synergy resources while the Docker management components can run as VMs instead of dedicated physical hosts.

[3] HPE and Docker Reference Configuration for infrastructure optimization using Docker containers on HPE infrastructure

Docker Enterprise Edition Standard management

The Docker Enterprise Edition Standard management components were deployed as virtual machines on a VMware ESXi 6.0 cluster as shown in Figure 6. The deployment of Docker UCP, DTR, and App Load Balancers, Docker UCP Swarm Managers, and Docker Trusted Registry replicas on virtual machines was done following standard Docker documentation found at Universal Control Plane overview, and Docker Trusted Registry 2.2 overview. Additional details on the deployment of the Docker Enterprise Edition Standard management components is found in Appendix B: Deploying Docker Enterprise Edition Standard management nodes as virtual machines. Instructions for using the swarm mode routing mesh and configuring load balancers is found in the Docker documentation, Use swarm mode routing mesh.

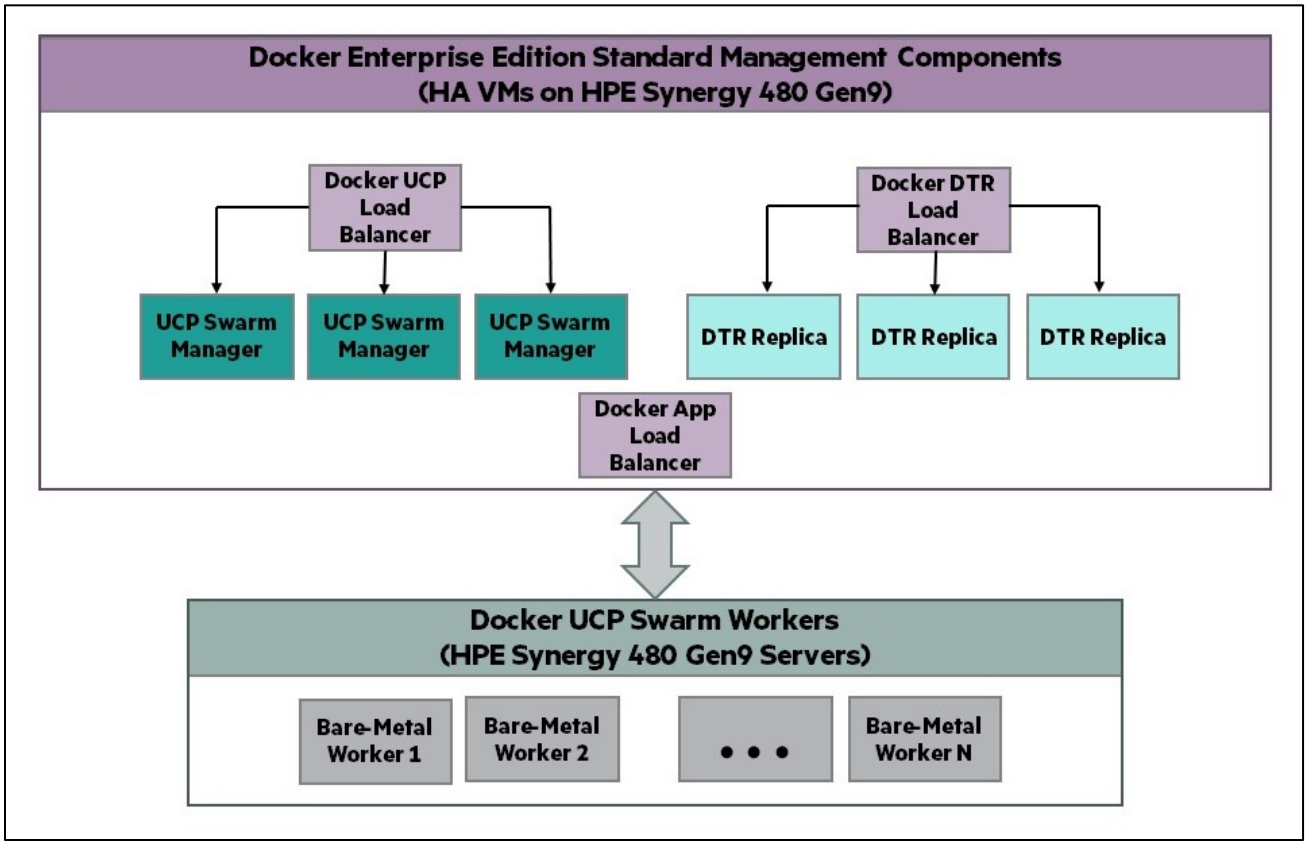

Figure 6: Hybrid virtual and physical node Docker Enterprise Edition Standard on HPE Synergy logical diagram

HPE Synergy configuration

The three HPE Synergy frames used for this Reference Configuration include HA deployment of HPE Synergy Composer and HPE Synergy Image Streamer as shown in Figure 7. The HPE Synergy D3940 Storage modules are used for local storage for the Docker images and for persistent storage local to the compute host. Only containers running on the same host can access volumes created on the HPE Synergy D3940. Refer to Appendix C: UCP worker node deployment plan custom attributes for details on specifying the percentage of the volume allocated for Docker images.

The Synergy compute modules are deployed as:

- 12x Synergy 480 Gen9 servers, decomposed in:
  - Docker Management plane: 3x servers, 1 per frame
  - Docker Workers: 9x servers, 3 per frame

Each HPE Synergy D3940 was configured with 10x 300GB SAS HDD which allowed for each VMware vSphere cluster host to be configured with redundant boot volumes and each Docker host to be configured with redundant Docker volume storage. Docker UCP swarm workers provisioned by HPE Synergy Image Streamer are provided with redundant boot volumes.

The HPE 3PAR StoreServ 8200 is used for the VMware vSphere cluster shared datastores. Depending on your intended workload, a different quantity or type of storage block may be used in the HPE Synergy D3940.

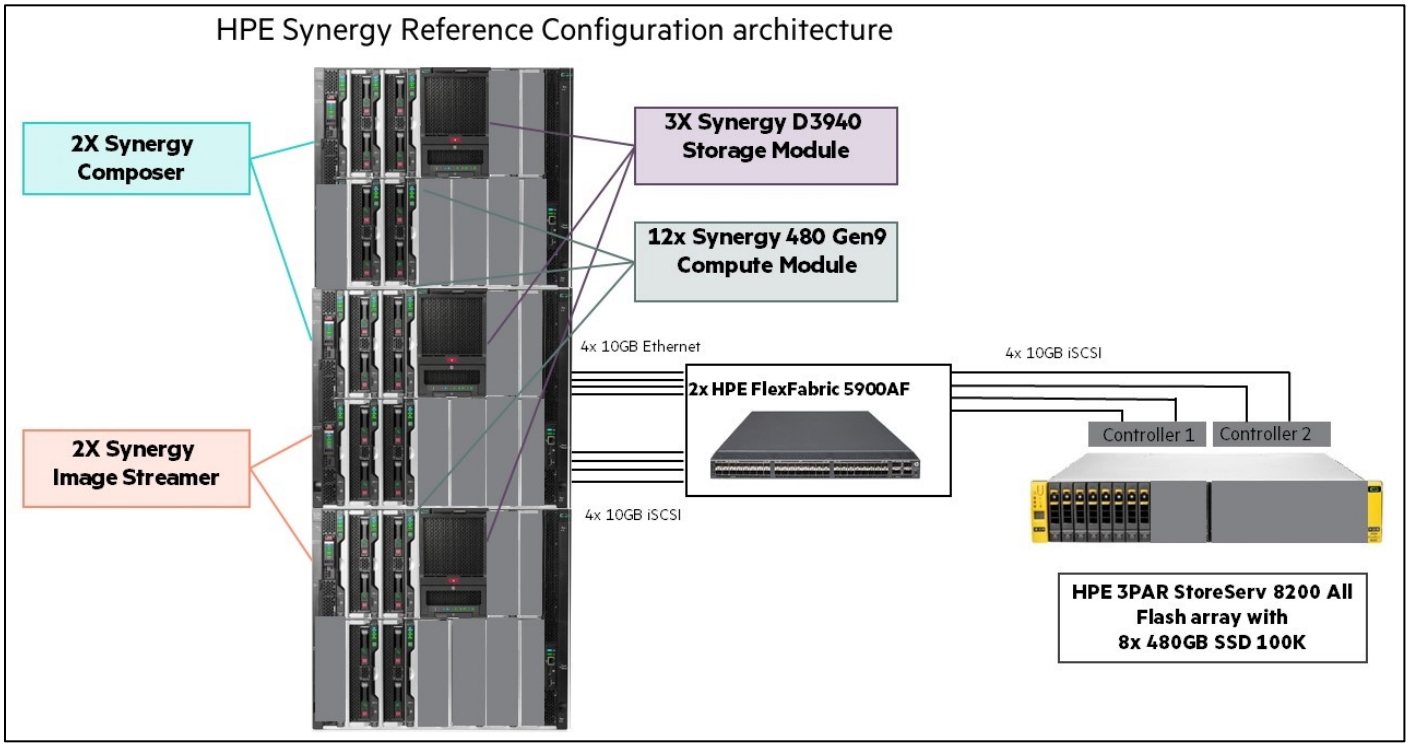

Figure 7: HPE Synergy and HPE 3PAR StoreServ 8200 configuration

This configuration provides high availability of storage using HPE 3PAR StoreServ 8200 All-Flash array to host datastores for the VMware vSphere clusters as well as to other hosts on your network. In this configuration we selected three Synergy compute nodes to provide full high availability to the VMware vSphere cluster that can, in turn, be used to provide additional redundancy for critical virtual machines running key Docker Enterprise Edition Standard roles.

While having multiple Docker UCP swarm managers and Docker DTR replica nodes does provide high availability of Docker UCP and DTR respectively, Hewlett Packard Enterprise does not recommend this as the sole means of making Docker UCP and DTR highly available. HPE recommends using the minimal number of manager and replica nodes (three each) needed to achieve high availability from a pure Docker Enterprise Edition Standard perspective as VMware vSphere high availability will already be protecting key virtual machines such as the Docker UCP managers, DTR replicas, and load balancers to assure they are restarted immediately in the event of a physical node failure. This leverages the flexibility of HPE Synergy to host any workload, minimizes licensing costs, and avoids potential performance degradation of the Docker Enterprise Edition Standard deployment.

The HPE Synergy 480 Gen9 Compute modules used in this Reference Configuration deliver the capacity, efficiency and flexibility in a two-socket half-height form factor to support demanding workloads. Each HPE Synergy 480 Gen9 compute module was configured with 2x Intel® Xeon® E5-2683 v4 2.1 GHz processors and 256GB RAM. The server profiles used for the swarm workers include best practices for high availability connections listed below and shown in Figure 8.

- 2x bonded primary Ethernet network connections for Docker traffic
- 2x bonded iSCSI connections for Image Streamer volume deployment

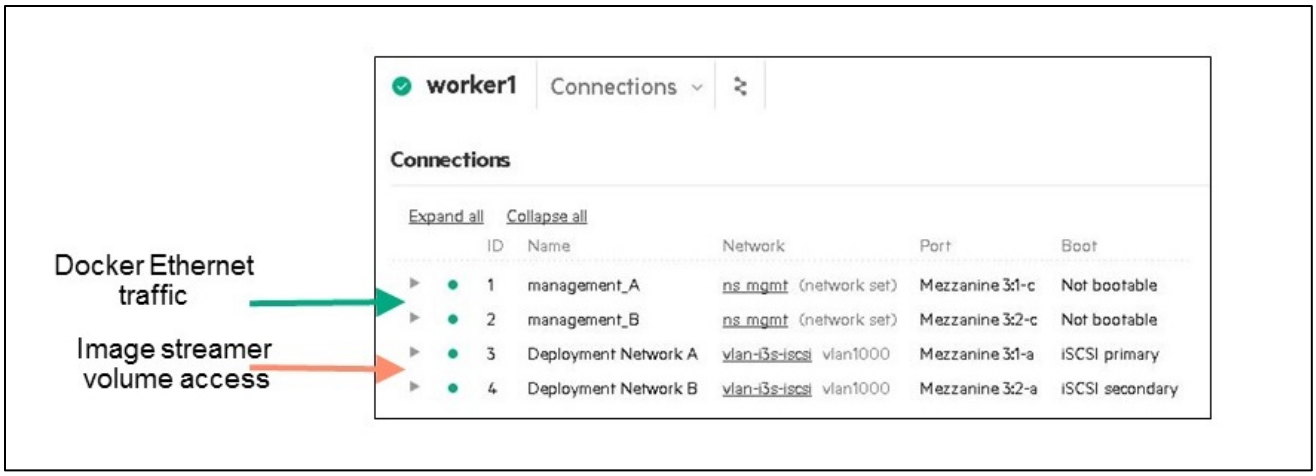

Figure 8: Server Profile connection for Docker swarm workers

The deployment plan provided as part of the HPE Synergy Image Streamer artifacts for Docker requires redundant Ethernet networks ports for Docker traffic and automatically configures the bonded network. Utilizing bonded network interfaces increases redundancy and throughput.

Docker Enterprise Edition Standard configuration best practices

This section outlines several best practices validated by Hewlett Packard Enterprise as part of this Reference Configuration. HPE recommends following Docker best practices for Docker Enterprise Edition Standard deployments, including:

- Create highly available load balancer VMs for use with Docker UCP and Docker DTR. In addition to the obvious benefits of balancing UI and API requests across the three manager nodes and DTR replicas, this also effectively provides external load balancing to any applications hosted in your Docker Enterprise Edition Standard instance.
- Use the VMware Distributed Resource Scheduler (DRS) to keep the management nodes (Docker UCP managers and DTR replicas) on separate physical hosts to prevent a host failure from impacting your Docker Enterprise Edition Standard deployment.
- Create a backup and recovery plan for both DTR images and configurations, Docker UCP configuration data, and Docker volume data. Specific guidance in this area is beyond the scope of this Reference Configuration; however, Docker has published guidelines at:
  - Docker UCP Backups and disaster recovery
  - Docker DTR backups and recovery

For more details on these best practices as well as configuration and deployment guidance, see Appendix B: Deploying Docker Enterprise Edition Standard management nodes as virtual machines.

HPE Synergy Image Streamer best practices

Best practices for HPE Synergy Image Streamer deployment and usage include:

- As shown in Figure 7, redundant HPE Synergy Image Streamers were deployed as part of this Reference Configuration, and are required for a production installation. If you need to scale your environment beyond 3 HPE Synergy Frames, be sure to follow HPE recommended guidelines to ensure your configuration meets minimum requirements.
- Deploy Docker images to a storage system such as the Synergy D3940 used for this Reference Configuration. Do not deploy the Docker images to your root filesystem on the HPE Synergy Image Streamer to avoid large and rapidly-growing smart clones.
- Create artifact bundles of your working deployment plans, build plans, build scripts and golden images and download them to alternate storage so they can be restored if necessary.
- As existing images and deployment plans are updated, be sure to remove any that are no longer used to preserve available storage. Monitor the available storage from the Deployment Appliances page under Storage.

For this Reference Configuration, HPE Synergy Image Streamer was used to deploy bare metal worker nodes to the swarm cluster. While not validated with this Reference Configuration, the VMware vSphere cluster hosts can also be provisioned using HPE Synergy Image Streamer. The OneView for VMware vCenter plug-in enables you to deploy and grow VMware vSphere clusters. See the HPE OneView for VMware vCenter User Guide for more information about this plug-in.

Utilizing HPE Synergy Image Streamer to deploy bare metal UCP swarm workers

The deployment of bare metal UCP swarm workers is greatly simplified through the use of HPE Synergy Image Streamer. The process to use HPE Synergy Image Streamer to automatically deploy bare metal swarm workers requires the following steps:

1. Configure the networking in HPE OneView
2. Create golden image
3. Download and import HPE Synergy Image Streamer artifacts
4. Customize the HPE supplied RHEL-7.3-Docker-Worker deployment plan
5. Create Server Profile Templates and Server Profiles in HPE OneView

Configure the networking in HPE OneView

Four networks were configured for the Docker deployment. A corresponding network set was created which includes a single network as a best practice. The network set is used in the server profiles. Using network sets inside the server profile allows for modification of the networks included in the network set without having to modify a server profile. This makes it easier to add or remove networks without having to power off the server.

The following Ethernet networks are required in the Synergy environment, for usage in the server profiles for the VMware vSphere cluster and the Docker worker nodes:

- Public management network (ns_mgmt)
- Image Streamer Deployment network (ns_i3s_iscsi)
- 3PAR iSCSI network (ns_3par_iscsi)
- vMotion network (ns_vmotion)

Table 4 summarizes the configuration for each network. All networks except for vMotion were created with a preferred bandwidth of 2.5 Gb/second and maximum bandwidth of 20 Gb/second because they all share a single Virtual Connect SE 40 Gb F8 module. The vMotion network was configured with preferred bandwidth of 1GB/second. No uplink set is needed for the vMotion network.

Table 4: Networks for Docker deployment

Network set name	VLAN	Subnet ID	Uplink set	Description
ns_mgmt	60	10.60.0.0/16	sus_prod	Communication for Docker workers and UCP
ns_i3s_iscsi	1000	192.168.10.0/24	i3s-iscsi	HPE Synergy Image Streamer deployment network
ns_3par_iscsi	300	192.168.30.0/24	sus_3par_iscsi	VMware vSphere cluster servers connection for shared datastore
ns_vmotion	1001	192.168.31.0/24	None	VMware vSphere vMotion network

Creating a golden image

The golden image for Docker deployment is the captured content of a previously deployed RHEL 7.3 boot disk customized with the addition of the Docker Enterprise Engine. The process to capture the image automatically removes system-specific information such as hostname and IP addresses, enabling the image to be re-deployed and automatically customized for deployment using HPE Synergy Image Streamer artifacts such as plan scripts, OS build plans and deployment plans.

The process to create a basic RHEL 7.3 golden image is documented in HPE Synergy Image Streamer – Capture RHEL 7.3. Use LVM for the Device Type when creating partitions when creating partitions as the deployment plan will configure the Docker `devicemapper` storage driver and expect LVM to be available. Follow the documented process to create the Golden Image, stopping prior to the step to **Capture the Golden Image from the Installed Volume**. At this point we want to install the Docker Enterprise Engine before we capture the image. The detailed steps to install Docker Enterprise Edition Standard are found in the Get Docker for Red Hat Enterprise Linux documentation, on the Docker website. The primary steps are:

1. Configure yum
   - Configure access to a yum repo with RHEL7.3
   - Update the yum.conf to specify a proxy if needed
   - `yum install wget`
2. Download the jq utility from github. This utility is used by the plan scripts to parse JSON data.
   - `wget https://github.com/stedolan/jq/releases/download/jq-1.5/jq-linux64`
   - `chmod +x jq-linux64`
   - `mv jq-linux64 /usr/bin/jq`
3. Download and test the docker engine to make sure it works with your proxy settings by pulling down a simple container.
   - `yum -y install docker-ee.17.03.1.ee.1-3`
   - `docker run hello-world`
4. If you are able to run the hello-world container, remove the container and image before capturing the golden image.
   - `docker rm hello-world`
   - `docker rmi hello-world`

Once the Docker Enterprise Engine is installed, continue with the steps in **Capture the Golden Image from the Installed Volume**. Be sure to specify a meaningful name for your golden image to easily identify it as your Docker worker golden image. The golden image you create in this step will be selected as the default value for the RHEL-7.3-Docker-Worker deployment plan golden image setting you will set in a later step.

Downloading HPE Synergy Image Streamer artifacts for Docker

Hewlett Packard Enterprise has created HPE Synergy Image Streamer artifacts and published them to HPE's GitHub location for customer download. The following artifact bundle was used in the development of this Reference Configuration, HPE-RHEL-7.3-Docker-2017-04-18.zip.

Import the downloaded artifact bundle into HPE Synergy Image Streamer and extract the contents. The artifact bundle includes:

- Deployment plan
- OS build plans
- Plan scripts

Customize the HPE supplied RHEL-7.3-Docker-Worker deployment plan

The deployment plan for Docker Workers as shown in Figure 9 needs to be copied and customized before it can be used. Make a copy of the plan and edit the values for the Plan Attributes to match the settings for your environment. You will probably want to hide some of the custom attributes and their values so that they are pre-configured when a server profile is created. For example, if you always specify the same proxy server, set this value and hide the corresponding custom attributes and values. Details on the custom attribute definitions and values are found in Appendix C: UCP worker node deployment plan custom attributes. Set the default for the golden image to use your newly-created RHEL 7.3 Docker Worker golden image.

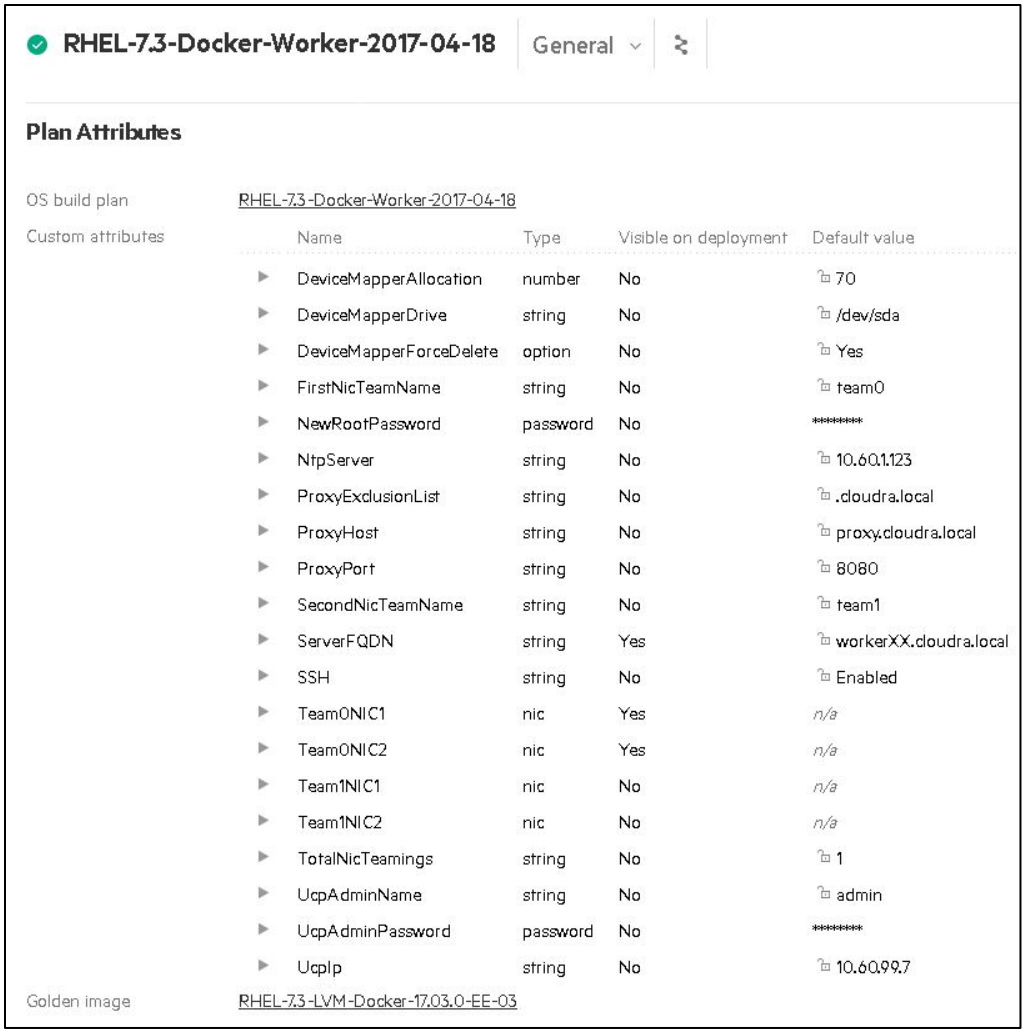

Figure 9: HPE Synergy Image Streamer deployment plan for Docker worker custom attributes

Create server profiles in HPE OneView

It is a best practice to create a server profile template for your Docker Workers and use this to create the server profiles. By using the Server Profile Template feature within HPE OneView you can specify and maintain a single configuration for the system firmware, BIOS, and boot-order at time of initial deployment as well as orchestrate updates to that configuration as needed. This provides a location to centrally manage and update configuration settings, such as system firmware, and provides assurance that each server is running with the same configuration and has event and health data being exposed up to the HPE OneView.

The server profile template for Docker Worker is shown in Figure 10. The local storage shown as **DockerVolume** is the storage on the HPE Synergy D3940. The storage controller mode must be set to RAID to configure redundant storage with RAID level 1. This storage will be used for Docker containers.

The Connections section in the server profile only includes the management network set used by Docker. **Do not** include the iSCSI network used for Image Streamer in the profile template. This network will automatically be included for you when the server profile is created.

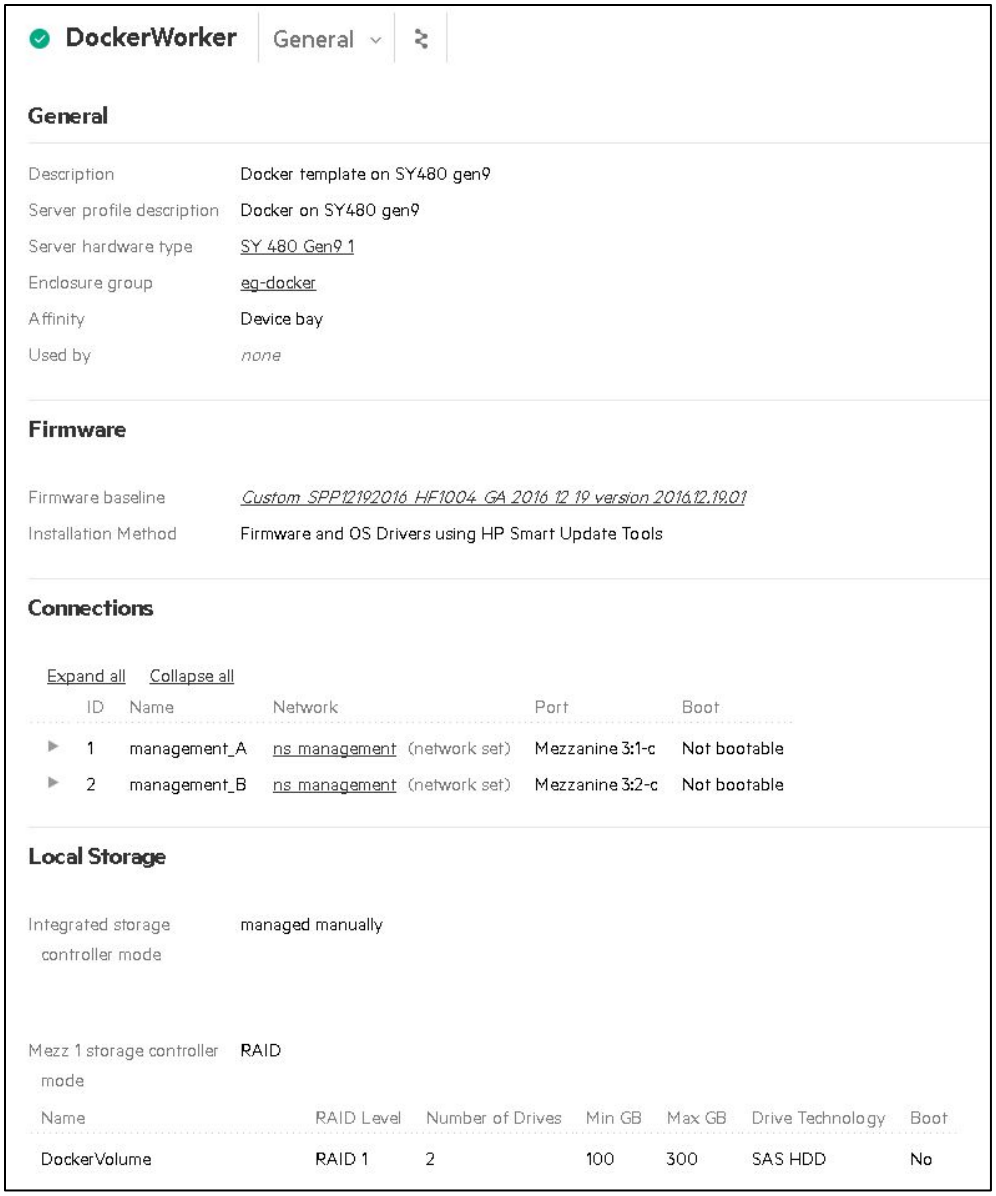

Figure 10: HPE OneView Server Profile Template for Docker Worker

Once the server profile template creation is complete it can be used to create server profiles to deploy your Docker Workers.

- Create a new server profile from the Docker Worker template you created
- Specify the OS deployment plan you created in Customize the HPE supplied RHEL-7.3-Docker-Worker deployment plan
- Set all custom attributes you have made visible when you created the deployment plan. Minimally you will need to set:
  - The ServerFQDN as the fully qualified domain name of the worker node
  - The values for the Team0NIC1 and Team0NIC2 to the names of the Docker Ethernet Traffic networks as shown in Figure 8 and Figure 11 and configure a User-specified static IP address.

Note
At the time of publication there is a restriction to select User Specified static IP address for the management network which will allow for dynamically changing the OS deployment plan when updates to golden images or other deployment scripts are needed.

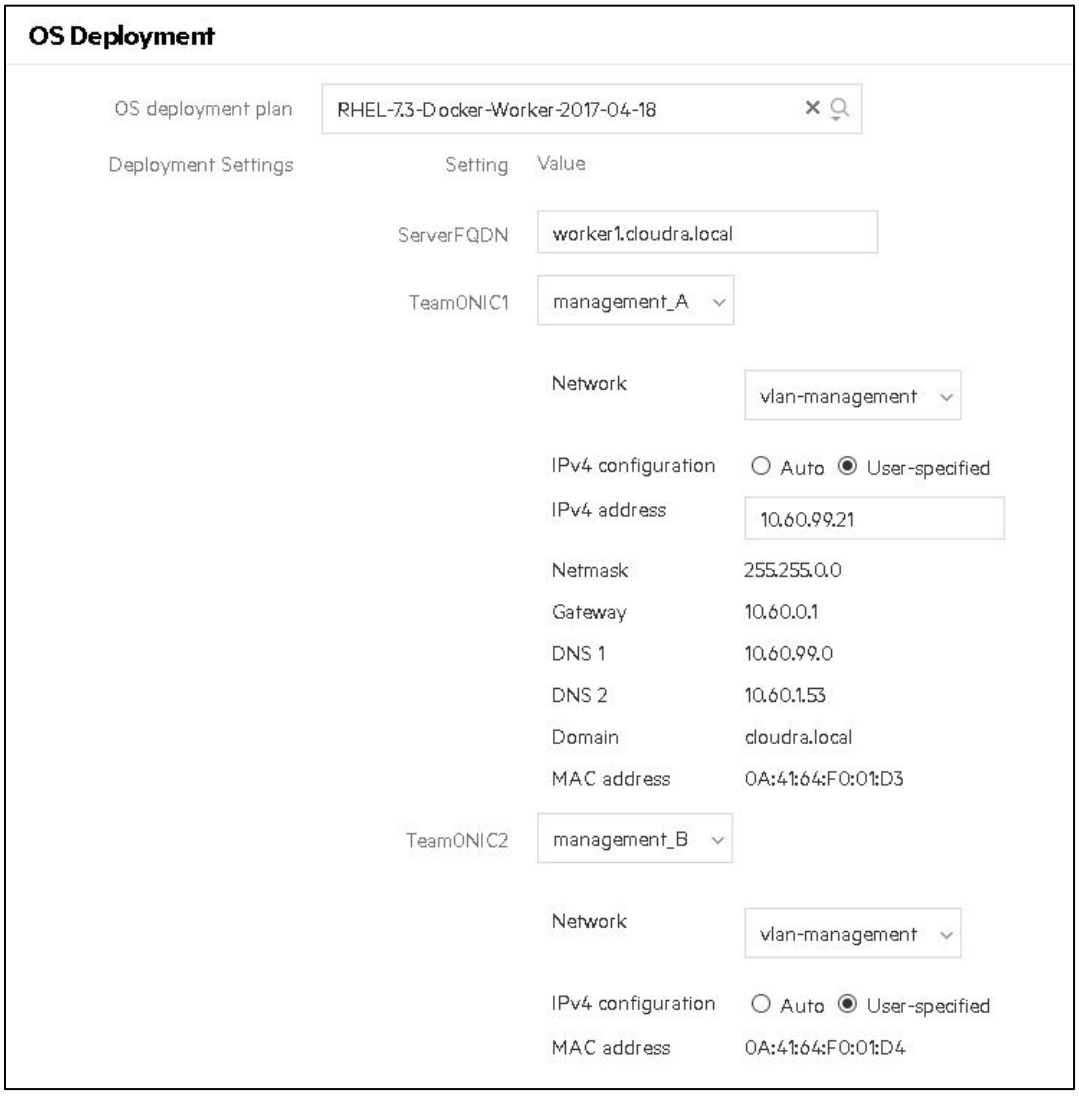

Figure 11: Docker Worker server profile creation

Once the server profile is assigned to an available server, the deployment process will begin. A smart clone of the golden image is created as a new volume and presented to the server. Power up the server. The server will automatically boot the newly created volume. The build plan and plan scripts that are part of the RHEL-7.3-Docker-Worker deployment plan will automatically customize the server with all the networking, storage connectivity, firewall, and other host settings. The plan scripts also automate the completion of the Docker Worker configuration and joining the swarm cluster. Once the scripts have completed, the newly added Docker Worker is visible in Docker UCP and available to host new container workloads as shown in Figure 12.

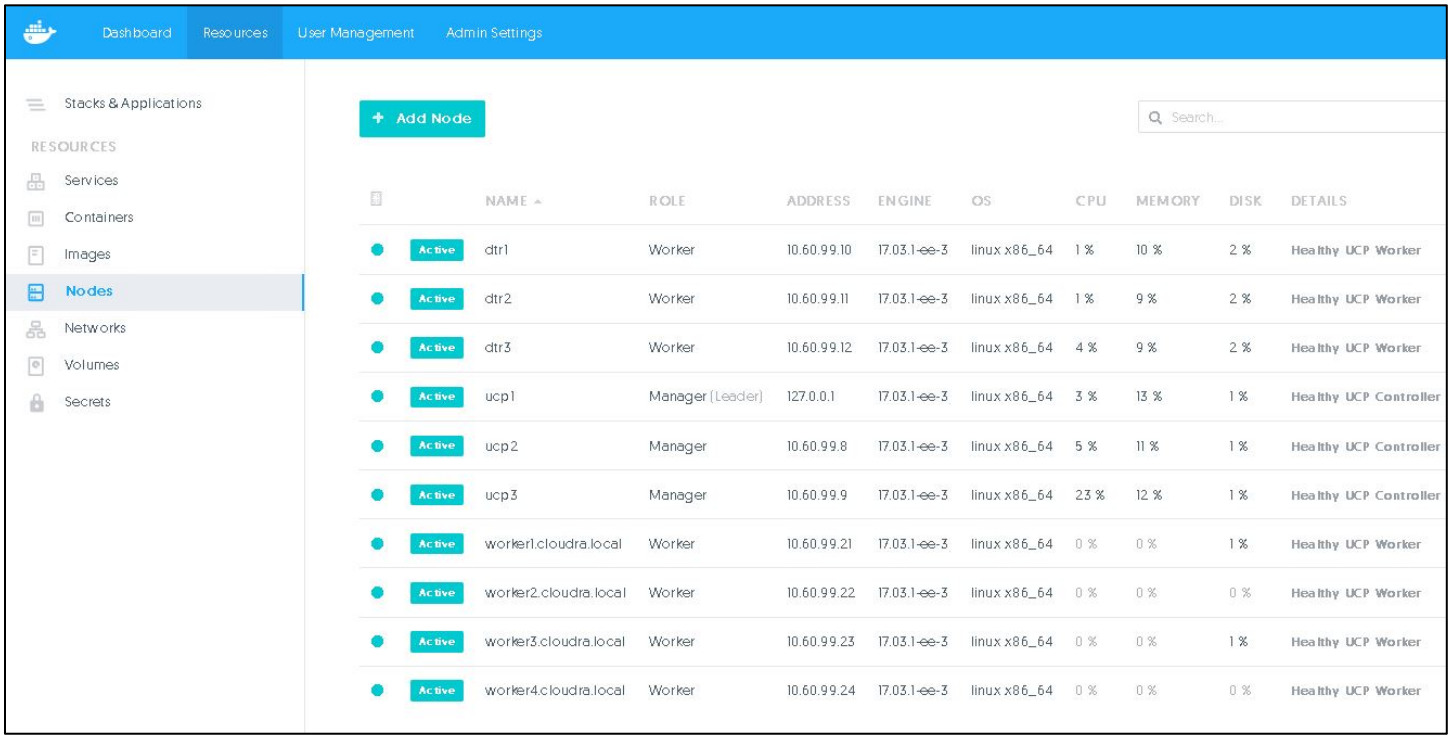

Figure 12: Docker UCP view of automatically provisioned Docker workers

Node maintenance and upgrade best practices

Over time it may be necessary to update your Docker worker nodes to change the node configuration. It should be noted that during maintenance, containers will be evacuated on other workers in the swarm cluster. It is good practice to ensure beforehand that the N-1 workers are properly sized to accommodate this extra (temporary) load without application impact. The following steps detail how to quickly deploy an updated image to your Docker worker nodes.

Note

The fields that need to be set during server profile creation in step 8 below depend on how the custom attributes are configured as described in Appendix C: UCP worker node deployment plan custom attributes.

1. Create a golden image with the updated Docker Enterprise Engine and any other desired packages.
2. From HPE Synergy Image Streamer, create a copy of your deployment plan and modify the copy to use the new golden image.
3. Passwords need to be reset when a deployment plan is copied. Re-enter the passwords and save the changes.
4. Using Docker UCP, select to **Drain the worker node**. Wait for all the containers to be evacuated from the worker before proceeding to the next step.
5. From Docker UCP, select to **Remove the worker node** from the cluster.

6. Use HPE OneView to power off the server. Since we've already drained all the containers there is no need to do a graceful shutdown as the OS boot volume will be replaced.
7. From HPE OneView, modify the server profile to use the new deployment plan.
8. Set all the custom attributes you have made visible in the new deployment plan:
   a. Enter the fully qualified domain name of the server in the ServerFQDN field.
   b. Select the management network and enter the User-specified IPv4 address under Team0NIC1.
   c. Select the management network and select User-specified IPV4 under Team0NIC2.
   d. Set any remaining custom attributes
9. Select **OK** to apply the profile.

Modifying a deployment plan on an existing server profile will give you a warning that your OS Volume will be deleted. This is expected. A new volume will be presented to your server automatically as the new server profile is applied. It will take a few minutes to apply the new server profile. Once the server profile has been applied, power up the server. The newly deployed worker node will automatically join the cluster as an active worker.

Performance benefits with HPE Synergy Image Streamer

As described in Docker Enterprise Edition Standard deployment best practices utilizing HPE Synergy Image Streamer, this Reference Configuration includes the artifacts that were used to automate the deployment of Docker worker nodes on bare metal servers and automatically join the Docker swarm cluster. By automating worker node deployment with HPE Synergy Image Streamer the overall deployment time is significantly reduced compared to a manual deployment or an automated deployment using HPE Insight Control server provisioning which uses a scripted installation methodology as shown in Table 5. The process to clone the volume takes less than 3 minutes. The worker OS deployment times shown below include the time to power on the server and boot the OS.

Table 5: Worker deployment comparison

Deployment method	Deployment type	Worker OS deployment time
HPE Synergy Image Streamer	Volume smart clone	10 minutes
HPE Insight Control server provisioning	Scripted install	30 minutes
ISO image deployment plus manual configuration	Manual install and configuration	75 minutes (estimated)

Summary

This document has described how to architect and deploy Docker Enterprise Edition Standard on HPE Synergy using HPE OneView and HPE Synergy Image Streamer to quickly install and scale Docker worker deployments. This solution combines the resource efficient usage of virtual machines for Docker management components with the performance efficiency of bare metal hosts for Docker worker nodes. Customers deploying Docker containers on large scale should consider Synergy as the deployment infrastructure. Utilizing HPE Synergy Image Streamer for worker node deployments will reduce overall Docker deployment time and improve resource utilization.

Appendix A: Bill of materials

The following BOMs contain electronic license to use (E-LTU) parts. Electronic software license delivery is now available in most countries. HPE recommends purchasing electronic products over physical products (when available) for faster delivery and for the convenience of not tracking and managing confidential paper licenses. For more information, please contact your reseller or an HPE representative.

Note

Part numbers are at time of publication and subject to change. The bill of materials does not include complete support options or other rack and power requirements. If you have questions regarding ordering, please consult with your HPE Reseller or HPE Sales Representative for more details. hpe.com/us/en/services/consulting.html

Table 6: Bill of materials

Quantity	Part number	Description
		Rack and network infrastructure
1	BW908A	HPE 42U 600x1200mm Enterprise Shock Rack
4	AF522A	HPE Intelligent 8.6kVA/L15-30P/NA/J PDU
1	HC790A	HPE Integration Center Routg Service FIO
1	BW932A	HPE 600mm Rack Stabilizer Kit
1	BW909A	HPE 42U 1200mm Side Panel Kit
1	JG505A	HPE 59xx CTO Switch Solution
2	JG510A	HPE 5900AF 48G 4XG 2QSFP+ Switch
4	JD096C	HPE X240 10G SFP+ SFP+ 1.2m DAC Cable
2	JC680A	HPE 58x0AF 650W AC Power Supply
2	JC682A	HPE 58x0AF Bck(pwr) Frt(prt) Fan Tray
		Synergy 12000 3 Frame components
3	797740-B21	HPE Synergy12000 CTO Frame 1xFLM 10x Fan
3	798096-B21	HPE Synergy 12000F 6x 2650W AC Ti FIO PS
2	804353-B21	HPE Synergy Composer
3	804942-B21	HPE Synergy Frame Link Module
1	804938-B21	HPE Synergy 12000 Frame Rack Rail Option
1	804943-B21	HPE Synergy 12000 Frame 4x Lift Handle
18	TK738A	HP 2.0m 250V 16A C19-C20 Sgl IPD Jpr Crd
2	804937-B21	HPE Synergy Image Streamer
		Synergy 480 Gen 9 compute components
12	732352-B21	HPE SY 480 Gen9 CTO Cmpt Mdl
12	826993-B21	HPE Synergy 480 Gen9 E5-2683v4 Kit
12	826993-L21	HPE Synergy 480 Gen9 E5-2683v4 Kit
96	805351-B21	HPE 32GB 2Rx4 PC4-2400T Memory
12	759557-B21	HPE Smart Array P542D/2GB Controller
12	814068-B21	HPE Smart Array P240 Controller
12	777430-B21	HPE Synergy 3820C 10/20Gb CNA
12	782958-B21	HPE 96W Smart Stor Battery 260mm Cbl Kit

Quantity	Part number	Description
		Synergy Fabric Components
2	794502-B23	HPE VC SE 40Gb F8 Module
4	779218-B21	HPE Synergy 20Gb Interconnect Link Mod
6	755985-B21	HPE Synergy 12Gb SAS Connection Module
		Synergy Composable Storage Components
3	835386-B21	HPE Synergy D3940 CTO Storage Module
3	757323-B21	HPE Synergy D3940 IO Adapter
30	785067-B21	HP 300GB 12G SAS 10K 2.5in SC ENT HDD
		Cables and Transceivers
8	804101-B21	HPE Synergy Interconnect Link 3m AOC
2	720199-B21	HP BLc 40G QSFP+ QSFP+ 3m DAC Cable
8	720193-B21	HP BLc QSFP+ to SFP+ Adapter
8	455883-B21	HP BLc 10G SFP+ SR Transceiver
8	AJ837A	HPE 15m Multi-mode OM3 LC/LC FC Cable
9	861412-B21	HPE CAT6A 4ft Cbl
2	838327-B21	HPE Synergy Dual 10GBASE-T QSFP+ 30m RJ45 Transceiver
		HPE 3PAR StoreServ 8200 with iSCSI adapters and accessories
1	K2Q36B	HPE 3PAR 8200 2N+SW Storage Field Base
2	H6Z10A	HPE 3PAR 8000 2-pt 10Gb iSCSI/FCoE Adptr
8	K2P88B	HPE 3PAR 8000 480GB+SW Non-AFC SFF SSD
1	HA114A1	HP Installation and Startup Service
1	HA114A1 5XU	HPE Startup 3PAR 8200 2N Fld Int Bas SVC
1	K2R29A	HPE 3PAR StoreServ RPS Service Processor
1	H1K92A3	HPE 3Y Proactive Care 24x7 Service
1	H1K92A3 W3G	HPE 3PAR 8200 2N+SW Storage Base Support
8	H1K92A3 X8G	HPE 3PAR 8000 480GB+SW LFF SSD Supp
1	H1K92A3 YNW	HPE 3PAR StoreServ RPS Service Proc Supp
2	H1K92A3 YTN	HPE 3PAR 8000 2-pt 10Gb FCoE Adptr Supp
1	L7F20AAE	HPE 3PAR All-in S-sys SW Current E-Media
1	L7F22AAE	HPE 3PAR All-in M-sys SW Current E-Media
1	C7535A	HP RJ45 to RJ45 Cat5e Black M/M 7.6ft 1-pack Data Cable
8	H0JD6A1	HPE 3PAR SSD Extended Replacement SVC
1	HA124A1	HP Technical Installation Startup SVC
1	HA124A1 5QW	HPE Startup 3PAR Vrt Cpy Lvl1 Tier 1 SVC
1	HA124A1 56X	HPE Startup 3PAR 8K Mlt Sys PM PP RC SVC
		VMware license for management cluster
6	BD715AAE	VMw vSphere EntPlus 1P 3yr E-LTU

Alternate solution components

Table 7. Alternate Docker licensing options (pick one) for the HPE Synergy 480 servers

Quantity	Part number	Description
15	Q0K87AAE	HPE Docker Ent Std 1yr 9x5 E-LTU
15	Q0K88AAE	HPE Docker Ent Std 3yr 9x5 E-LTU
15	Q0K93AAE	HPE Docker Ent Std 1yr 24x7 E-LTU
15	Q0K94AAE	HPE Docker Ent Std 3yr 24x7 E-LTU

Note
Each server or VM installed with the Docker CS Engine requires a Docker Enterprise Edition Standard license. At minimum, 15 Docker Enterprise Edition Standard licenses are required for the UCP deployment as outlined in this Reference Configuration, as six Docker Enterprise Edition Standard licenses are required for the management VMs (UCP swarm managers and DTR replicas) and nine licenses are required for the UCP swarm workers.

Appendix B: Deploying Docker Enterprise Edition Standard management nodes as virtual machines

In this section we will provide a high-level overview of the Docker Enterprise Edition Standard installation process on the six Docker and three load balancer virtual machines. For specific installation and configuration processes, refer to the official Docker documentation and installation guides. In our Reference Configuration, there are three Docker Universal Control Plane manager nodes and three Docker Trusted Registry UCP worker nodes running as VMs as shown in Figure 6. The Docker Enterprise Edition Standard management nodes used for this Reference Configuration were deployed as virtual machines on a VMware vSphere 6.0 cluster. The Docker documentation for Universal Control Plane specifies the system requirements for the Linux servers. For this Reference Configuration, Red Hat® Enterprise Linux version 7.3 was used.

A VM template for Docker was created with VMware vSphere client and used to create the control plane virtual machines. The VM template was configured with the firewall settings as described in the system requirements documentation for UCP.

The Docker Control Plane VMs were deployed with the settings listed in Table 8.

Table 8: Docker Control plane virtual machine configuration

Component	CPU	Memory	Storage	Networks
UCP (3x)	4	6GB	50GB boot 300GB Docker Volume	Mgmt 3par-iscsi
DTR (3x)	4	6GB	50GB boot 300GB Docker Volume	Mgmt 3par-iscsi
App-LoadBalancer	2	2GB	50GB boot	Mgmt
UCP-LoadBalancer	2	2GB	50GB boot	Mgmt
DTR-LoadBalancer	2	2GB	50GB boot	Mgmt

Additional details on the virtual machines deployed in the Docker Enterprise Edition Standard setup are listed in Table 9

Table 9: VMs deployed for initial Docker Enterprise Edition Standard setup

Hostname	Node type	DRS rules (recommended)	Notes
ucp-lb	HAProxy load balancer	None	Use your preferred Linux image with minimal packages as appropriate
app-lb	HAProxy load balancer	None	Use your preferred Linux image with minimal packages as appropriate
dtr-lb	HAProxy load balancer	None	Use your preferred Linux image with minimal packages as appropriate
ucp1	UCP manager	Keep separated from other ucpManager VMs	Use your Docker VM Template
ucp2	UCP manager	Keep separated from other ucpManager VMs	Use your Docker VM Template
ucp3	UCP manager	Keep separated from other ucpManager VMs	Use your Docker VM Template
dtr1	UCP worker / DTR replica	Keep separated from other DTR VMs	Use your Docker VM Template
dtr2	UCP worker / DTR replica	Keep separated from other DTR VMs	Use your Docker VM Template
dtr3	UCP worker / DTR replica	Keep separated from other DTR VMs	Use your Docker Image

Configure Docker Enterprise Edition Standard management components

Installing Docker Universal Control Plane management components

Once the initial VM deployment is complete, use the vSphere Web Client or ssh client to open a session to each VM to configure them for their specific Docker Universal Control Plane (UCP) roles. Use Table 9 to note the recommended role for each node. All nodes in the solution except for the load balancers need to be joined to the UCP cluster.

Start with the load balancers (as at least the DTR load balancer must be up and functional before installing DTR). After the load balancers are up, and pre-configured with the expected addresses of the other nodes, install the Docker nodes starting with a Docker UCP manager node, ucp1 in this Reference Configuration. Next, deploy the VMs for the remaining UCP manager nodes and join them as managers. Finally, deploy and join the DTR nodes as UCP workers.

Important

The process described in this section deploys the control plane. The swarm cluster will not have any true worker nodes until the steps in the Utilizing HPE Synergy Image Streamer to deploy bare metal UCP swarm workers section of this document have been completed.

Refer to the Docker Install UCP for production documentation, for detailed UCP manager and worker installation instructions. Hewlett Packard Enterprise recommends following the Docker best practices for the Docker UCP deployment including:

- To enable load balancing, the IP address and/or domain name of the UCP load balancer should be specified as a Subject Alternative Name (SAN) using the `--san` option when installing the UCP controller and replicas.
- The swarm scheduler should be configured to prevent accidentally scheduling containers on the UCP controller nodes. This can be accomplished in the Docker Universal Control Plane by selecting Admin Settings → Scheduler under Scheduler Settings and clearing the checkbox in “Allow Admins to deploy workloads to manager nodes or nodes running DTR replicas”.

Installing Docker Trusted Registry

Docker Trusted Registry will be installed on cluster nodes dtr1, dtr2, and dtr3 as per Table 9. These nodes should already be joined to the Docker UCP cluster and appear as workers on the Nodes pages within the Docker UCP web user interface.

Refer to the official Docker Trusted Registry documentation for full detailed instructions for installing and configuring Docker Trusted Registry. HPE recommends following the Docker best practices for the Docker DTR deployment including:

- To enable load balancing, the IP address or domain name of the DTR load balancer node should be specified for the `--dtr-external-url` option when installing DTR. Additionally, as that address will be probed as part of the DTR installation process, the DTR load balancer should be installed and configured prior to installing DTR on the first node.
- Create a DTR backup and disaster recovery plan as per the Docker documentation.
- Be sure to apply the Docker license to DTR in the Web UI. Images cannot be pushed to DTR until the license is applied.
- Microsoft® Azure blob storage was used as the DTR storage backend during testing of this Reference Configuration to provide for high availability. Details on alternatives for DTR HA storage options can be found in the Docker documentation.

Note
If you are working in an environment that requires an HTTP proxy, note that the DTR install command does not read such settings from environment values of your shell or the Docker daemon configuration. The DTR install command requires proxy settings such as `--http-proxy`, `--https-proxy`, and `--no-proxy` to be provided directly. Failure to provide such settings may result in errors pulling images, failure communicating to UCP, or in DTR containers failing to start even though no errors are reported from the install command.

App, UCP and DTR load balancing

Three virtual machines (app-lb, ucp-lb and dtr-lb) were created to act as load balancers for the Docker Universal Control Plane controller nodes and the Docker Trusted Registry cluster nodes. In our example we are using HA Proxy to provide load-balancing services. Other load balancers may be used to provide load-balancing services. For more information on configuring Docker Universal Control Plane and Docker Trusted Registry, refer to the High-availability sections for those products at https://docs.docker.com. Instructions for using the swarm mode routing mesh and configuring load balancers is found in Use swarm mode routing mesh.

Appendix C: UCP worker node deployment plan custom attributes

The RHEL-7.3-Docker-Worker-2017-04-18 deployment plan provided in the downloaded artifact bundle requires changes to the custom attributes used to deploy the Docker worker node. The following custom attributes are included:

Table 10: Custom Attributes for Docker worker deployment

Name	Description	Visible	Sample Value
DeviceMapperAllocation	Percentage of the D3940 disk drive which is allocated for Docker volume images. The rest of the storage is available for the Docker root directory and can be used for volume creation. It should be noted that the volumes created on local storage are only available to containers running on the same host.	Yes	70
DeviceMapperDrive	The filesystem location for the D3940 data drive	Yes	/dev/sda
DeviceMapperForceDelete	Forces a disk wipe so logical volumes can be re-used. This custom attribute is hidden and must be set to yes or the Docker containers may not load properly	No	yes
FirstNicTeamName	Unique name for the NIC Team used for Docker networking. This name will be used by the plan scripts to create the NIC team.	Yes	Team0
NewRootPassword	Password to be configured for the root user. Note that when you assign the server profile you need to re-enter the password for security purposes.	Yes	
NtpServer	IP address for the NTP server. An NTP server is required or communication between containers could fail.	Yes	10.10.10.100
ProxyExclusionList	A comma separated list of domain names which will be used to create the no_proxy environment variable on the deployed server. If you don't have a proxy in your environment, or use a transparent proxy, edit the OS build plan and remove the step which configures the proxy (070-Docker-configure-proxy)	Yes	
ProxyHost	Proxy host IP address if needed. If no proxy is needed, remove the plan script (070-Docker-configure-proxy) from the OS build plan. Do not include http in the ProxyHost name.	Yes	proxy.acme.com
ProxyPort	Proxy port used with the proxy host.	Yes	8080
SecondNicTeamName	Reserved for future use	Yes	
ServerFQDN	Fully qualified domain name	Yes	server1.acme.com
SSH	Enable the SSH service and root login over ssh. The default is Enabled.	Yes	enabled
Team0NIC1	A static IP address for the Docker worker host on your production network. Select Static User Assigned for this address.	Yes	
Team0NIC2	This NIC is used for teaming. Leave the default value of static. No IP address is needed	Yes	
Team1NIC1	Reserved for future use	No	
Team1NIC2	Reserved for future use	No	
TotalNicTeamings	The total number of NIC teams set by the plan scripts. Leave this value set to 1.	No	1
UcpAdminName	The administrator account for accessing UCP	Yes	admin
UcpAdminPassword	Password for UCP administrator user	Yes	
Ucplp	IP address for UCP Load Balancer	Yes	

As noted in Table 10 above, the OS build plan delivered as part of the artifact bundle for Docker includes a step to configure the proxy host. If a proxy host is not required in your environment, remove XXX-Docker-configure-proxy from your OS build plan, (XXX = 070 at the time of writing).

Resources and additional links

Docker Enterprise Edition, https://docs.docker.com/enterprise/

Docker Trusted Registry documentation, https://docs.docker.com/datacenter/dtr/2.2/guides/

Docker Universal Control Plane documentation, https://docs.docker.com/datacenter/ucp/2.1/guides/

Docker Reference Architecture: Universal Control Plane 2.0 Service Discovery and Load balancing, https://success.docker.com/Architecture/Docker_Reference_Architecture%3A_Universal_Control_Plane_2.0_Service_Discovery_and_Load_Balancing

HA Proxy, haproxy.org

HPE Reference Architectures, hpe.com/info/ra

HPE GitHub Reference Architectures, https://github.com/HewlettPackard/image-streamer-reference-architectures

HPE Servers, hpe.com/servers

HPE OneView, hpe.com/oneview

HPE Storage, hpe.com/storage

HPE Synergy, hpe.com/synergy

HPE Networking, hpe.com/networking

HPE Technology Consulting Services, hpe.com/us/en/services/consulting.html

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