

# Understanding the HP CloudSystem Reference Architecture

White paper





## Table of contents

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1. Introduction .....	3
2. CloudSystem overview .....	3
3. Basic CloudSystem architecture .....	4
4. HP CloudSystem Matrix .....	5
5. HP CloudSystem Enterprise .....	6
CloudSystem Enterprise core .....	6
CloudSystem Enterprise block diagram .....	6
Cloud Service Automation: delivery and demand layers .....	8
CloudSystem Enterprise portals and interfaces ...	10
HP Cloud Maps .....	10
6. HP CloudSystem Service Provider .....	11
Aggregation Platform for SaaS (AP4SaaS) .....	11
CloudSystem Service Provider portals and interfaces .....	12
7. HP CloudSystem extensions .....	12
8. Summing up .....	17
9. Resources .....	17
Appendix: HP CloudSystem details at a glance .....	18

## 1. Introduction

HP CloudSystem is an integrated system for building and managing services across private, public, and hybrid clouds. HP CloudSystem combines servers, storage, networking, and security together with an integrated approach to automate the application-to-infrastructure lifecycle. The result is a complete cloud solution that can provide “cloud driven” services for enterprises and service providers alike. HP CloudSystem uses industry-leading HP technologies to provide dynamic, easily scaled computing resources such as servers and storage.

This white paper provides a look at the architecture of HP CloudSystem. The paper gives an overview of CloudSystem, including three CloudSystem offerings and their major extensions, and it provides details of one offering: HP CloudSystem Enterprise.

## 2. CloudSystem overview

HP CloudSystem is built on proven HP Cloud Service Automation and Converged Infrastructure technologies using HP BladeSystem and HP Matrix Operating Environment. With support for a broad set of applications, CloudSystem provides IT with a unified way to offer, provision, and manage services across private clouds, public cloud providers, and traditional IT. It enables the flexibility to scale capacity within and outside the data center, it is extensible to existing IT infrastructure, and it can support heterogeneous environments.

HP CloudSystem enables businesses to build and manage cloud services across private, public, and hybrid clouds—without having to know, or care, whether those services come from CloudSystem’s own “on-premises” resources, from a customer’s existing infrastructure, or from the public domain.

### Full range of cloud offerings

As shown in Figure 1, HP CloudSystem has three integrated offerings. These offerings provide a range of services for all customers as well as an avenue for growth and expansion. The offerings are:

- **HP CloudSystem Matrix:** A private cloud solution that provides infrastructure as a service, as well as basic application deployment and monitoring. This entry offering allows you to provision infrastructure and applications in minutes, not months.
- **HP CloudSystem Enterprise:** For those looking to deploy private and hybrid cloud environments and the full range of service models (IaaS, PaaS, and SaaS). This offering provides a single service view of the client’s environments, from private cloud to public clouds to traditional IT, with advanced application-to-infrastructure lifecycle management.
- **HP CloudSystem Service Provider:** Public or hosted private cloud designed for service providers to provide a public cloud infrastructure as a service (IaaS) and software as a service (SaaS), including aggregation and management of those services.

Figure 1. Three integrated HP CloudSystem offerings offer a full range of cloud capabilities.

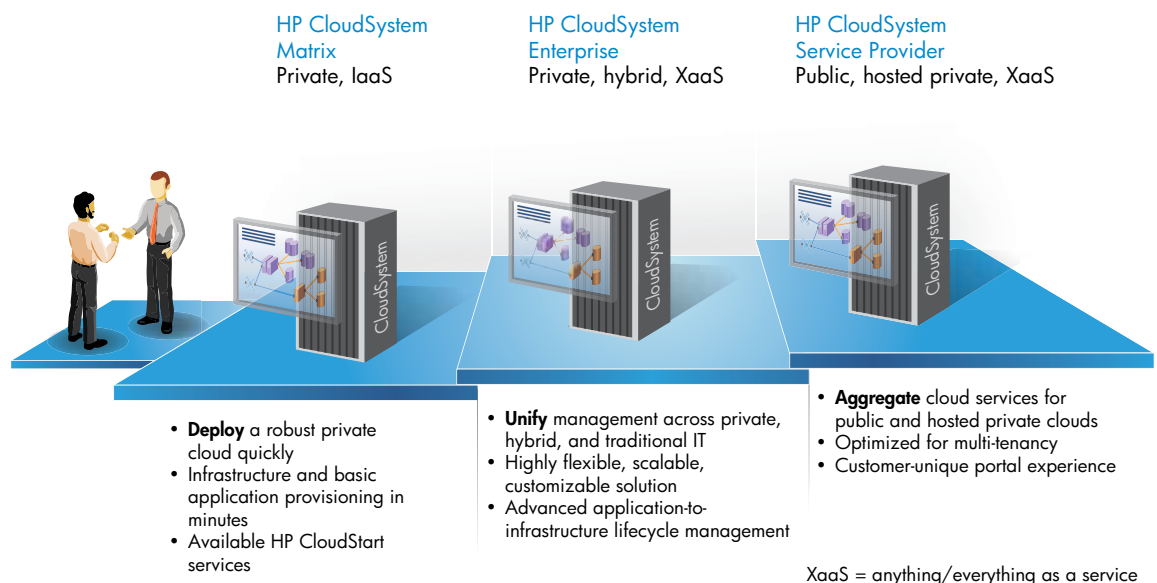
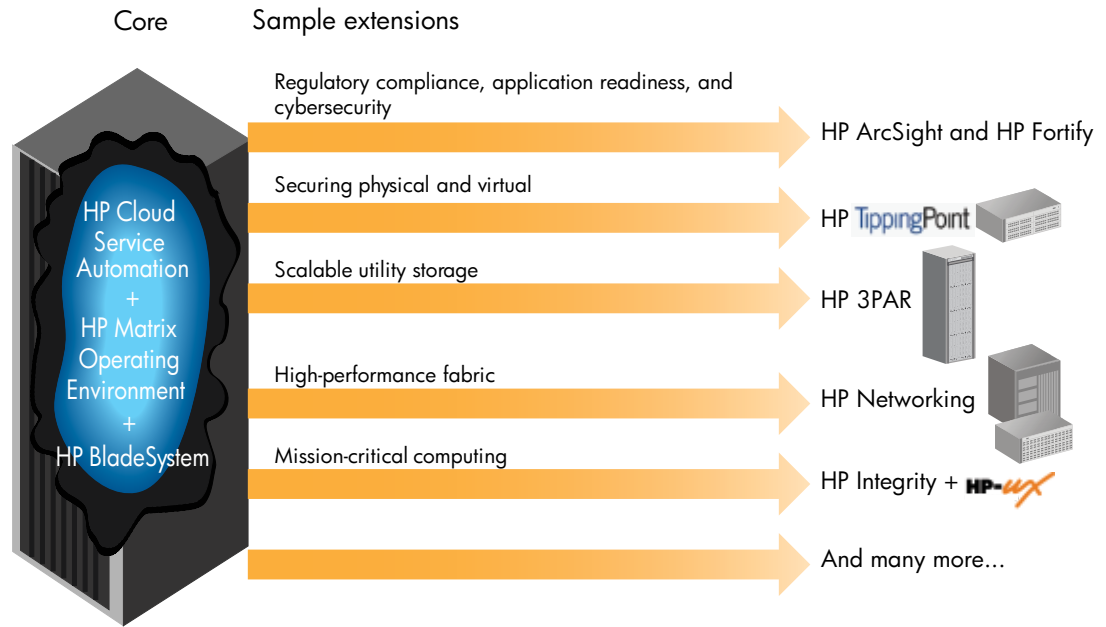


Figure 2. An HP CloudSystem is easily expanded with hardware and software extensions.



Each of these offerings is available as a small, medium, or large configuration, and each can be modified and expanded with additional hardware and software from HP and third parties, making CloudSystem suitable for virtually any desired variety or scale of cloud services.

The offerings all provide scalable and elastic IT-enabled capabilities, which can be delivered as a service to customers using the Internet or an intranet.

#### Expandable and extensible

As illustrated by the example in Figure 2, each offering consists of a core platform and a number of extensions. The core HP CloudSystem platform is built on key elements of HP's Converged Infrastructure, including HP BladeSystem, the Matrix Operating Environment, and Cloud Service Automation. That core platform is fully extensible via other elements of the Converged Infrastructure portfolio, including storage, security, networking, mission-critical computing, and aggregation technologies.

#### A fast track to create service catalogs with Cloud Maps

HP Cloud Maps are an important CloudSystem capability. These provide tools and best practices that enable CloudSystem to quickly and easily create service catalogs for various kinds of common application environments from major vendors such as Oracle, SAP, and Microsoft®. Cloud Maps can substantially reduce the time and effort needed to develop a catalog of CloudSystem services. (For more information, see page 10.)

### 3. Basic CloudSystem architecture

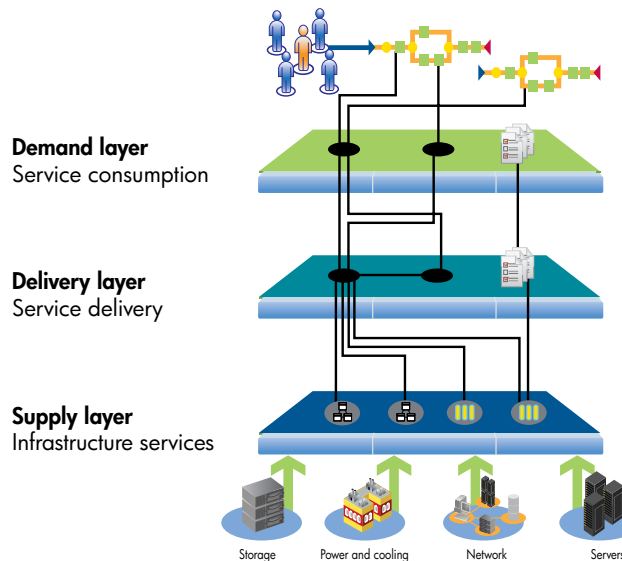
In cloud computing, scalable and elastic IT-enabled capabilities are delivered as a service to customers using the Internet or an intranet. The most important capabilities are a self-service portal; a pool of shared resources; automated provisioning, flexing, and release of those resources; a facility to meter and charge for usage; and ubiquitous access. HP CloudSystem provides these capabilities using

#### Cloud models

HP CloudSystem offerings cover the full range of cloud models, including:

- **IaaS:** infrastructure as a service, in which the computing infrastructure, including physical and virtualized servers, storage, and networking, is delivered as a service.
- **PaaS:** platform as a service, where an entire computing platform, including infrastructure and a solution stack and development platform, is delivered as a service.
- **SaaS:** software as a service, which makes available not only the infrastructure and the platform, but also software applications running on that platform.

Figure 3. HP CloudSystem's three-layer structure includes supply, delivery, and demand layers.



the three-layer architecture shown in Figure 3, which enables IT as a service. Within this architecture:

- The supply layer provides all the infrastructure services for CloudSystem; this is where the physical and virtual assets reside.
- The delivery layer provides application service delivery.
- The demand layer contains the self-service portals and is where services are actually consumed by end users or subscribers.

HP CloudSystem is based on the HP Converged Infrastructure. Employing a shared services model, with pools of compute, storage, and network resources, the Converged Infrastructure is an ideal foundation for cloud computing.

From a management perspective, CloudSystem provides a complete management environment to help ensure the cloud service meets the needs of the end user. In addition to automated provisioning and resource management, extensions allow a cloud service based on CloudSystem to offer such added features as governance, application readiness, service monitoring, and enhanced security.

## 4. HP CloudSystem Matrix

HP CloudSystem Matrix is an entry cloud solution for customers who want to set up their own private cloud. This offering enables quick deployment of a private IaaS solution featuring a self-service infrastructure portal for auto-provisioning, along with built-in lifecycle management to optimize infrastructure,

manage the resource pool, monitor applications, and help ensure uptime.

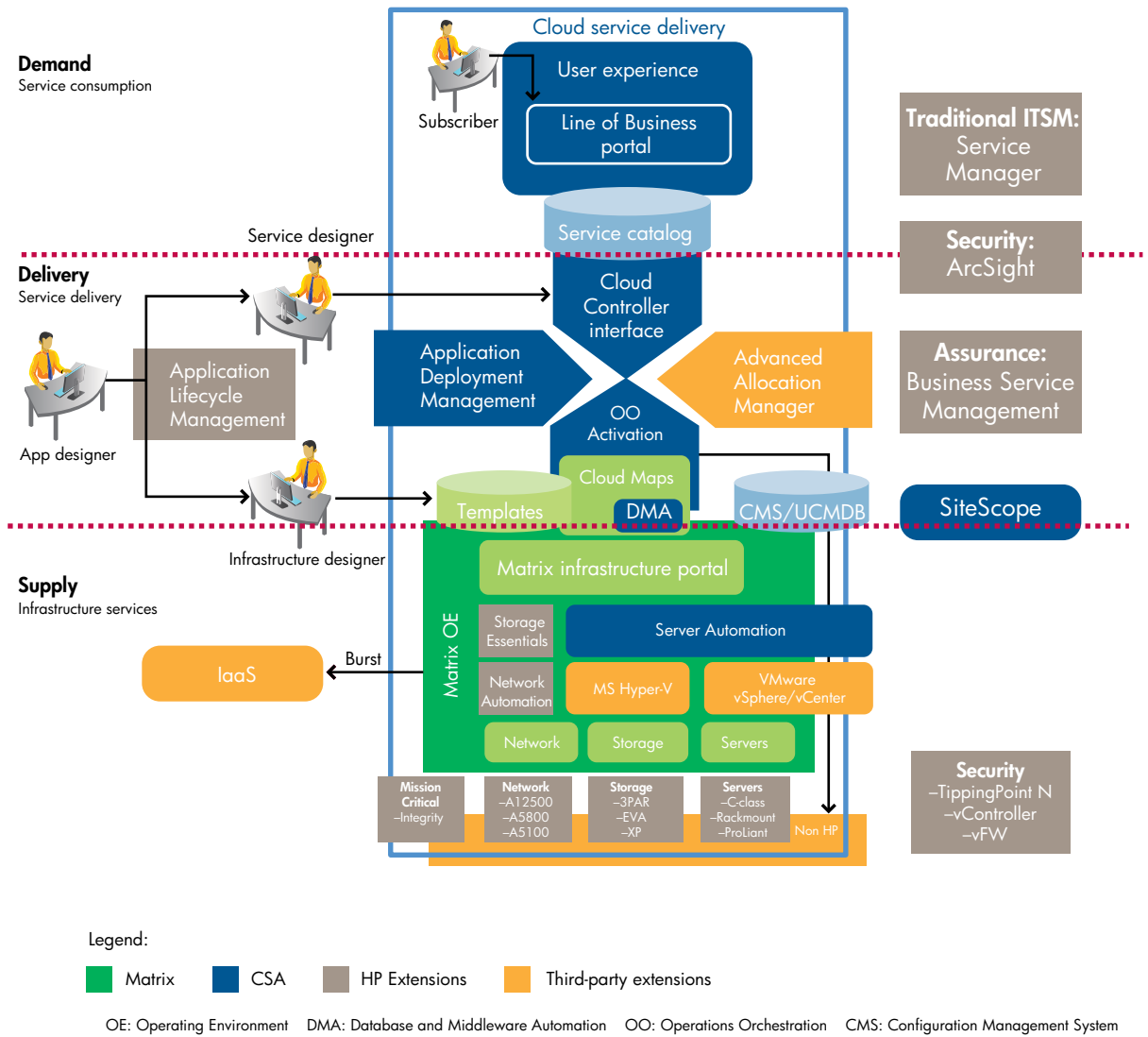
**Supply layer:** The infrastructure services of CloudSystem are based around HP BladeSystem technology with the Matrix Operating Environment (Matrix OE). For more details about the CloudSystem infrastructure, see section 5, HP CloudSystem Enterprise. CloudSystem can also support heterogeneous infrastructure.

**Delivery and demand layers:** In the HP CloudSystem Matrix offering, service delivery and the mechanism for service consumption are provided by the Matrix OE, which supports both HP and heterogeneous environments. For providing Infrastructure as a Service (IaaS) with basic application service delivery, the Matrix Operating Environment is tightly integrated with Cloud Service Automation for Matrix, which consists of Server Automation and SiteScope.

The HP CloudSystem Matrix offering is a complete private cloud solution and includes all the features expected in the cloud: an infrastructure-centric self-service portal; a pool of shared resources; automated provisioning, flexing, and release; metering for usage; and ubiquitous access. Customers who want to get started as quickly as possible can use HP CloudStart, a service offering that allows them to be delivering secure private cloud services within 30 days based on a CloudSystem Matrix implementation, complete with up to four compute services, storage integration, backup policies, security policies, and usage metering and reporting.



**Figure 4. CloudSystem architecture includes the supply, delivery, and demand layers. This illustration shows details of HP CloudSystem Enterprise architecture.**



## 5. HP CloudSystem Enterprise

This section provides a detailed view of the HP CloudSystem Enterprise offering. Like all CloudSystem offerings, CloudSystem Enterprise employs the three-layer architecture, with supply, delivery, and demand layers, and includes both a core offering and a number of extensions.

### CloudSystem Enterprise core

The CloudSystem Enterprise core is built on the modular HP BladeSystem architecture, and includes the highly automated Matrix Operating Environment (Matrix OE) that enables rapidly provisioning complex infrastructure services and adjusting them to meet changing business demands. HP Cloud Service Automation software manages the entire cloud lifecycle, including orchestrating infrastructure and application provisioning. Cloud Service Automation anchors the delivery and demand layers of

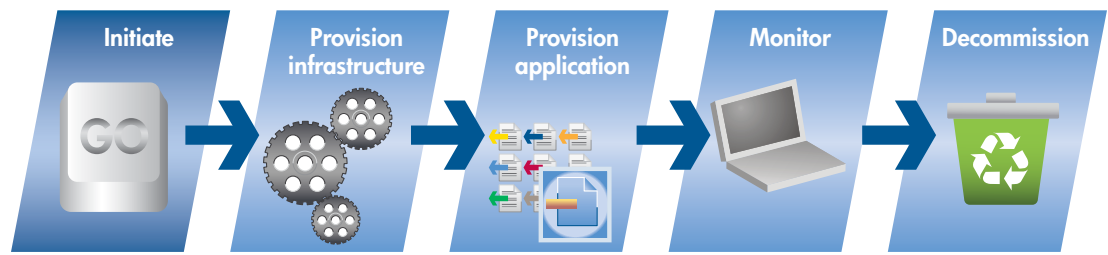
CloudSystem Enterprise; its roles include provisioning the application, managing and monitoring the cloud, and releasing resources back to the cloud.

### CloudSystem Enterprise block diagram

The block diagram in Figure 4 illustrates the architecture of the CloudSystem Enterprise offering. The diagram shows how Cloud Service Automation software is linked to Matrix OE and to CloudSystem extensions.

**Supply layer:** The supply layer provides for service delivery of infrastructure elements such as compute, network, storage, and other resources both physical and virtual. These infrastructure elements may be HP hardware and virtualization, or they may be provided by a customer's existing infrastructure or by third parties, including public clouds.

Figure 5. CloudSystem handles provisioning, monitoring, and release of infrastructure resources and applications.



**Delivery layer:** Above the supply layer is the delivery layer, where Cloud Service Automation software enables and manages the delivery of application services. User interfaces allow infrastructure design, for specifying what assets will be available, and service design, where a service designer can add to and manage service catalogs.

**Demand layer:** Cloud Service Automation also provides the portal services for the demand layer, where consumers or business users can request services.

#### Provisioning and monitoring

Figure 5 shows the lifecycle for provisioning services and applications, as well as monitoring and decommissioning the services and applications.

#### CloudSystem supply layer

The infrastructure found in HP CloudSystem's supply layer includes a number of well-established HP technologies and functionality:

- HP BladeSystem c-Class c7000 enclosure, server blades, Virtual Connect with Flex-10 or FlexFabric, and Thermal Logic.
- HP Matrix Operating Environment software.
- Networking connectivity to standard storage area network or Fibre Channel network.

CloudSystem is optimized for HP infrastructure and it also supports servers, storage, and networking from third parties.

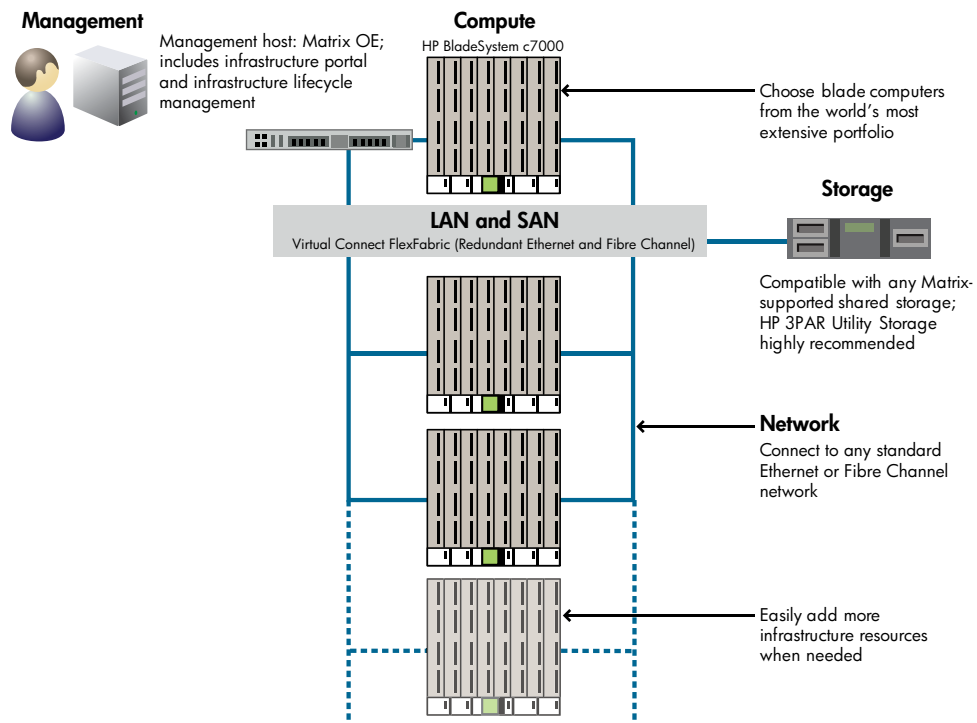
**HP BladeSystem technology:** Blade servers and technology from HP are the ideal environment for CloudSystem. Blades provide a common modular infrastructure designed for efficiency, scalability, and flexibility. In fact, CloudSystem customers can run mission-critical HP-UX on HP Integrity blades side-by-side in the same chassis with VMware, Windows®, and Linux on x86 blades, resulting in simple, consolidated management and support.

**HP Virtual Connect:** Virtual Connect simplifies the connection of blade servers to data center networks. It allows adding or changing a server, or moving the workload from one server to another, without the need to involve LAN and SAN administrators in every change. Virtual Connect options include Flex-10, which offers high-performance connectivity to the data center and makes server administration and server applications more efficient. Another option is HP Virtual Connect FlexFabric that can connect servers to any combination of Fibre Channel, Ethernet, and iSCSI links with a single interconnect module.

**HP Matrix Operating Environment:** HP Matrix OE is an integrated infrastructure management stack that includes the tools needed to build and manage an infrastructure as a service. Key roles of the Matrix OE are:

- **Provisioning the infrastructure:** The HP Matrix OE can provision infrastructure in minutes to automatically activate physical and virtual servers, storage, and networking from pools of shared resources. It finds available resources, streamlines the approval process, and automatically provisions and configures what's needed across infrastructure pools. It also enables the easy creation of a shared service catalog and provides an infrastructure portal to instantiate individual services, based on service templates that have been created.
- **Optimizing the infrastructure:** The Matrix OE provides capacity planning that monitors system utilization and captures key data points such as power, CPU, storage, and network I/O utilization, making it easy to quickly adjust and optimize the environment, and make predictable changes, without time-consuming analysis.

Figure 6. HP CloudSystem's supply (infrastructure) layer is built on HP BladeSystem and Matrix OE.



- **Protecting continuity of services:** The Matrix OE protects quality of service and offers continuity of services with a wide spectrum of high-availability and recovery solutions. These solutions range from server-aware and application-aware availability solutions, to disaster recovery solutions for both physical and virtual server environments.<sup>1</sup>

HP Matrix OE also includes the essential server management delivered by HP Insight Control, which unlocks the management capabilities built into HP servers. Insight Control enables the user to proactively manage server health—whether physical or virtual—and deploy servers quickly, optimize power consumption easily, and control servers from almost anywhere. Matrix OE also leverages HP Virtual Connect Enterprise Manager (VCEM). This tool centralizes connection management and workload mobility for HP BladeSystem servers that use Virtual Connect to access LANs, SANs, and converged network infrastructures.


## Cloud Service Automation: delivery and demand layers

The delivery and demand layers of CloudSystem architecture are primarily provided by HP Cloud Service Automation. It is Cloud Service Automation that imbues CloudSystem with its hybrid and public cloud capabilities.

Cloud Service Automation is a software solution for managing the entire cloud service lifecycle, including provisioning the infrastructure either through extension to one or several Matrix OE systems, or into non-matrix infrastructure pools; provisioning the application; provisioning, patching, and ensuring compliance of business and complex custom applications; managing and monitoring the cloud; and releasing resources back to the cloud. Extensions to this software can add further service assurance, enhanced security, storage management, and network management. Cloud Service Automation helps to maximize the agility offered by cloud technologies and minimize the risks and costs of cloud adoption.

<sup>1</sup> HP ProLiant server blades are protected by the included the Matrix recovery management capability, while HP Integrity server blades are protected by the available HP Serviceguard portfolio.





HP Cloud Service Automation orchestrates the deployment of compute resources and complex multi-tier application architectures. It integrates and leverages the strengths of several mature HP management and automation products, adding workload management, service offering design, and a customer portal, to create a comprehensive service automation solution.

Within HP CloudSystem, Cloud Service Automation provides:

- **Scalable architecture:** Cloud Service Automation is a highly flexible, scalable architecture that can support heterogeneous environments.
- **Automated provisioning:** Cloud Service Automation orchestrates provisioning of servers, network, and storage across Matrix OE resource pools and enables monitoring of configured services. Administrators can further automate application provisioning and configuration as well as utilize industry best practice templates in the Matrix OE.
- **Role-based portals and interfaces:** The software includes a variety of role-based portals and interfaces for building and consuming both private and public cloud services.
- **Extensible platform:** The flexible platform can be extended with support for service assurance, application lifecycle management, governance, and security.
- **Database for configuration management:** The HP Universal Configuration Management Database (UCMDB) provides advanced configuration management that models configuration items (CIs) for the service architecture that has been built, allowing them to be shared with other applications.
- **Automation of content library and management:** HP Database and Middleware Automation (DMA) provides a content library for database and middleware management. DMA provisions simple and complex application architectures, including DMA content, onto existing infrastructure. After applications—especially middleware—have been provisioned and are up and running, DMA can

manage those applications, providing pre-packaged workflows for application patching, compliance, and code release—eliminating the need for manual customization. DMA puts processes and procedures in place for managing applications, such as those from Oracle or Microsoft, when they are in production, and links them into the monitoring process and the general understanding of the contents of the UCMDB. DMA helps IT administrators answer questions such as:

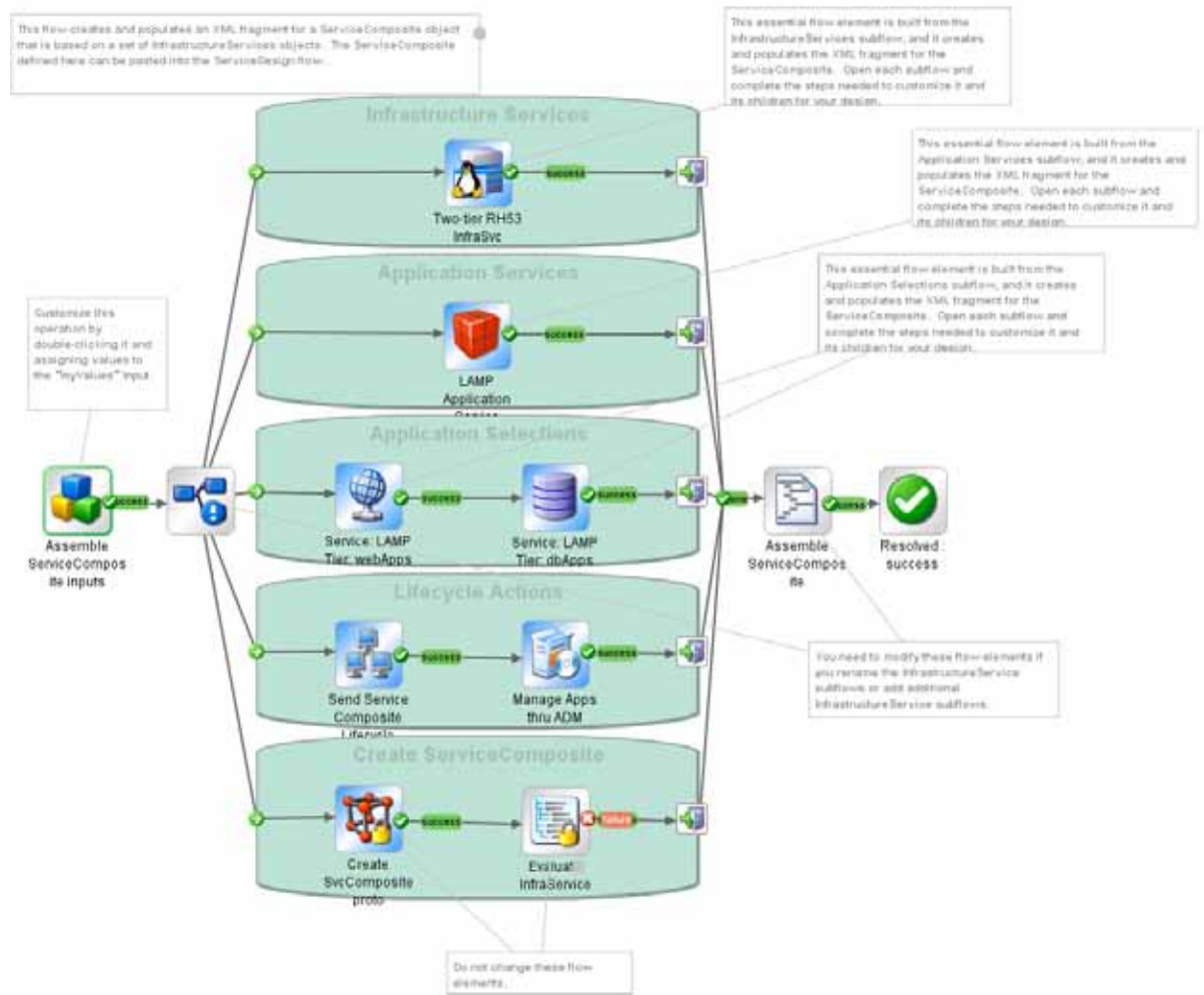
- How do I expand table spaces?
- How do I reconfigure disk configurations?
- How do I know if all necessary patches have been applied?

These are standard queries that normally require expensive manual intervention to answer. With DMA, they are all wrapped up into very simple operations that the IT administrator can choose from a menu. The administrator answers a few questions and then proceeds to manage and monitor all the details in that particular installation.

- **Agentless monitoring:** HP SiteScope provides agentless monitoring of an infrastructure platform and an application's key performance indicators, such as CPU, disk, and memory usage.
- **Provisioning, patching, and compliance of simple or complex application architectures:** HP Server Automation with HP Application Deployment Manager (ADM) provisions simple and complex application architectures, including DMA content, onto the existing infrastructure. HP Server Automation is also capable of OS provisioning. In addition, HP Server Automation automates the ongoing lifecycle management of a deployed operating system or application with policy-based patching and compliance capabilities.

Because it significantly brings down the cost of running servers, HP Server Automation is normally run on all HP CloudSystem servers. While the default is to have HP Server Automation on, customers can also turn it off, if desired.

Figure 7. The service designer uses handy graphical representations to construct and stand up services.



## CloudSystem Enterprise portals and interfaces

To be truly effective, a cloud service needs to have different groups engaging with the service in different ways. For this reason, HP CloudSystem provides a variety of role-based portals and interfaces. Role-based portals and interfaces enhance the user experience for designing, building, and consuming private and public cloud services.

Among the interfaces HP CloudSystem provides are those for consumers of services, service designers, service assurance, and IT administration—four areas companies need to address in order to manage a cloud service. Examples of some of the interfaces are shown in Figure 7 and Figure 8.

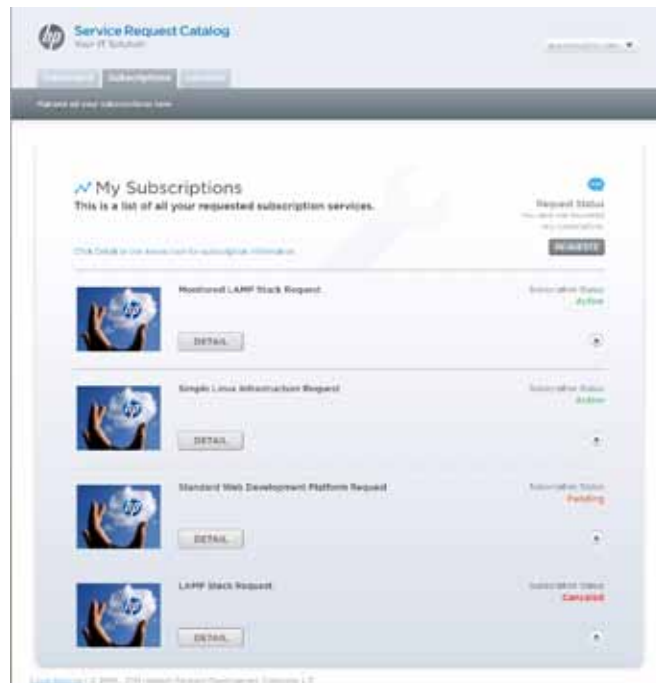
## HP Cloud Maps

Cloud Maps are pre-configured infrastructure-to-application service definitions that simplify, optimize, and accelerate the creation of your CloudSystem service catalog. Cloud Maps fast-track the automation of business applications, saving days or weeks of time, while ensuring accurate deployment, configuration, and sizing of your cloud services.

HP has worked closely with our ISV partners to develop service definitions that encapsulate proven best practices for deploying specific database, middleware, and applications—such as Oracle RAC, Oracle WebLogic, Microsoft SQL, Microsoft Exchange, SAP NetWeaver, and many others—architecting the optimal mix of infrastructure, platform, and application configuration.

For up-to-date information on Cloud Map availability, see: <http://www.hp.com/go/cloudmaps>

Figure 8. Consumers and business users have a convenient, easy-to-use dashboard, a list of current subscriptions, and a service catalog for browsing.



## 6. HP CloudSystem Service Provider

HP CloudSystem Service Provider is a cloud solution that enables service providers to deliver a public cloud infrastructure as a service and software as a service, including aggregation and management of those services. A service provider can create IaaS and SaaS offers via a multi-tenant environment and to provide those offers via a portal. CloudSystem Service Provider also allows organizations to enable provisioning and access and control, and to bill to multiple tenants.

**Supply layer:** As with other CloudSystem offerings, the Service Provider infrastructure services are based on HP BladeSystem technologies, along with the Matrix Operating Environment (Matrix OE). (For more details about the CloudSystem infrastructure, see section 5, HP CloudSystem Enterprise, starting on page 6).

**Service delivery and consumption:** As with CloudSystem Enterprise, in HP CloudSystem Service Provider the application service delivery (the delivery layer) and the mechanism for service consumption (the demand layer) are provided by Cloud Service Automation.

## Aggregation Platform for SaaS (AP4SaaS)

The Aggregation Platform for SaaS is a key component of the HP CloudSystem Service Provider offering. The HP AP4SaaS serves as the single point of access for all applications (SaaS and hosted services), delivering a “one stop shop” for cloud service providers.

This platform allows cloud service providers and large enterprises to manage the complete lifecycle of their compute and other cloud services products and bundles. The platform enables product creation based on service templates that are generated by utilizing the underlying CloudSystem software and hardware.

The Aggregation Platform for SaaS enables the distribution, subscription, and consumption of IaaS, SaaS, and other on-demand cloud services, and it also contains flexible charging functions that enable the service provider to offer a variety of pricing schema for cloud services. Moreover, AP4SaaS is a common platform from which service providers can deliver compute-on-demand and other IaaS and hosted services, as well as third-party SaaS services.

The AP4SaaS supports a variety of functions needed to create public cloud service offering, such as:

- Customer charging through leverage of the service provider's existing BSS systems.
- Support for charging models relevant to a compute services business model—e.g., flat fee, pay-per-use, etc.
- Reseller support that allows the service provider to manage revenue streams to reseller partners.
- Monitoring of the availability of compute services to guarantee service level agreements.

Using this platform, a service provider's customers can discover SaaS and hosted services and bundles, run trials, and subscribe to and consume services. The platform also provides an environment for product managers to develop and price bundles and enable efficient lifecycle management of SaaS service and providers.

## CloudSystem Service Provider portals and interfaces

Besides other portals and interfaces available in CloudSystem, the Service Provider offering adds other ways to interact with the system, including:

- An administrative portal to be used by service provider product management for product and offer creation and to register and manage SaaS providers.
- A marketplace portal where the service provider's customers can discover, order, and manage the compute services products and bundles using an easy-to-use Web application.
- A self-service portal with tools for monitoring capacity and power usage, and provision for rebalancing to keep the environment optimized.

These portals can be customized with the service provider's logo and other information.

## 7. HP CloudSystem extensions

HP CloudSystem is fully heterogeneous and supports a variety of physical and virtual assets and operating systems. Moreover, all core HP CloudSystem platforms are extensible via the HP Converged Infrastructure portfolio, which includes storage, security, networking, mission-critical computing, and aggregation technologies. Depending on the CloudSystem offering (CloudSystem Matrix, CloudSystem Enterprise, or CloudSystem Service Provider), some items listed as extensions below may be provided as part of the core system or may be available only as an extension. See "Appendix: HP CloudSystem details at a glance" for details.

### Operating systems

HP CloudSystem offerings are flexible at the operating system layer and can support Windows®, Linux, and HP-UX. Contact HP for certified reference architectures for each OS as they become available.

### HP CloudSystem infrastructure

CloudSystem provides a common approach to managing all storage pools and server resources, including HP 3PAR Utility Storage, reducing the manual overhead required to allocate assets for the cloud infrastructure. HP CloudSystem also includes optimized support for HP storage and integrates with other technologies to provide a proven, open platform for delivering IT infrastructure services.

The core CloudSystem infrastructure can be expanded and scaled up with additional hardware, such as:

- **Servers:** Add HP ProLiant or Integrity server blades. CloudSystem can also support virtual machines running on rack-mounted HP ProLiant servers as well as third-party servers.
- **Storage:** Add any Matrix-supported shared storage such as HP 3PAR F-class or T-class Utility Storage, HP EVA, or HP XP storage products. Third-party storage can also be added.
- **Networking:** For a cloud-optimized networking fabric, add HP Networking components such as the A12500, A9500, and A5800 switches. Third-party networking can also be added.

### HP 3PAR Utility Storage

HP 3PAR Utility Storage technology is a highly recommended extension for HP CloudSystem. This storage supplies highly scalable, thin provisioned, multi-tenant storage optimized for cloud computing. Customers who are now employing standalone 3PAR storage as a “storage cloud” can use it as a migration point to CloudSystem.

HP 3PAR storage is based on an architecture specifically designed for cloud security and includes resiliency features for constant data availability. Powered by HP 3PAR Utility Storage technology, this Tier 1 storage for cloud computing can deliver virtually unlimited tiered storage capacity and multi-tenant support. It delivers the agility and efficiency required by virtual and cloud data centers.

HP 3PAR storage employs policy-driven tiering technologies that balance cost and performance to meet service level requirements, while increasing business agility and helping minimize risk. It also features autonomic provisioning: that is, the storage is designed to handle volume provisioning and change management autonomically—quickly, intelligently, granularly, and without administrator intervention. Moreover, host-based HP 3PAR software products reduce manual administration by offering autonomic performance and capacity utilization monitoring, and by establishing secure, autonomic communication channels between storage and hosts.

**The hardware technology:** HP 3PAR storage for HP CloudSystem includes the F-class and T-class products. The HP 3PAR technology in these products is designed to provide the agility, performance, and scalable capacity that is the optimum match for HP CloudSystem.

HP 3PAR storage makes use of thin technologies that can save customers 50 percent or more on the cost of a storage technology refresh by dramatically reducing overall capacity requirements and keeping utilization rates high over time. These thin technologies help minimize not only upfront and ongoing storage costs, but also the cost of housing, powering, cooling, and managing storage.

Some of HP 3PAR’s other hardware features include:

- **Mesh-Active controller technology:** The Mesh-Active design allows each LUN to be active on every mesh controller in the system. This design delivers robust, load-balanced performance and greater headroom for cost-effective scalability.
- **Fine-grained virtualization:** This divides each physical disk into granular allocation units, or 256-MB chunklets, each of which can be independently assigned and dynamically reassigned to virtual volumes of different Quality of Service (QoS) levels. This fine-grained virtualization means that each disk drive can support many QoS levels, so the system can make the most efficient use of physical assets.
- **Persistent cache:** This eliminates performance impacts resulting from unplanned component failures, making it an excellent choice for maintaining service levels in the virtual data center. This resiliency feature helps to gracefully handle component failures by eliminating the performance penalties associated with “write-through” mode.

**The software:** With the HP 3PAR extension for HP CloudSystem, customers receive software designed to enhance the agility and efficiency of their utility storage deployment, including:

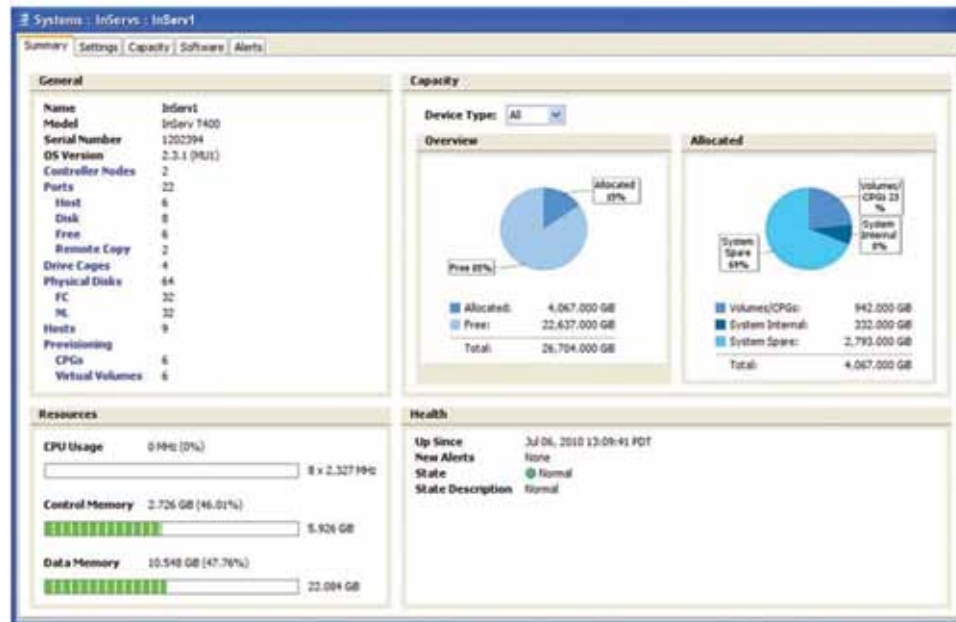
- **HP InForm operating system:** It employs advanced internal virtualization to enhance administrative efficiency, system utilization, and storage performance.
- **Management console:** It simplifies administration through a unified, point-and-click interface that supports HP 3PAR software and provides rich instrumentation for the physical and logical objects within all HP 3PAR storage systems. Figure 9 shows the console.

### Storage Provisioning Manager (SPM)

In order to be effective in an increasingly shared, converged, or cloud environment, administrators have to comprehend the differing roles of server and storage admins in IT. Server admins manage and deploy servers and the applications on them. Storage admins look at the health of storage and manage the consumption and protection of data. SPM takes this into account and, with HP CloudSystem Matrix, provides a single solution for both types of admins.



Figure 9. HP 3PAR management console



HP 3PAR Storage and CloudSystem Matrix together with SPM are the best of breed platforms for converged infrastructures and clouds. SPM enables the creation of a Storage Catalog in Matrix that allows the storage admin to establish a set of secure, optimized storage resources that adhere to key storage governance policies. The resources can then be provisioned and utilized by the server admins with minimal interaction. This saves operations time, improves storage efficiency, and maintains a secure, available environment, all in a repeatable, reliable process.

#### HP TippingPoint security

HP TippingPoint security is another important extension available for HP CloudSystem. TippingPoint technology extends existing security inspection, visibility, and protection to the virtual infrastructure and delivers seamless security for the cloud. This solution enables customers to deploy security policies that automatically adapt to changes in virtual environments, such as introducing a new virtual machine. It offers continuous protection of both the physical and virtual landscape from a single, integrated offering.

**TippingPoint IPS:** HP TippingPoint technology centers on the Intrusion Prevention System (IPS), an inline security appliance with full inspection of

every packet of network traffic that passes through it. The TippingPoint IPS incorporates intrusion protection intelligence from HP's security research and development organization Digital Vaccine Labs (DVLabs), which regularly provides new filters that guard against the industry's latest malicious attacks.

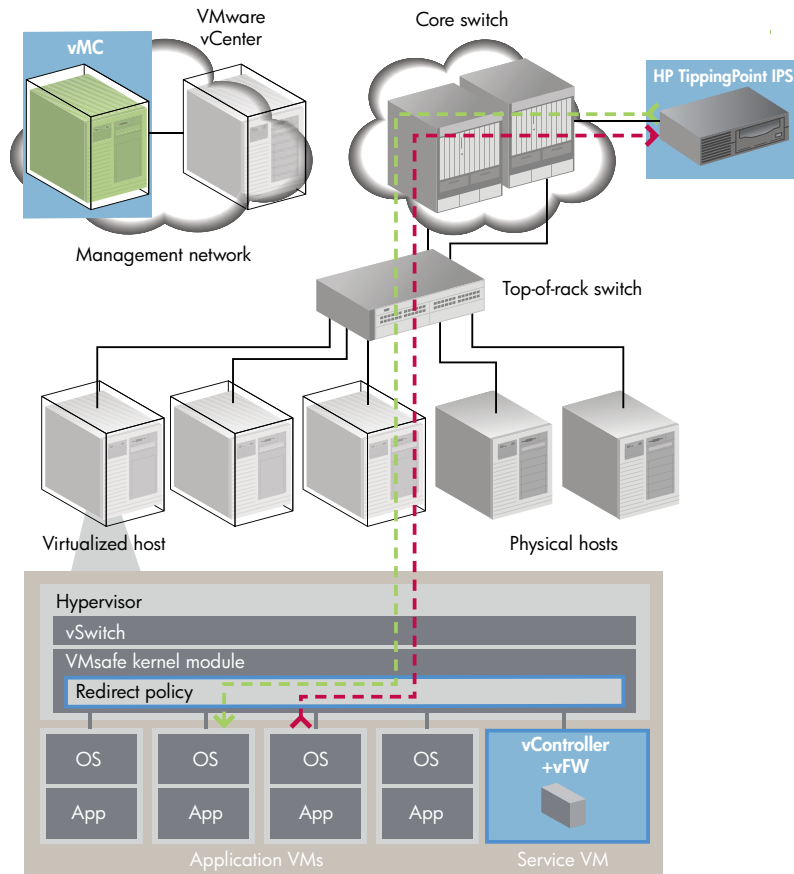
The TippingPoint IPS is a vital inline tool for protecting against Web application attacks, malware, and data exfiltration. CloudSystem customers can include a TippingPoint extension to protect public, private, or hybrid cloud offerings, even those that require scaling well over 10 Gbps.

**Secure Virtualization Framework (SVF):** The Secure Virtualization Framework is a combination of products designed to secure the entire data center, including even the virtualized infrastructure. The SVF consists of:

- The physical TippingPoint IPS appliance.
- The Virtual Management Center (vMC), shown in Figure 10 installed on a virtualized host on the management network.
- A virtual controller plus virtual firewall combination (vController+vFW), shown installed on a virtualized host.

The Secure Virtualization Framework provides a single security model for both physical and virtualized assets.

Figure 10. The HP TippingPoint extension provides a physical IPS, as well as a virtual controller and firewall for each virtualized host.



**TippingPoint Architecture:** In Figure 10, the physical IPS is installed at the perimeter of a simple data center with both physical hosts and virtualized hosts, a top-of-rack switch, and a core switch, which could also be a distribution switch. This architecture provides the ability to inspect all traffic moving into and out of the data center. The solution can scale from this simple example to large global deployments spanning many data centers across public, private, or hybrid clouds.

The vMC is installed as a virtual machine (VM), even on the same server hosting VMware's vCenter, the VMware management console. Once the vMC is installed on the management network, it communicates with the VMware vCenter. The vMC is able to auto-discover the entire virtualized data center, and it can provide real-time visibility of every virtualized host and every virtual machine on each host. In addition, the vMC provides a logical overview of the network topology, showing how all of the virtual machines are interconnected in the data center and how protection is applied.

One vController+vFW combination is deployed to each virtualized host from vMC thru vCenter. The vController+vFW integrates with VMware's hypervisor

through the VMsafe API, providing a certified supported solution.

Once installed, the vController+vFW introduces a firewall policy into the hypervisor that controls traffic in and out of each VM. In this role, vController+vFW can see all traffic coming from any of the application VMs on the virtualized host and allows applying policies. For example:

- Is the traffic permitted or not? If permitted, the traffic is allowed to pass. If not permitted, vFW can block it at the hypervisor level.
- If the traffic is permitted, should it be inspected? To inspect the traffic, the vController redirects the traffic via a dedicated VLAN to the physical IPS for inspection.

This solution provides complete enforcement of security policies in both the physical and virtual data centers. And because every vController+vFW in the data center has knowledge of all security redirection policies, the same security posture remains with each VM or application no matter where it moves in the data center. When new VMs are brought up, they can be automatically detected and protected with vController.



The solution provides these key elements of security required in any virtualized environment:

- Securing the hypervisor from internal threats.
- Protecting against host-to-host threats.
- Protecting against VM-to-VM threats.
- Protection regardless of VM mobility.

High availability is provided at multiple levels throughout the system: the vController monitors that the IPS is active and will bypass inspection if it fails. The IPS will bypass inspection upon failure. And redundant IPSs and paths can easily be deployed.

**Virtual patching:** To stay abreast of new threats and vulnerabilities, the HP TippingPoint IPS is updated regularly with Digital Vaccine service. Once vulnerability filters are enabled on the IPS, it is like having all systems in the data center fully patched against the latest vulnerabilities—in essence having a “virtual patch” in place. Any malicious traffic intended to exploit a particular vulnerability is immediately detected and blocked. The solution is highly scalable: the intrusion prevention system can protect thousands of unpatched systems with a single virtual patch. Patching is done seamlessly and quickly, allowing for full testing and deployment of patches as system maintenance schedules permit.

#### **HP Network Automation**

Network Automation software helps prevent errors before they occur and delivers measurable cost savings by using process-driven network automation. HP Network Automation automates the complete operational lifecycle of network devices, from provisioning to policy-based change management, compliance, and security administration.

When integrated with CloudSystem, HP Network Automation takes the automation of IT workflows beyond traditional network change and configuration management. It provides an integrated solution that unifies network fault, availability, and performance management with change, configuration, and

compliance management along with automated diagnostics.

HP Network Automation supports an exhaustive set of network devices from over 70 vendors—along with virtual devices—providing comprehensive network change and configuration management coverage for an extensive range of physical and virtual hardware. HP Network Automation enables a resilient, maintainable, and cost-effective network that is compliant with both company standards and government regulations.

HP Network Automation is available as an extension to the HP CloudSystem Matrix and CloudSystem Enterprise offerings and is included in CloudSystem Service Provider.

#### **HP Storage Essentials**

Storage Essentials is a CloudSystem extension that provides comprehensive storage resource management and storage automation for CloudSystem’s physical and virtual infrastructures. It improves efficiency in managing, visualizing, and reporting on the CloudSystem storage environment and infrastructure.

HP Storage Essentials integrates with Operations Orchestration, applying pre-packaged storage operations and workflows to automate repetitive, time-consuming storage tasks. In conjunction with the UCMDB, Storage Essentials can record SAN changes and audit SAN configuration compliance, revealing the potential impact of changes before they occur.

Storage Essentials also works to monitor the health and availability of storage hosts, switches, and arrays, and it shows the impact of storage alerts on critical business services. Along with HP Server Automation software, Storage Essentials helps visualize and report on servers and storage through a single pane of glass. It even includes storage compliance audits.

### **Business Service Management**

Business Service Management is a CloudSystem extension that can help ensure the performance and availability of CloudSystem's virtualized and cloud-based services. It helps pinpoint and repair system failures before they become business service problems, and it enables greater efficiency because the correct teams are dispatched to fix problems. Moreover, Business Service Management provides better prioritization of IT issues by making visible the links between technology and business services.

### **HP ArcSight software**

ArcSight software is another complementary software component for HP CloudSystem. ArcSight adds cybersecurity and compliance solutions that protect organizations from enterprise threats and risks. The use of ArcSight with HP CloudSystem can help organizations safeguard physical and virtual digital assets, comply with corporate and regulatory policy, and control the internal and external risks associated with cybertheft, cyberfraud, cyberwarfare, and cyberespionage.

### **HP Fortify software**

Fortify software is an excellent security enhancement for HP CloudSystem. Fortify is a suite of integrated applications for identifying, prioritizing, and fixing security vulnerabilities in software and managing the business of ensuring application security. By enabling enterprises to quickly identify and fix the security holes within their software applications, Fortify dramatically reduces the risk of catastrophic attacks on applications deployed as a cloud application on the Internet and further helps ensure compliance with government and regulatory mandates.

### **HP Networking**

HP provides networking solutions that improve service levels, ensure business continuity, enable service agility, and reduce capital and operating costs. HP networking solutions are built from the ground up to meet the demanding needs of today's highly virtualized, large-scale application and cloud environments.

### **Mission-Critical Computing**

One particularly valuable extension for HP CloudSystem is HP Mission-Critical Computing. With the Mission-Critical Computing extension,

HP CloudSystem Matrix optimizes IT capacity while ensuring predictable delivery and service levels for organizations. The HP-UX capabilities for Mission-Critical Computing are integrated into the Matrix OE level as well as the Cloud Service Automation level.

### **Third-party virtualization support**

HP CloudSystem is scalable and expandable with third-party resources, including third-party servers, third-party storage, third-party networking, third-party operating systems, and heterogeneous virtualization platforms. CloudSystem supports leading hypervisors, including VMware vSphere and Microsoft Hyper-V:

- **VMware:** CloudSystem fully supports a customer's existing investment in vSphere and vCenter Server. It also supports interoperability with many vCenter tools.
- **Microsoft Hyper-V:** CloudSystem supports Hyper-V virtualization, SCVMM, and Microsoft applications. It also supports interoperability with many Microsoft System Center tools.

In addition, CloudSystem can burst to public clouds from providers.

## **8. Summing up**

HP CloudSystem is a complete, integrated, open system to build and manage services across private, public, and hybrid cloud environments. It combines the strength of HP Converged Infrastructure with the established leadership of HP Cloud Service Automation software, yielding a solution that delivers unified security, governance, and compliance across applications as well as physical and virtual infrastructure.

## **9. Resources**

- For more about HP CloudSystem, see: [www.hp.com/go/cloudsystem](http://www.hp.com/go/cloudsystem)
- To learn the details of Matrix Operating Environment, visit: [www.hp.com/go/matrix](http://www.hp.com/go/matrix)
- To learn about Cloud Service Automation, go to: [www.hp.com/go/CSA](http://www.hp.com/go/CSA)
- For the latest up-to-date information about Cloud Maps, visit: [www.hp.com/go/cloudmaps](http://www.hp.com/go/cloudmaps)
- To learn more about HP CloudStart, go to: [www.hp.com/services/cloudstart](http://www.hp.com/services/cloudstart)

## Appendix: HP CloudSystem details at a glance

This section shows details of the three CloudSystem offerings, showing the core components and extensions available.

### CloudSystem infrastructure components

Component	Description	Value and benefit	CloudSystem configuration		
			Matrix	Enterprise	SP
<b>HP Matrix OE</b>	<ul style="list-style-type: none"> <li>Operating environment, management for Matrix</li> </ul>	<ul style="list-style-type: none"> <li>Maximizes resource utilization; provisions infrastructure in minutes rather than months</li> </ul>	●	●	●
<b>HP BladeSystem</b>	<ul style="list-style-type: none"> <li>Modular blade and Virtual Connect architecture</li> </ul>	<ul style="list-style-type: none"> <li>Modular, efficient blade architecture with flexibility to connect servers to any network</li> </ul>	●	●	●
<b>HP 3PAR Utility Storage: F-class and T-class</b>	<ul style="list-style-type: none"> <li>Next-generation thin-provisioned storage, optimized for hybrid cloud</li> </ul>	<ul style="list-style-type: none"> <li>Reduces acquisition costs by up to 50%, reduces operating costs by up to 90%, improves security via full multi-tenancy</li> </ul>	○	○	○
<b>HP EVA, XP, P4000 storage</b>	<ul style="list-style-type: none"> <li>Diverse portfolio of traditional architecture storage arrays</li> </ul>	<ul style="list-style-type: none"> <li>Bridge to traditional storage technology; preserves existing investment</li> </ul>	○	○	○
<b>TippingPoint IPS; vController and vFW</b>	<ul style="list-style-type: none"> <li>Security solutions for physical and virtual cloud domains</li> </ul>	<ul style="list-style-type: none"> <li>Seamless security for entire data center attack surface, including hypervisor</li> </ul>	○	○	○
<b>Networking (A12500, A9500, A5800)</b>	<ul style="list-style-type: none"> <li>High-performance, flexible core-to-edge networking fabric</li> </ul>	<ul style="list-style-type: none"> <li>Up to twice the performance at half the power consumption</li> </ul>	○	○	○
<b>Mission-critical HP-UX*</b>	<ul style="list-style-type: none"> <li>Matrix with HP-UX for most demanding mission-critical workloads</li> </ul>	<ul style="list-style-type: none"> <li>Uncompromising resiliency; instant agility; consistency with existing mission-critical deployments</li> </ul>	○	○	○

\* With CloudSystem Matrix, all of the functionality is supported for HP-UX, although some functions may be performed through a different interface.

● Included

○ Extension



## CloudSystem software components

Component	Description	Value and benefit	CloudSystem configuration		
			Matrix	Enterprise	SP
<b>Cloud Maps</b>	<ul style="list-style-type: none"> <li>Predefined templates, workflows, and white papers for enabling infrastructure, popular applications, databases, and middleware</li> </ul>	<ul style="list-style-type: none"> <li>Fast track the development of a cloud service catalog and accelerate application deployment</li> </ul>	●	●	●
<b>SiteScope</b>	<ul style="list-style-type: none"> <li>Agentless infrastructure and application performance monitoring, alerting, and reporting</li> </ul>	<ul style="list-style-type: none"> <li>Improves private cloud service performance and availability; decreases time to repair and IT admin overhead; pre-integrated with Matrix OE</li> </ul>	●	●	●
<b>Server Automation (Starter edition)</b>	<ul style="list-style-type: none"> <li>Policy-based provisioning, configuration, patching, and compliance management of servers, OS, and application infrastructure; 1000 VM per OS limit</li> </ul>	<ul style="list-style-type: none"> <li>Decreases system admin overhead while increasing accuracy and compliance to configuration standards; pre-integrated with Matrix OE for rapid CloudSystem Matrix IaaS deployment</li> </ul>	●		
<b>Server Automation (Enterprise edition)</b>	<ul style="list-style-type: none"> <li>SA Starter Edition plus: Application Deployment Manager, MultiMaster Mesh, Satellite, and unlimited VM/OS scale</li> </ul>	<ul style="list-style-type: none"> <li>Pre-integrated to CSA 2.0, enables composite application lifecycle management and DMA extensions; synchronizes multi-site for scale and disaster recovery</li> </ul>		●	●
<b>Cloud Service Automation 2.0</b>	<ul style="list-style-type: none"> <li>Full lifecycle management and automation for building and managing hybrid cloud environments</li> <li>In addition to SiteScope and Server Automation Enterprise Ed., includes: <ul style="list-style-type: none"> <li>CSA Foundation Server (self-service portal, cloud controller, resource management, UCMDB)</li> <li>Operations Orchestration</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Comprehensive cloud service delivery and management across public, private, and traditional IT environments with one-touch provisioning and monitoring for large-scale, heterogeneous environments <ul style="list-style-type: none"> <li>Rich enterprise portal for Line of Business</li> <li>Intelligent, multi-resource pool management and orchestration</li> <li>Service model enables seamless integration to BSM/ITSM</li> <li>IT process automation and run book automation</li> </ul> </li> </ul>		●	●
<b>Database and Middleware Automation</b>	<ul style="list-style-type: none"> <li>Best-practice automation for database and middleware</li> </ul>	<ul style="list-style-type: none"> <li>Pre-packaged and supported content improves efficiency, speed, and accuracy of database lifecycle management</li> </ul>		●	●
<b>Business Service Management</b>	<ul style="list-style-type: none"> <li>Performance and availability management solutions for virtualized and cloud-based services</li> </ul>	<ul style="list-style-type: none"> <li>Improves service quality and monitors total customer experience by integrating infrastructure, application, and end-user performance and availability management</li> </ul>	○	○	○
<b>Storage Essentials</b>	<ul style="list-style-type: none"> <li>Deep performance and availability management of HP disk arrays and multivendor SANs</li> </ul>	<ul style="list-style-type: none"> <li>Increases storage resource efficiency, service performance, and availability through automated discovery, mapping, monitoring, and capacity management of virtual and physical storage environments</li> </ul>	○	○	○
<b>Network Automation</b>	<ul style="list-style-type: none"> <li>Lifecycle management for globally distributed heterogeneous networks</li> </ul>	<ul style="list-style-type: none"> <li>Change, configuration, and compliance management for multivendor physical and virtual networks</li> </ul>	○	○	●
<b>Aggregation Platform for SaaS</b>	<ul style="list-style-type: none"> <li>Single point of access that integrates and aggregates multiple SaaS and hosted services offerings</li> </ul>	<ul style="list-style-type: none"> <li>Enables service providers to accelerate revenue growth by providing SMBs with “one-stop-shop” experience for multiple SaaS and hosted service offerings from unified portal access</li> </ul>		○	●

● Included ○ Extension

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