VMware® Operations Management and EMC® Storage Analytics for the VSPEX® Proven Virtual Infrastructure

TECHNICAL WHITE PAPER
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Introduction

This whitepaper provides an overview of the best EMC® and VMware® datacenter management products and services that work together to empower our customers to accelerate the adoption and implementation of the private cloud. This paper outlines the capabilities of VMware® vSphere™ with Operations Management, VMware® vCenter™ Operations Management Advanced Suite and EMC Storage Analytics (ESA) building on the VSPEX® Private Cloud with vSphere proven Infrastructure solution.

On October 14th, 2014, VMware announced the rebranding of VMware vCenter Operations Management Suite to VMware® vRealize Operations™. See the addendum for the list of products that were rebranded.

EMC VSPEX Solution Overview

EMC has joined forces with industry leading providers of IT infrastructure to create virtualization solutions that accelerate the deployment of cloud infrastructure. VSPEX enables faster deployment, more simplicity, greater choice, higher efficiency, and lower risk. Validation by EMC provides predictable performance and enables customers to select technology that uses existing IT infrastructure while reducing planning, sizing, and configuration burdens. VSPEX provides an infrastructure for customers who want to gain the simplicity of converged infrastructures and have more choice in individual solution components.

VMware Software Defined Datacenter and Cloud Management

The Software-Defined Data Center is not a product or a set of products, but an architectural approach that enables customers to achieve the promises of agility and lower costs provided by cloud services for on-premise infrastructure.

This approach to data center architecture is to break down the traditional silos of IT where each application has dedicated services provided for compute, storage and availability, networking and security, and compliance. This architecture includes the following components:

- Virtualized Infrastructure services-- where resources (compute, network, storage) are abstracted from the hardware and pooled to enable agility and ease of management
- Policy-based management and automation
- Physical / Converged Infrastructure

In the cloud era, intelligent virtual infrastructure provides the foundation for faster, more agile and accelerated delivery of IT services and business applications. However, within virtual and cloud environments, the boundaries between operations and infrastructure management have blurred. As a result, managing these new environments using tools designed for physical environments creates operational and business problems—blocking the path to flexible, service-oriented cloud infrastructure.

This paper explores the need for a novel management approach to meet the challenges that infrastructure and operations management teams face most often in today's heterogeneous IT environments, such as:

- Performance and availability issues
- Capacity management and optimization
- Configuration and compliance issues
- Workload mobility and rapid changes on demand

As virtual environments continue to grow, converge, and evolve toward self-service private clouds, and merge with public clouds, IT needs new capabilities to anticipate and overcome the challenges of the next stage of the virtualization journey.

This management solution demonstrates the new cloud management approach by offering quality of
service, comprehensive visibility, policy-based automation for guided troubleshooting, root-cause isolation, and remediation of even the most complex scenarios. When coupled with the EMC VSPEX validated modular architecture, the solution enables faster deployment, greater efficiency, lower risk, easier management, and faster problem resolution.

Datacenter and Cloud Management approaches

Issues with legacy management tools

Using yesterday’s solutions on today’s operations management challenges leads to costly and time-consuming business impacts across the entire organization.

Organizations that manage virtual and cloud environments using legacy infrastructure practices and tools cannot deliver the cost efficiency or the quality of service and business agility their customers expect. In fact, the organizational and business ramifications can be wide ranging. Failure to transform your management approach impacts people across the entire organization.

Virtual and cloud environments have remapped the way infrastructure is organized. Workloads no longer operate independently which means the boundaries separating operations and infrastructure management are less distinct. Instead, workloads move within and between private datacenters and the public cloud.

Rebalancing and reconfiguration, auto-scaling, and workload movement across pools of resources also occurs much more quickly in virtual environments than it does in physical environments.

For IT, both virtualization awareness and situational awareness are essential for quick problem resolution. Without this awareness, administrators depend on “rules of thumb,” “tribal knowledge,” and best guesses to hunt down issues, especially when it comes to configuration changes that can cause contention far from the problem’s source.

Another day-to-day challenge that crystallizes the inability of yesterday’s solutions to successfully manage today’s virtual and cloud environments is false alerts triggered by overly conservative thresholds or “high normal” conditions. Traditional static thresholds can’t adapt to rapid change in dynamic environments where workloads and infrastructure are interdependent. The resulting false alerts consume administrators’ time and focus with firefighting and manual attempts to set and reset threshold levels that reduce operational efficiency. False alarms also encourage resource over-commitment to accommodate high normal conditions, undermining virtualization’s cost-effectiveness. The net impact is wasted IT labor, assets, and budget.

These IT inefficiencies do not exist in a vacuum. In fact, these inefficiencies ripple throughout the entire organization. Management becomes slow and costly because people and processes at the operational or administrator level can’t work at the speed and volume of events. The management of these legacy systems interferes with the resource optimization needed to meet budgets and service-level requirements set by IT managers or directors. At the business/CIO level, operations management issues show up as failures to both maintain promised service levels and to deliver economies expected from virtualization.

To alleviate negative business impact and drive IT efficiency, today’s virtual infrastructure requires a new, simplified approach to the traditional disciplines of operations management as well as an updated approach to the processes and tools that support them.

A better approach to management

VMware takes a comprehensive approach to simplifying virtual and cloud infrastructure complexity that is not only based on embedded, integrated and converged management, but is also based on running IT like a business.

As the complexity of IT environments increases, so does the need for greater simplicity when it comes to managing those environments. VMware simplifies management by eliminating as many tasks as possible through intelligent automation. This simplification means the IT staff can focus on activities with greater
business impact.

VMware’s approach to enterprise management is based on Integrated and Converged management.

**Integrated Management**

Performance issues can originate from any component, virtual machine (“VM”), physical host, or cluster. What’s more, the rate of change for workloads has outstripped the capabilities of traditional management approaches. For this reason, it’s essential for management capabilities to be tightly integrated with the virtualization and cloud platforms themselves.

**Converged Management**

Workload interdependence in virtual and cloud environments stymies the ability of specialized teams to address performance, capacity and configuration issues in isolation. Highly virtualized and cloud environments require both the integration of management disciplines and metrics for a holistic view of the health of virtual and physical infrastructures, and the tools to maintain it.

In operations, the disciplines of performance, capacity, and configuration management are converging, necessitating greater collaboration between traditionally siloed IT teams. VMware facilitates this collaboration, for example, by providing a single dashboard that can be used by VI and operations administrators alike to look at health, risk, and efficiency across the entire IT environment. When deployed as part of the EMC VSPEX architecture, the VMware management tools provide a significantly lower operational expense as well as a faster time to problem resolution.

**Managing the Software Defined Datacenter**

Interdependent, dynamic virtual and cloud infrastructures exceed the capabilities—and outstrip the speed—of traditional management processes and tools designed to manage physical IT assets.

Virtual and cloud infrastructures differ from the traditional physical architectures that preceded them in important ways. Traditional, siloed environments are built on tightly-coupled applications as well as infrastructures dedicated to certain components and application tiers. The resulting rigid vertical stack offers limited flexibility and agility, and requires a complex stack of tools and equally complex set of processes to manage it.

In contrast, highly-virtualized and cloud-abstracted resources, shared capacity and fluid configurations characterize environments. Tools and processes designed for traditional architectures have difficulty managing this highly dynamic, constantly changing, and interdependent environment. Virtual and cloud computing requires organizations to embrace a new management approach—one that is as agile, flexible and dynamic as their new IT infrastructure.

By converging and integrating the disciplines of performance, capacity, and configuration management into a consolidated, context-sensitive, virtualization-aware solution, vSphere with Operations Management offers IT a tool designed to take on today’s enterprise management challenges.

**Operations management in a VMware vSphere infrastructure**

**VMware vSphere with vCenter Server**

vCenter Server provides a centralized and extensible platform for managing virtual infrastructure. vCenter Server manages vSphere environments, giving IT administrators simple and automated control over the virtual environment to deliver infrastructure with confidence.

vCenter Server provides centralized management of virtualized hosts and virtual machines from a single console. It gives administrators deep visibility into the configuration of the critical components of a virtual
infrastructure—all from one place. Key capabilities enabled by vCenter Server include vSphere vMotion, vSphere Distributed Resource Scheduler, vSphere High Availability (HA), and vSphere Fault Tolerance.

The next steps
vCenter management is a powerful tool for administrators, but there’s another solution that provides a visibility into the overall performance of the environment, includes the ability to monitor operational trends, analyzes potential problems, and provides the capability to find and resolve the root causes of the issue. That solution is vSphere with Operations Management.

Datacenter and Cloud management using vSphere with Operations Management
vSphere with Operations Management integrates vCenter Operations Manager Standard with vSphere to offer comprehensive visibility, policy-based automation and proactive management required by today’s complex and constantly changing IT reality. It provides:

- Powerful visualization of performance, capacity and configuration issues, and risks across your IT environment’s heterogeneous virtualized infrastructure stack. It collects and analyzes virtual machine performance data, correlates abnormalities and identifies the root cause of building performance problems.
- Infrastructure context — connecting elements logically according to dependencies, peer relationships, and interactions in specific virtual environments. This dynamic solution learns normal conditions and cycles, and gauges departures from those cycles to track trends and anticipate performance degradation or capacity shortfalls.
- Dashboard abstracts of millions of metrics into health, risk, and efficiency measures across the entire IT environment to help administrators manage overall system performance and ensure operational efficiency. These views give the administrator better visibility and actionable intelligence to quickly identify what’s causing current workload conditions as well as spot potential future problems, and find areas with inefficient resource use.
- Capacity planning, reporting, and optimization views to help administrators deliver on performance SLAs while ensuring the efficient utilization of the vSphere virtual infrastructure. It shows you the impact of capacity shortfalls on performance and identifies opportunities to increase VM density and to reclaim excess capacity and idle VMs. Automated “what-if” scenario planning forecasts and evaluates the effects of administrative actions. From a business point of view, this approach to capacity management is a major step toward IT as a service, delivered on demand, and helps determine the optimal configuration for ensuring service levels and operational efficiency.

This converged, integrated approach enables rapid problem resolution, higher quality of service with fewer incidents, and less downtime of critical business application services. It allows the administrator to be more proactive and to enable optimal performance and resource utilization in the face of growing service level expectations and accelerating change.

Business Benefits
This virtualization-aware, context-sensitive, and predictive analytics-based approach to operations management helps streamline processes, achieve efficiencies, and to deliver on SLAs.

Organizations that make the transition to this new class of management tools may see improvements in:

- Efficiency with less time required for routine tasks and issues resolution.
- Span of control since administrative staff can accomplish more within the constraints of currently available resources.
• Cost-effectiveness due to improved staff and resource utilization leading to reduce operational expenditures.
• Quality of service because routine issues are resolved quickly with automated assistance.
• Availability because issues are resolved “on the fly” without planned downtime and before they raise risks of service interruption.
• Planning via “what-if” scenarios to ensure future capacity needs are met while optimizing capital expenditure and operational efficiency.

In addition to these benefits for the business as a whole, management staff often sees improvements in their ability to manage their time and professional growth. Firefighting an endless list of routine issues is replaced by proactive, high-level administration with automated support.

The information presented so far explains how vSphere with Operations Management provide overall virtual machine performance data as well as information about the virtual environment. Suppose an administrator needs more information about hardware, applications, configurations, other parts of the datacenter and cloud environments—the complete converged environment. Being able to collect information directly from hardware and applications provides the administrator with the ability to see a problem from both application-down and hardware-up perspectives for even faster resolution of complex issues in the environment. To enable this expanded set of features, vSphere with Operations Management can be upgraded to the vCenter Operations Management Advanced Suite.

**VMware vCenter Operations Management Advanced Suite**

**Why move to vCenter Operations Management Advanced Suite?**

The role of operations management is to ensure and restore service levels while continuously optimizing operations for efficiency and cost. Today’s virtual and cloud infrastructure present new challenges to infrastructure and operations teams, including the following:

• **Scale** – An administrator might manage up to 5–10 times more virtual machines (compared to physical environments), and a large number of alerts and false positives need a response. Span of control with administrative staff accomplishing more within the constraints of currently available resources.

• **Change** – Infrastructure and application services delivered through self-service portals enable business agility, but also make workloads and demand for resources unpredictable, resulting in unplanned changes.

• **Convergence** – Management capabilities directly embedded in the platform and new hardware architectures require a new class of metrics that enable IT to understand the overall workload and health of the environment.

vCenter Operations Management Advanced Suite provides a new approach that delivers on three characteristics essential for success:

• **Automated** – Predictive, self-learning analytics enable a much higher degree of automation than traditional management tools, delivering nearly 70 percent gains in IT productivity, 30 percent reduction in resource consumption, and additional business benefits, according to Forrester1.

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1 Forrester Consulting Reports on the Total Economic Impact of VMware vCenter Operations Management Advanced Suite
● Integrated – The suite provides an integrated approach to performance, capacity and configuration management. It converges management disciplines and unifies teams across infrastructure and operations.

● Comprehensive – Built on an open and extensible operations platform designed for hybrid cloud environments, vCenter Operations Management Advanced Suite delivers a comprehensive set of management capabilities, including performance, capacity, change, configuration, and compliance management, and application discovery and monitoring.

The vCenter Operations Management Advanced Suite gives you greater visibility across all layers of the infrastructure. It collects and analyzes performance data, correlates abnormalities, and identifies the root cause of emerging performance problems. vCenter Operations Management Advanced Suite provides capacity management to optimize resource usage and policy-based configuration management to assure compliance. Application discovery and dependency mapping enable infrastructure and operations teams to ensure service levels of critical applications and build disaster recovery plans.

Intelligent Operations
Gain deep operational insights into the health, risk, and efficiency of infrastructure and applications to help ensure quality of service and early detection of performance, capacity, and configuration issues.

● Enhanced application monitoring with vCenter Hyperic® provides out-of-the-box dashboards for business-critical applications (Microsoft SQL, Exchange).

● Storage analytics provides deep visibility into storage infrastructure, bringing together views into topology, statistics, and events across host bus adapters, fabric, and arrays.

● Monitoring data is automatically analyzed and expressed as health, risk, and efficiency measures that enable IT to detect potential issues in the environment more easily.

● Prebuilt and configurable operations dashboards provide real-time insights into infrastructure behavior, upcoming problems, and opportunities for optimization.

● Visual correlation of change events with performance data across virtual infrastructure, OS, and applications provide visibility into performance degradation from configuration changes.

● Flexible group policies define specific thresholds, alert types, notifications, and other configuration settings at a group level to prioritize operational activities for business-critical applications and production workloads.

Policy-Based Automation
Automated root-cause analysis with advisory tools and orchestration workflows to enable optimal resource utilization, operational efficiency, and enforcement of configuration standards.

● Infrastructure and operations analytics eliminate time consuming problem resolution processes through automated root-cause analysis.

● Actionable recommendations provide simplified explanations of underlying problems and corrective actions to remediate them.

● Automated workflow triggers enable administrators to associate workflows created in vCenter Orchestrator with vCenter Operations alerts.

● Detection, enforcement, and remediation of security-hardening guidelines, configuration standards, and regulatory requirements are automated across virtual and physical infrastructure and operating systems.

● Automated capacity optimization reclaims overprovisioned capacity and eliminates the need for spreadsheets or complex scripts. “What if” scenarios facilitate capacity optimizations and help defer unnecessary hardware investments.
Unified Management
Get a holistic view into what is driving performance, capacity, and configuration issues as well as infrastructure and application dependencies. Meet service-level agreements (SLAs) by using real-time performance dashboards across hybrid and heterogeneous cloud environments.

- Extensibility enables integration with existing monitoring tools to provide a holistic view and proactive management capabilities across hybrid cloud infrastructure, including physical and virtual hardware and applications.
- Self-learning performance analytics and dynamic thresholds adapt to the environment to simplify operations management and eliminate false alerts.
- Real-time, integrated dashboards of performance, capacity, and configuration change events enable a proactive management approach and help ensure that SLAs are met.
- Application dependency, discovery and visualization bring application-level awareness to infrastructure and operations teams to ensure service levels and disaster-recovery protection for all critical application services.
- Out-of-the-box compliance templates ensure continuous compliance with security best practices, hardening guidelines, and regulatory requirements across all aspects of the data center infrastructure.

Problem resolution with vCenter Operations Management Advanced Suite

Comprehensive visibility into the environment
vCenter Operations Management Advanced Suite also offers a wide variety of third party Operations Management Packs and solutions that extend the capabilities of the suite. These management packs offer administrators a view into the physical infrastructure, specific applications, or services. This expanded view can significantly decrease the time needed to resolve problems.

vCenter Operations Management Packs
vCenter Operations Management Packs extend the capabilities of vCenter Operations to third-party products and technologies to enable end-to-end operations intelligence with data visualizations, dashboards, reports, alerts, and actions. An Operations Management Pack can be delivered in the form of an agent plugin, content pack or compliance pack. vCenter Operations Management Packs extend the power of vCenter™ Operations Management Advanced Suite to hybrid and heterogeneous environments, providing comprehensive visibility in a single operations console across applications, storage, and network devices. The next section of this paper takes a closer look at the EMC Storage Analytics™ (ESA™) management pack.

EMC Storage Analytics

Storage management with EMC Storage Analytics
EMC Storage Analytics (ESA) delivers actionable performance analysis and proactively facilitates increased insight deep into storage resources to help detect capacity and performance issues so they can be corrected before they cause a major impact. ESA provides increased visibility, metrics, and a rich collection of storage analytics for EMC VNX®, VNXe®, VMAX®, VPLEX® and XtremIO® storage infrastructures in VMware virtual environments.

Benefits include:
- Visibility and customizable dashboards for storage administrators, showing health, performance and capacity metrics.
• Simplified troubleshooting and reduced IT infrastructure management complexity.
• Problem detection (performance and capacity anomalies), isolation, and remediation assistance to ensure service levels.

Problem resolution with vCenter Operations Manager Advanced and EMC ESA

vCenter™ Operations Manager presents aggregated data through alerts, dashboards, and in pre-defined reports that administrators can easily interpret. EMC Storage Analytics further extends the integration capabilities across EMC and VMware solutions to provide out-of-the-box analytics and visualization across the physical and virtual infrastructure.

EMC Storage Analytics provides pre-configured, customizable dashboards so users can manage their storage environment. Dashboards types include:

• **Topology Dashboards** — enables greater visibility across the VMware and storage domains in terms of an end-to-end mapping.
• **Metrics Dashboards** — provides metrics based on “normal” behavior of that application workload (which it learns over a period of time), after which it can analyze and make sense of all the data that has been collected and appropriately point out anomalies in behavior.
• **Overview Dashboards** — populates heat maps that show administrators the health of their systems and reflect which workloads are stressed. In addition, it shows performance and utilization statistics for features such as EMC FAST™ Cache and SRDF®.
• **Top-N Dashboards** – identifies the top 5 storage resources by metric categories including IOPs, bandwidth, Latency and Capacity.
• **Create-Your-Own-Dashboard** — choose from a list of several templates and customize the look of a dashboard based on a specific environment.
vCenter Operations in Action: Use Cases

The following use cases demonstrate vCenter Operations’ integrated performance, capacity and configuration capabilities, including EMC ESA for complete storage monitoring.

Virtual machine CPU performance

Change is a constant in data centers, whether planned or completely unexpected. Administrators need the ability to proactively solve for performance issues, including CPU, Memory, Network, and Storage. vCenter™ Operations helps diagnose workload-related performance issues, perform root cause analysis, proactively single out looming problems and identify resource usage inefficiencies. In this example, CPU performance is a dynamic value that can change from second to second. Analysis of CPU performance requires the ability to monitor both average and peak values. As shown in Figure 1, vCenter Operations presents health badges and alerts that can be monitored for situations where the CPU utilization is beginning to impact performance of the virtual machine.

![Figure 1: Excessive virtual machine CPU utilization](image)

**Figure 1:** Excessive virtual machine CPU utilization
Virtual machine Memory performance

Occasionally, over-consolidation or virtual machine sprawl can lead to memory or other resource contention and can degrade overall system performance. vCenter Operations provides easy to use dashboards and visual charts that help VI administrators pinpoint performance hotspots in the data center and determine how frequently these incidents occur so they can balance workloads across their data center resource pool. As seen in Figure 2, memory utilization is at 29% and, being the highest value, sets the Workload health sub-badge to 29. If memory utilization were to become excessive, the workload badge would transition from green to yellow to red, which would generate a risk value, as seen in Figure 3. The transition to yellow would alert the administrator to address the issue before it leads to an application performance issue.

Figure 2: Monitoring virtual machine utilization
Figure 3: Potential memory utilization risk
Virtual machine Storage performance

Storage I/O is critical and is often a leading cause of performance bottlenecks in virtualized environments. vCenter Operations offers in-depth visibility into data center elements including storage (IOPS, throughput, latency). As seen in Figure 4, this enables VI administrators to design their virtual data centers to effectively rule out or diagnose storage I/O contention and other storage-related VM performance issues.

**Service Levels: Troubleshoot Across App, VM, and Storage**

1. Admin gets alerted that Oracle App is slow
   - Oracle VM has performance issue
   - Storage LUN health is red

2. Check LUN Details
   - Transaction latency above normal
   - High I/O outstanding

3. Check EMC VNX Analytics
   - Target HBA Resets is high, limiting application performance
   - SP-A is red

4. VNX | Target HBA Resets

Figure 4: Root cause analysis
Physical Storage monitoring with ESA

The next three figures show what additional information can be provided using EMC Storage Analytics (ESA) for vCenter Operations (vCenter Operations Management Advanced Suite or higher required). Figure 5 shows information about the storage system from the top down and would enable an administrator to determine that the root cause was due to resets on the host bus adapter (HBA). An administrator could then dive deeper into the storage system using the ESA management pack. Figure 5 demonstrates the view into the topology and health of the EMC storage system. Being able to view the health of the storage system all the way from the virtual machine to the individual components provides the ability to quickly find and schedule repair for the defective component.
As seen in Figure 6, VNX arrays have their own specific dashboard – VNX Performance Overview. This dashboard covers the main storage system resource types: thin pools, storage groups, LUNs, storage processors (VNX), and FAST Cache Performance (VNX). The dashboard also provides a few metrics from each one. The heat map colors work on two different levels. There is a green-to-red legend for some, which represents either usage (for example, thin pool allocation) or performance (for example, latency), and there is a blue legend for relative usage across that metric within an array (for example, total writes). For any one of the objects shown, a full historical perspective is available on the EMC Storage Metrics dashboard as seen in Figure 7.

![Figure 6: VNX Performance Overview](image-url)
Figure 7: EMC Storage Metrics
Optimizing the environment

Effective capacity management allows the administrator to match the right amount of resources with the represented workload demand in order to maintain service health while limiting overhead and waste. vCenter Operations helps assess capacity risk, and identifies opportunities to reclaim unused capacity to optimize virtual resource utilization. It also simulates “what-if” scenarios to model the impact of capacity changes to the datacenter as seen in Figure 8.

Figure 8: What-if scenario models
Summary

Operations management disciplines are converging in the cloud. Performance and capacity management are becoming inseparable due to the heterogeneous nature of converged infrastructure. Traditional tools and processes designed for siloed and legacy infrastructures don’t provide the automation, insight, and control needed to effectively manage highly virtualized and private cloud environments. vCenter Operations Advanced Suite is designed to simplify and automate operations management. This integrated approach provides the visibility needed to proactively ensure service levels in dynamic virtual and cloud environments.

Virtual and cloud environments will continue to grow in scale and complexity, outstripping the capabilities of manual processes—even those augmented by automated troubleshooting, analysis, and remediation tools. The VMware vision for the management end-state includes:

- Automation with embedded problem solving and management expertise at each layer to optimize virtual and cloud environments.
- Intelligent policy management that provides services’ performance, compliance, and security for self-service with complete control.

As companies and organizations continue on their virtualization and cloud journey, EMC VSPEX validated architecture, EMC Storage Analytics, and vCenter Operations Management Advanced Suite can help them proactively manage the evolving needs of their IT environment by:

- Continuing to integrate management capabilities into the infrastructure platform, thereby turning “management” into “manageability” and freeing staff from routine tasks to focus on activities that add higher value to the business.
- Continuing to converge, adding security, compliance, and business-process layers to virtual infrastructure and applications.
- Evolving toward self-service and IT business management so business owners can select services with capabilities, performance, and compliance that match their requirements while understanding the true cost and value of the services IT delivers.
- Incorporating public cloud services such as infrastructure and software as services, when they suit business objectives without surrendering visibility or control.

At the end of the day, this is the kind of IT operations management solution that enterprises need—a solution that delivers on SLAs for business critical applications, enables continuous compliance with operational and regulatory requirements, optimizes resource utilization, and streamlines operational costs. In other words, an operations management solution designed for today that’s ready for tomorrow.
Addendum

The list below are the rebranding and name changes of the cloud management products for vRealize Operations™ and vRealize Suite™.

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