Technical Report

ITaaS with fluid Operations eCloudManager and NetApp Shared Storage

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Abstract

This document describes the integration of fluid Operations™ eCloudManager™ and NetApp® shared storage. It describes Landscape as a Service™ (LaaS), which is the core management feature of eCloudManager, and it leverages NetApp storage technology.

Selected use cases for provisioning virtualized instances as well as complete landscapes are provided. This document also explains how these use cases can be implemented to achieve unmatched efficiency, speed, and agility with NetApp Data ONTAP® software.

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1 Executive Summary

This document describes the integration of fluid Operations eCloudManager and NetApp shared storage. It also describes Landscape as a Service (LaaS), which is the core management feature of eCloudManager. This document explains how NetApp storage supports LaaS functionality.

Selected use cases for provisioning single virtualized instances as well as complete landscapes are provided. The document also explains how these use cases can be implemented to achieve unmatched efficiency, speed, and agility by using NetApp Data ONTAP.

2 Introduction

The management and operation of today's data centers are changing dramatically. Data centers and IT departments rely on service organizations to unite conflicting requirements and trends. Service organizations are expected to offer IT as a service (ITaaS) in a flexible, managed, and secure way that is both instantaneous and cost efficient. The architecture of the automated software stack is expected to:

- Implement storage practices and storage layouts according to the industry's best-practice recommendations and naming conventions.
- Address the specific needs of growing and changing storage infrastructure.
- Address the roles of infrastructure, service, and storage administrators as well as consumers.

These attributes are critical to achieving agility in IT infrastructure and in the automated software stack.

The outlined solution automates many standard industry best practices, which creates documented and repeatable end-to-end service delivery.

The use cases described in this document pair eCloudManager and NetApp Workflow Automation (WFA) to provide self-service interfaces for customers and a central management tool for the entire service lifetime, from instant service delivery to service deprovisioning.

2.1 Scenario and Use Case

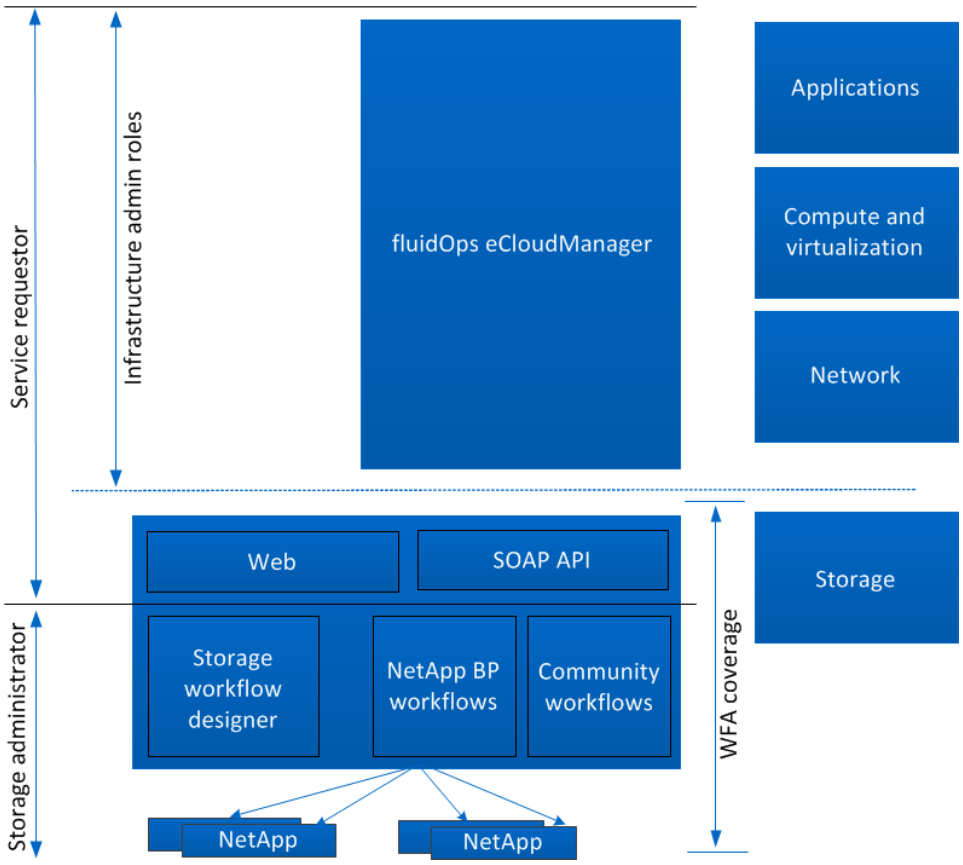
We describe the integration of eCloudManager and WFA from the viewpoint of an enterprise customer or service provider. Within this context, we describe data center use cases and how they work with fluid Operations and NetApp solution components.

In this scenario there are two different roles:

- **Service requestor.** A service requestor processes IT infrastructure requests. The service requestor can be a person (someone processing tickets, for example) or an implementation of a self-service desk. We describe how either type of service requestor discovers and supports WFA workflows from an orchestration automation framework.
- **Storage administrator.** A storage administrator offers storage-specific workflows using WFA. The storage administrator defines storage best practices and naming conventions for his or her organization. Due to the storage centricity of NetApp WFA, much higher agility is achieved to adapt to changes in the storage infrastructure.

Figure 1 further describes the two roles and their responsibilities.

Figure 1) Integration and responsibilities of roles.



Within the context of this document, two software stacks are used to address the above-mentioned challenges of service-oriented IT resource delivery: the eCloudManager product suite and NetApp WFA.

2.2 About NetApp Storage

NetApp provides industry-leading storage solutions that are scalable, flexible, and available. Together with advanced storage and data management capabilities, NetApp storage solutions create a perfect fit for state-of-the-art data centers to build tomorrow's private cloud and converged IT infrastructure. NetApp Data ONTAP is the operating system that is designed to run scalable, nondisruptive operations of storage protocols through the use of clustering.

Operational Flexibility

NetApp DataMotion™ software is the feature used to migrate storage volumes between physical members of a cluster online. This process is transparent to the applications and infrastructure that attach the storage. Use DataMotion to accomplish the following tasks:

- **Manage utilization.** Volumes can be selectively moved and redesignated to different aggregates and controllers within the cluster to drive better average utilization across the storage pool.
- **Balance I/O and capacity.** Optimize the required input/output (I/O) demand by relocating volumes to aggregates composed of a higher number of disks or faster drive types.
- **Provide agility in storage service levels and tiering.** Provide different storage service levels with easy online transitions for upgrading and downgrading.
- **Realize a nondisruptive data center.** Perform phased tech refreshes and updates. DataMotion is a key component in providing a nondisruptive data center.

Storage Consolidation

NetApp storage offers a shared resource for the consolidation of IT infrastructures throughout the entire IT stack, which reduces cost and complexity. The operational flexibility and scalability of Cluster-Mode systems enable individual applications to grow independently and get the resources that are required throughout an application's lifetime.

Scalability Without Downtime: Scale Up and Scale Out

Scalability without downtime is a vital need in a converged IT infrastructure. Infrastructure is shared among a typically growing set of consolidated applications with different growth characteristics. To operate this type of infrastructure economically, a seamless path to scale is key to providing service levels to today's business applications and to meeting customer expectations.

With Cluster-Mode, there are two independent dimensions to scale economically: scale up and scale out. Individual cluster nodes can be scaled up without downtime, and the cluster itself can be extended without downtime, too. The online nondisruptive storage expansion and reconfiguration capability of Cluster-Mode makes it the industry-leading scale-out storage platform.

Availability

Storage failover protection is a core attribute of Cluster-Mode. High-availability (HA) pairs of controllers are the building blocks that form the storage cluster. This architecture enables transparent controller clustering and failover capability in which a failed storage controller causes its partner node to take over its disk arrays, volumes, and running services to provide continuous operation.

2.3 About NetApp Management

NetApp delivers a suite of monitoring and automation tools to simplify storage-related tasks, especially for large shared-storage infrastructures.

NetApp WFA is a framework that automates storage provisioning tasks. It brings together feature richness and simplicity and enables easy customization for specific needs and conventions. WFA comes with predefined and supported base building blocks to realize individual provisioning needs. A standard-compliant Web Service Description Language (WSDL) interface enables triggering of WFA workflows from almost any source and orchestration software. WFA relies on NetApp OnCommand® software for an up-to-date overview of the storage landscape.

WFA addresses the following challenges:

- **Manual processes are expensive and error prone.** Most storage management tasks such as provisioning, migration, and decommissioning are performed manually.
- **Long provisioning cycles keep consumers waiting.** In many cases it takes days or weeks to provide storage for an application. This includes selecting the resources and provisioning and updating the internal systems.
- **Errors in configuration can happen even with well-trained personnel.** Mistakes made while performing manual steps can result in outages and delays, wasting time and money.
- **Underutilizing the power of smart storage.** To fully leverage the power of the storage system, it must be optimized for the specific application. Frequently, best practices are not followed and advanced features are not used.
- **The cloud promise is delayed.** Using the cloud requires a high level of automation that cannot rely on manual processes. Many IT groups are being challenged by management to meet the self-service and IT automation goals that drive the business.
- **Total cost of ownership of automation.** Many organizations turn to in-house software engineers or partners to write custom code for automation. These approaches are often expensive and slow to

adapt to the changing needs of storage consumers. In most cases, the total cost of ownership of custom software makes it an ineffective solution.

- **Clean storage automation architecture and general-purpose data center orchestration.** Although orchestration solutions can be beneficial for end-to-end automation, they lack a comprehensive storage component to meet customers' process needs. As seen in other domains such as monitoring, an expert storage solution is required to address storage automation requirements.

For a more detailed overview and background information on WFA, refer to the following resources:

- https://communities.netapp.com/servlet/JiveServlet/downloadBody/11606-102-3-30627/WFA_Product_Brief_1.2.pdf
- https://communities.netapp.com/community/interfaces_and_tools/wfa

NetApp OnCommand Unified Manager provides a single management and an application programming interface (API) for integration with other management software. The API uses well-defined XML objects for communication that provide transparency and interoperability. For easy integration, the NetApp manageability Software Developer's Kit (SDK) provides libraries for all major programming languages that use the DataFabric® Manager server API.

2.4 About fluid Operations

fluid Operations provides an innovative cloud and data management platform based on semantic technologies for complex virtualized and physical enterprise environments. This includes creating a flexible cloud infrastructure, the rapid provisioning of enterprise application landscapes through LaaS (a self-service portal), as well as the automated handling of the daily operations of an enterprise cloud.

Leveraging its semantic integration foundation and partnerships with major storage, virtualization, network, and application vendors, the fluid Operations eCloudManager product suite delivers an innovative platform for private and public cloud management. Enabling end-to-end integration of resources, eCloudManager provides a unified overview of all aspects of a private or public cloud. Therefore, multiple multivendor hypervisors, storage systems, public clouds, and enterprise applications can be managed and controlled from eCloudManager's easy-to-use user interface. Moreover, the eCloudManager LaaS concept enables companies to bring their mission-critical applications to the cloud, deliver them to end users as standardized services through a self-service portal, and keep costs under control.

3 Use Cases

This section provides an overview of certain scenarios that can be supported using NetApp shared storage and fluid Operations eCloudManager.

3.1 Use Case 1: On-Demand Storage Provisioning for Infrastructure and Applications

This use case focuses on storage provisioning according to NetApp's best-practice guidelines. NetApp WFA supports the duties of storage administrators who define the rules and layout of storage for certain purposes, such as infrastructure and application-related storage provisioning. WFA also supports the duties of infrastructure administrators and service request managers. Both infrastructure administrators and service request managers use storage best practices for instantiating either new applications or IT infrastructure; they have a broader responsibility and tend to consume storage best practices defined by the storage administrator in a catalog-like experience. fluid Operations eCloudManager supports the duties of infrastructure administrators and service request managers.

3.2 Use Case 2: Definition of an Application Landscape

This use case complements the use case described in section 3.1 by defining how storage layout is consumed by a multitiered enterprise application that consists of Web, application, integration, business intelligence, and database servers.

Defining which systems form a logical unit is crucial for managing the infrastructure in an application-consistent way. Consider the following examples:

- **Landscape snapshots.** All systems in the landscape must be collectively put into an application-consistent state before a storage NetApp Snapshot™ copy is created.
- **Backup and restore.** The landscape definition provides the management software with the metadata required to back up and restore the correct data.
- **Copy and deployment.** The landscape definition identifies which storage content should be copied.

3.3 Use Case 3: Provisioning a Landscape by Template

There are many scenarios in which multitiered enterprise application landscapes must be deployed onto enterprise storage, for example:

- A cloud provider might want to roll out such landscapes on the fly for new customers.
- Hosters and internal service providers must rapidly provide sandbox application landscapes for testing, development, and training.

Traditional provisioning steps involve preparing the hardware, installing the operating system, and installing and configuring the application. Virtualization simplifies many of these steps by introducing the concept of templates. Templates are prebundled packages that contain an application plus its operating system. Extending this concept to enterprise application landscapes means that templates can become very large and must be deployed using advanced storage technology. It also means that several templates that make up an application landscape must also be configured automatically after the provisioning step is complete.

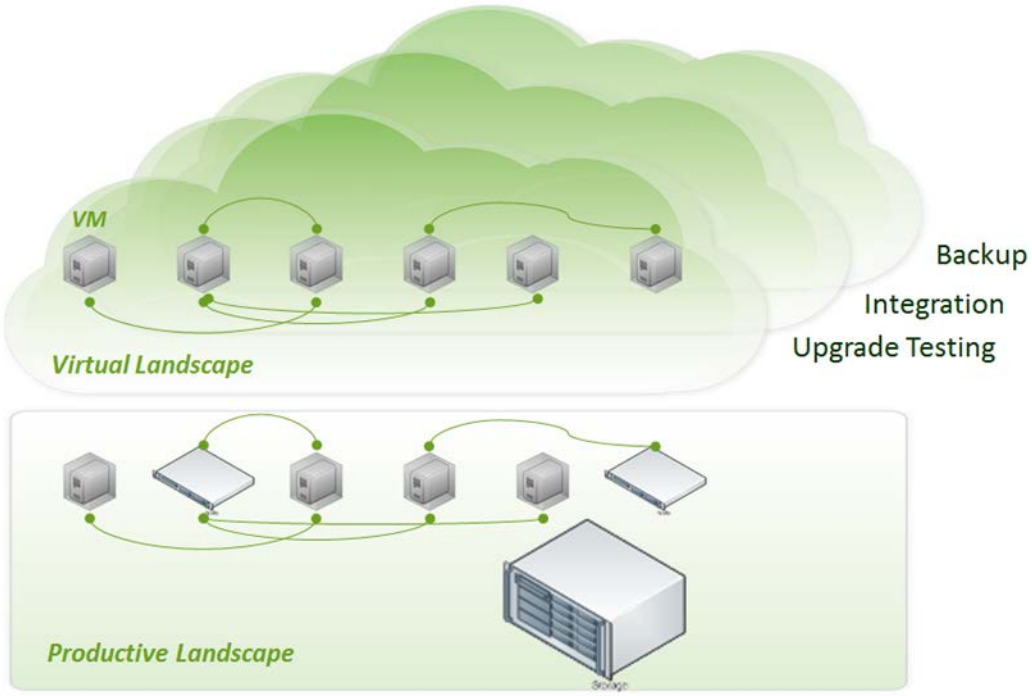
3.4 Use Case 4: Cloning a Running Landscape

IT departments must support the daily operations of productive landscapes. This includes:

- Cloning the landscape for upgrade tests
- Supporting the development, quality assurance, and production cycle
- Reducing backup windows and restore times

All of these tasks can be performed more efficiently by leveraging the features of modern enterprise storage. Being able to quickly create a Snapshot copy and clone the application-consistent state of an enterprise application landscape is key for all three tasks.

Figure 2) Landscape provisioning use cases (graphic provided by fluid Operations).



3.5 Use Case 5: IT Service Management

The increasing degree of automation has had a positive effect on IT service management (ITSM) by making self-service and ad hoc reporting possible.

IT services should be available through a self-service portal to eliminate the need for departmental users to interact with system administrators. To avoid excessive resource consumption by end users, billing, cost centers, and consumption, quotas enforce corporate policies and make cost and consumption transparent.

In the context of managing enterprise application landscapes, any use case previously described, such as providing an upgrade test sandbox landscape or on-boarding a new customer to an application cloud, is available through a self-service portal. It can be completed automatically without requiring system administrators to participate in the process.

System administrators and IT decision makers thereby gain the freedom to focus on business-critical tasks, such as planning backup and HA strategies or optimizing resource consumption. To support system administrators with these tasks, management software needs to provide capabilities for ad hoc dashboards that offer an overview of all aspects of ITSM. This involves infrastructure data as well as information and documentation of SLAs and the people involved in the processes.

4 Software Components and Integration

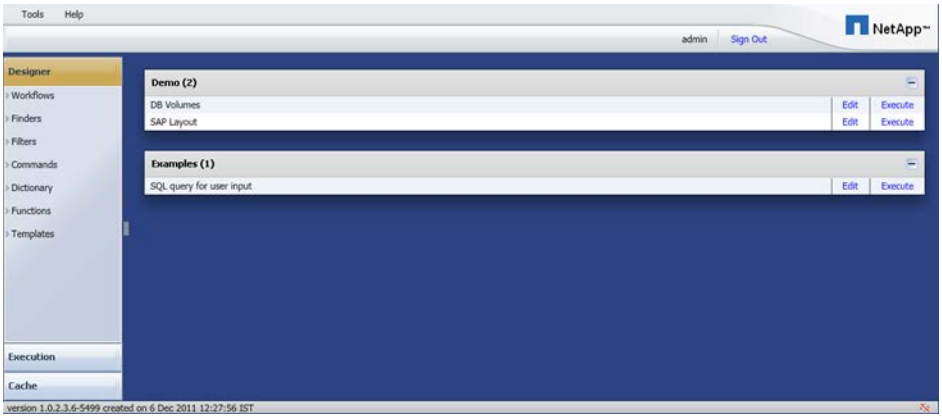
This section focuses on the architecture of the solution components. Figure 1 schematically shows the interaction of the components and the typical roles performing the actions.

4.1 NetApp WFA and NetApp OnCommand Integration

NetApp WFA is a framework that automates storage provisioning tasks. It brings together feature richness and simplicity and easily enables customization for specific needs and conventions. WFA comes with predefined and supported base building blocks to meet individual provisioning needs.

A standard-compliant WSDL interface can trigger WFA workflows from almost any source and orchestration software. WFA relies on OnCommand for an up-to-date overview of the storage landscape. Figure 3 shows a WFA screen with configured storage-related workflows.

Figure 3) WFA screen with configured storage-related workflows.



4.2 fluid Operations eCloudManager

The WFA workflow environment executes storage provisioning workflows that are designed to work specifically with the respective software. fluid Operations eCloudManager uses NetApp WFA to implement storage procedures according to defined best practices. Industry-compliant Web service interfaces make integration fast and easy. As part of the installation process, eCloudManager binaries are laid down and storage workflows are deployed into WFA. The advantage from the ISV's point of view is that encapsulating the provisioning logic in a WFA workflow makes it easy to leverage WFA's features, such as access to other prepackaged best-practice workflows and the features of the engine itself, which include access to all registered storage as well as current capacity information.

eCloudManager benefits from two workflow scenarios. During setup and design, the initial storage setup can be automated. If, for example, the environment is virtualized using VMware® and NetApp NFS datastores, then storage volumes can be provided according to the best-practice guidelines of NetApp and VMware.

5 Use Cases in Detail

This section provides detailed descriptions of the use cases discussed in section 3.

5.1 Use Case 1: On-Demand Storage Provisioning for Infrastructure and Applications

During operation of the self-service cloud offering, a cloning workflow can identify the storage components involved in the operation and choose the ideal data replication plan. Using the VMware example again, a landscape can be cloned most effectively by using a traditional volume clone or by using NetApp FlexClone® technology for file-based cloning, which copies the individual VMware disk files. This decision is based on various factors, such as the deduplication level, whether or not all landscape storage components reside on a single volume, and what portion of the volume is occupied by the landscape.

Technically, integration of storage-centric WFA workflows is done with the WFA WSDL API. This is a simple and concise API that enables consumers to:

- Browse a catalog of existing WFA workflows.
- Plan and execute an existing workflow.
- Track the status of running and finished workflows.

For more information, refer to the NetApp WFA Web Services Primer and "ITaaS Storage Provisioning Using NetApp Workflow Automation, fluid Operations eCloudManager, and Activiti."

5.2 Use Case 2: Definition of an Application Landscape

To offer out-of-the box services to end users, eCloudManager allows users to create a template library from existing application systems. Templates can be updated any time, which helps keep the template library up to date. Additionally, combinations of single-application templates can also be made available as landscape templates.

Golden images are special constructs that are intended to provide better template management. Templates must be defined for each golden image. These templates are distributed across various compute infrastructures and can be used later to create new systems. Golden landscapes extend the concept of golden images from single systems to system landscapes. A golden landscape is a combination of golden images that represents a multitiered system landscape.

Figure 4) Golden image (graphic provided by fluid Operations).

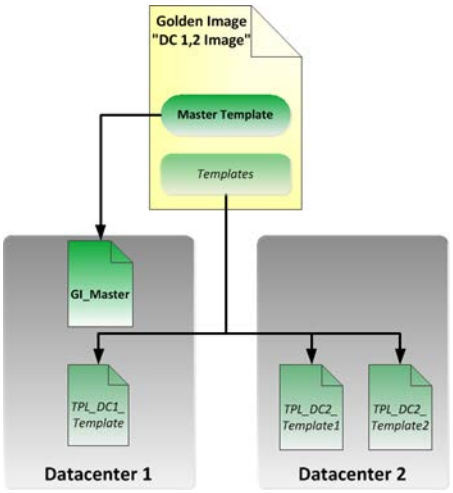


Figure 5) Golden landscape (graphic provided by fluid Operations).

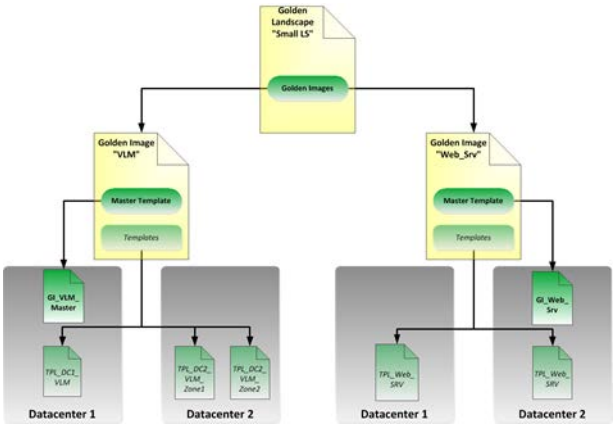
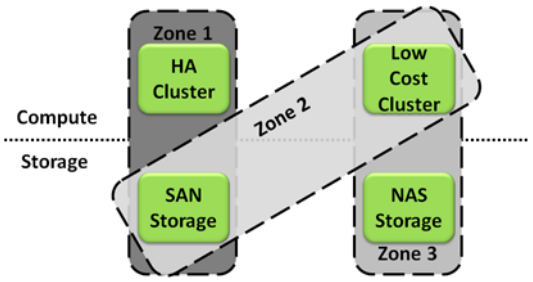


Figure 6) Zones (graphic provided by fluid Operations).



Golden images and golden landscapes are usually made available for deployment in various zones. A zone consists of a cluster, a datastore, and, optionally, service-level agreements (SLAs). By making templates available in different zones, users can deploy the templates in different environments with different SLAs.

By adding the landscape and multicompute infrastructure dimensions, eCloudManager significantly extends the current template concept found in VMware and other hypervisors.

Within eCloudManager, a virtual landscape (VL) is an isolated logical group that consists of a number of applications that are made available as virtual machines (VMs) by underlying hypervisors, such as VMware vSphere®, Microsoft® Hyper-V™, Citrix XenServer, and so on. VLs can also run on physical servers. The landscape isolation happens at the VLAN level.

A dedicated Virtual Landscape Manager™ (VLM), which is a preinstalled virtual appliance, manages each VL from a networking and application perspective and controls the structure, properties, and outside interactions of the VL. The VLM provides services within the landscape, including DHCP, DNS, firewall, and so on, and it enables operations, such as adding or removing a VM from a landscape, to be handled properly.

The VLM holds accumulated background data about storage, network, and system connections for the optimal customer VL environment. This configuration is then replicated with each new VL so that the landscape runs as desired from the beginning. After cloning, the landscape is ready to start, and no additional postcloning installation or configuration is needed.

Once cloned and instantiated, the systems and landscapes can be accessed remotely through RDP or SSH, depending on the operating system that is running on the server. In addition to the RDP and SSH connections, eCloudManager also provides access to the VM console of the VMware vCenter™. This requires that a plugin be installed within the browser to display the VM controls for the VM. The eCloudManager Enterprise Edition also allows a setup in which each Advanced Business Application Programming (ABAP) instance inside the virtual landscape can be accessed directly using the SAP GUI.

To facilitate monitoring the multitude of VLs and physical systems across a customer's private cloud, eCloudManager offers an application monitoring service that gathers relevant information on a real-time basis and automatically detects the number of instances running across the cloud.

Where there are SAP applications, this includes ABAP instances, as well as Java® Platform Enterprise Edition (J2EE) and double-stack instances. Monitoring is performed by an agent that runs on the VLM. It works as a relay between the eCloudManager back end and the VMs in the landscape. The monitored information includes the status of the respective SAP® instance, the database status, and a summary of the running processes. The services offered by a SAP system (gateway, spool, and so on) are also automatically detected. For ABAP systems, the Computing Center Management System (CCMS) information is also retrieved. Similarly, for J2EE instances, J2EE parameters are retrieved.

5.3 Use Case 3: Provisioning a Landscape by Template

Aimed at enabling the easy consumption of IT services, eCloudManager leverages native storage functionalities through tight API integration to deliver faster and more efficient instantiation capabilities, for example, Data ONTAP functionalities that allow users to snap and restore entire volumes or selective objects contained in a volume. This translates to the ability to clone and create Snapshot copies from several landscapes down to the granularity of individual VMs. eCloudManager leverages this feature to enable the rapid provisioning of single systems or system landscapes with little to no manual effort and with minimal use of infrastructure resources.

The eCloudManager template library allows enterprises (internal or external hosters) to make new services available to their business clients with a click of the mouse. End users can select the services that meet their requirements and specify the desired SLAs, and eCloudManager automatically triggers the cloning process. Combined with eCloudManager's ability to fully leverage storage cloning techniques, this makes it possible to deploy preconfigured, prepopulated landscapes with multiple terabytes of associated storage data within minutes.

Based on the eCloudManager VL concept, when a preconfigured system or landscape is cloned it is isolated in a separate VLAN so that the cloned systems can run without interfering with any existing systems. This creates the advantage of allowing several systems with the same hostname or system identifier to run in parallel to support testing, training, or development sandboxes, for example. Moreover, the VLM cloned together with the landscape holds the optimal storage, network, and system connections for the landscape. This means that the cloned landscape does not require any postprovisioning configuration.

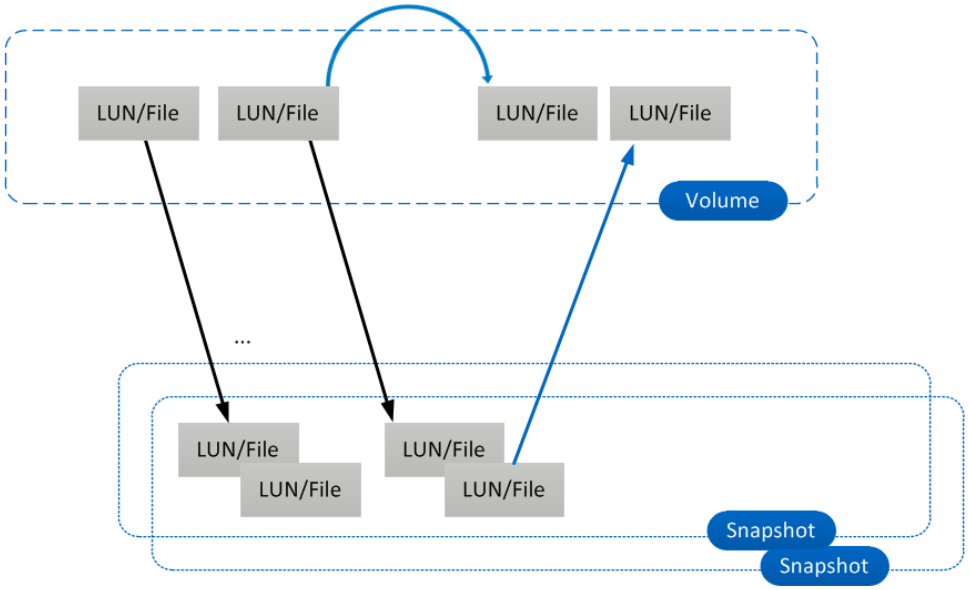
This use case leverages the FlexClone features of Data ONTAP to perform instant and space-efficient cloning of the template data. Specifically, with Data ONTAP, cloning selected objects within a volume or its Snapshot copies can be performed automatically without any intermediate steps.

Using FlexClone with Data ONTAP

NetApp FlexClone technology was enhanced in Data ONTAP 7.3.1 to provide space-efficient cloning at different granularities. FlexClone technology now gives users the ability to clone individual files that are present in a FlexVol® volume in a NAS environment, or inside a LUN in a SAN environment. The new technology provides a way to clone LUNs without the need for a backup Snapshot copy. Cloning files and LUNs using FlexClone technology is space efficient, because the cloned copies share the same physical data space as the source, and their initial metadata occupies negligible space in the storage system. Cloned files or LUNs start occupying extra space only when the data in the source or the clone is overwritten. FlexClone creation is also a fast and time-efficient process, because no physical copy of the data is involved.

From a user perspective, cloning a LUN or a file within a volume, or cloning a LUN or a file from a Snapshot copy back to its volume, is an automatic operations without any intermediate steps. Additionally, the clone is available immediately while the cloning operation completes in the background. These FlexClone enhancements support efficient data handling for thin provisioning and deduplication with minimal allocation of additional capacity. Figure 7 illustrates how the new FlexClone technology works.

Figure 7) New FlexClone features in Data ONTAP.



Clones of objects within the volume can be created and are made available in the same volume. Clones of objects residing in Snapshot copies can be created in the volume from which they were originally made. This operation does not require moving data and can, therefore, be performed very fast and make efficient use of capacity.

The following use cases benefit from this new feature:

- Cloning sets of VMs represented by virtual disk files in a datastore
- Creating individual backup cycles for specific objects in the volume
- Restoring individual objects from Snapshot copies

The new feature simplifies the use case for cloning a landscape by allowing a datastore to keep the virtual disk image for the hypervisor layer. Virtual disk images belonging to the landscape are stored within the datastore. Using these images, a clone can be created and is available immediately for attachment to virtual instances and booting.

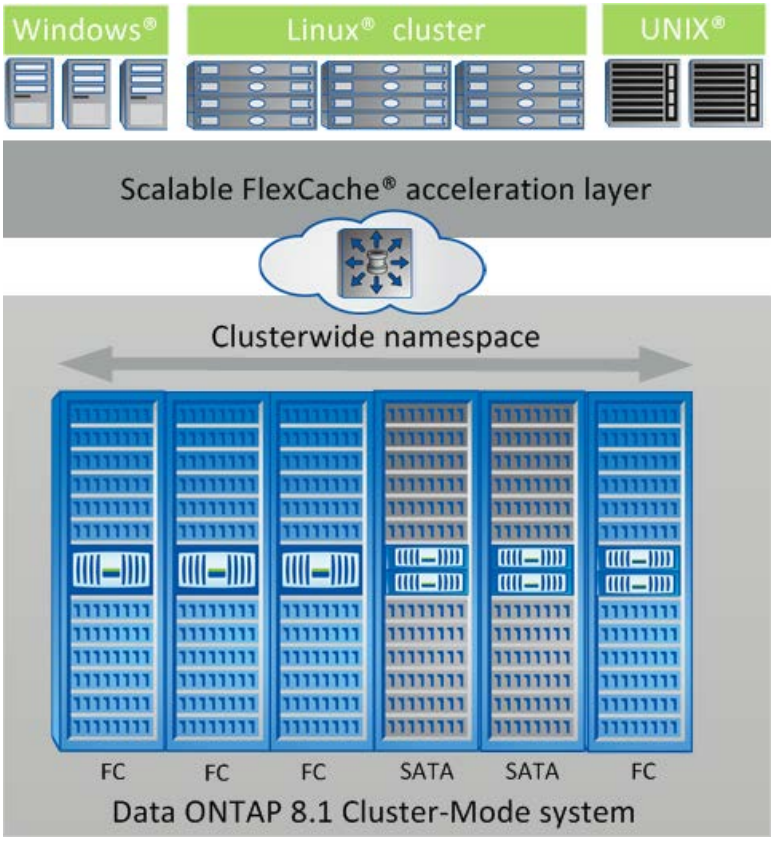
The new feature also increases the flexibility of Data ONTAP 8.1 operating in Cluster Mode.

Operational Flexibility: Leveraging Scale-Out Architecture with Data ONTAP 8.1

The trend toward virtualized infrastructures and IT consolidation with shared infrastructures poses special requirements to storage infrastructure. Virtualized and consolidated applications exhibit different input/output (I/O) patterns, which makes it difficult to predict resulting I/O patterns and resource consumptions. NetApp's economical solution to this challenge is Data ONTAP 8.1 operating in Cluster Mode. Data ONTAP operating in Cluster-Mode provides agility and flexibility by decoupling capacity, performance, and uptime requirements.

For example, to maintain peak application performance and availability, customers need the ability to add storage and move data between systems and tiers of storage without disrupting ongoing operations. At the same time, to control costs, customers need to effectively manage their storage environment. A NetApp storage cluster can scale up to 24 nodes with each controller servicing its own workload and monitoring other controllers.

Figure 8) Simplified operation of shared storage using Cluster-Mode.

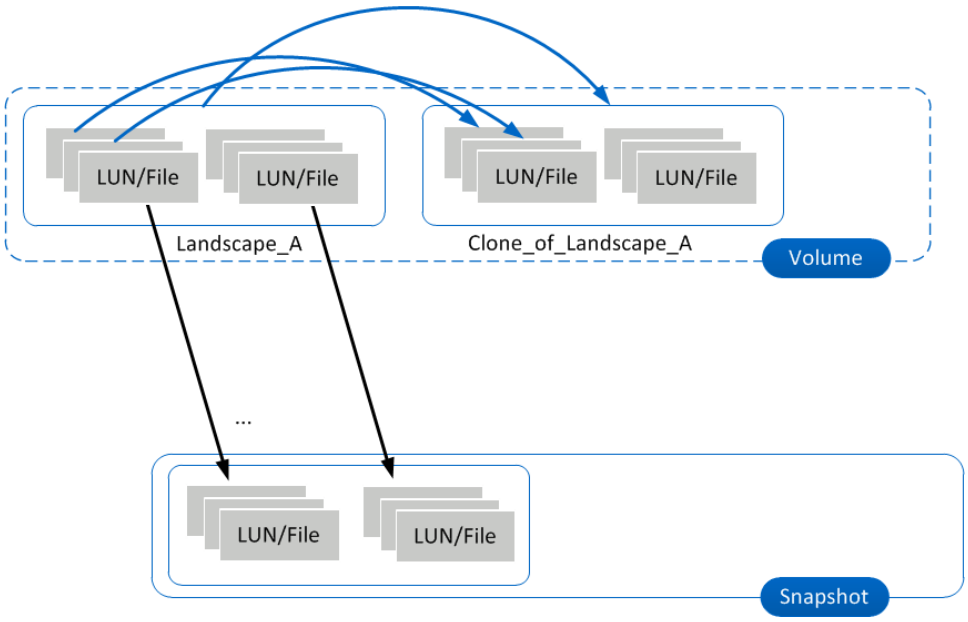


5.4 Use Case 4: Cloning a Running Landscape

The use case described in the previous section is enhanced by the ability to clone running systems or landscapes using eCloudManager. Cloning a running landscape is more challenging than deploying from a template or cloning an offline landscape, because of ongoing network traffic and because all systems within the landscape must be snapped at the same time.

This use case describes creating a new instance of an existing running landscape. From a storage perspective, this landscape is characterized by a set of virtual disk images in a datastore. To create a point-in-time copy of a running landscape, the disk images that belong to the landscape must be cloned. Using the latest cloning capabilities, cloning can be performed instantly, as shown in Figure 9.

Figure 9) Cloning storage of a landscape.



The bold arrow symbolizes the cloning of all storage objects attached to the VMs in the selected landscape. Technically, this comes down to individually creating FlexClone copies of each storage object. Due to the fast and constant time behavior, cloning complex landscapes is feasible. Creating application-consistent backups and clones within the landscape has few negligible application implications due to the fast cloning of individual objects.

Note: This does not require the creation of a Snapshot copy of the volume.

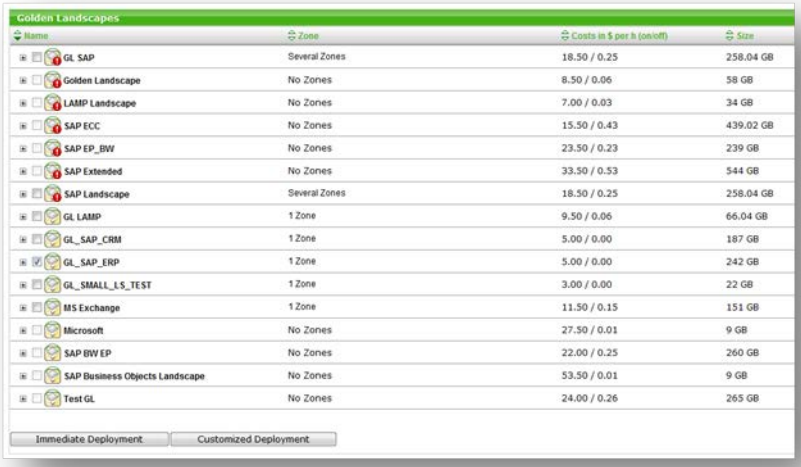
Leveraging NetApp SnapManager® and NetApp Snap Creator™ products, eCloudManager allows users to take application-consistent Snapshot copies of their running systems or landscapes for upgrade tests, development, quality assurance, and training sandboxes or for backup.

5.5 Use Case 5: IT Service Management

eCloudManager enables enterprises to make resources available to internal or external business clients as standardized services through a fully customizable self-service portal or through existing enterprise portals. This allows end users to request, deploy, manage, extend, and retire infrastructure and application resources anytime and anywhere.

The end user can log into the eCloudManager self-service portal, review the offerings available in the service catalog, select the system or system landscape that fits his or her needs, select the required SLAs, and click Deploy. Based on the selected SLAs, eCloudManager automatically determines which infrastructure resources to use for the deployment, thus abstracting the infrastructure from the end user. The clone is ready within a few minutes, regardless of the system size, and the end user is notified by e-mail or SMS as soon as the systems are accessible.

Figure 10) eCloudManager self-service portal example (graphic provided by fluid Operations).



Once the systems are cloned, the end user has full control over them, which means he or she can start, access, stop, suspend, or delete those systems. Moreover, end users can also easily and rapidly extend their services by adjusting existing systems that no longer meet their requirements. End users can extend CPU, memory, or disk allocation, or they can extend deployed landscapes and add new systems to a landscape on demand.

In addition to its rapid cloning functionality, eCloudManager delivers a billing and metering component based on a fully customizable cost-calculation formula that can include anything from time of day to CPU or memory consumption to resource location. This provides full cost transparency, and it allows end users to monitor their resource usage while administrators can easily track actions to users and issue bills accordingly.

Figure 11) Cost overview dashboard (graphic provided by fluid Operations).

Supporting CxOs to identify data center risks, problems, and optimization opportunities, eCloudManager has the flexibility to create dashboards and reports that provide deep insights into a customer's data

center. This includes the ability to interrogate and visualize resources in a unified way and to create dashboards on demand to display the overall costs for running the enterprise cloud, resource consumption over time, and the number of customer and internal projects and their associated costs.

6 Conclusion

This document outlines the integration of fluid Operations eCloudManager and NetApp storage management software to leverage NetApp shared storage. The integration and its value are shown by means of typical use cases in a virtualized IT environment. Leveraging NetApp Snapshot technology and cloning features allows customers to handle landscapes in a simple and agile way. fluid Operations eCloudManager uses these functionalities to provide an on-demand user experience even for landscapes rather than single virtual machines.

References

The following references were used in this report:

- "NetApp WFA Web Services Primer" https://communities.netapp.com/docs/DOC-12977
- "NetApp WFA Communities" https://communities.netapp.com/community/interfaces_and_tools/wfa
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