



OPEN DATA CENTER ALLIANCESM USAGE: VIRTUAL MACHINE (VM) INTEROPERABILITY IN A HYBRID CLOUD ENVIRONMENT REV. 1.1

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EXECUTIVE SUMMARY

Ideally, cloud subscribers would like to select any cloud provider based on cost and performance/capabilities. They also want to link, per need, private clouds made up of dedicated services with public clouds that consist of shared services. In order to make this feasible for the cloud consumer, the various hypervisor platforms and virtual machines (VMs) involved will need to be interoperable and portable.

Furthermore, consistent management interfaces would help considerably in enabling interoperability among cloud environments. Managing systems, networks and storage is already a complex endeavor. The addition of virtual resources—which are the foundation of cloud services—adds yet another layer of complexity. Challenges increase even further as workloads or virtual machines (VMs) cross the boundaries between data centers. These complexities do not come cheap. Between 2010 and 2014, Bain & Company estimates that IT organizations will spend up to \$2 trillion in deployment and operations unless management practices can be automated and simplified¹.

The Open Data Center AllianceSM (ODCA) recognizes the need for interoperable cloud environments and management solutions that incorporate standard mechanisms to create consistencies across all VMs. This Usage Model specifies actions and processes to spur development of interoperable solutions aimed at lowering management complexity and costs, especially in heterogeneous, multi-vendor environments.

This document serves a variety of audiences. Business decision makers looking for specific solutions, and enterprise IT groups involved in planning, operations, and procurement will find this document useful. Solution providers and technology vendors will benefit from its content to better understand customer needs and tailor service and product offerings. Standards organizations will find the information helpful in defining standards that are open and relevant to end-users.

¹ www.opendatacenteralliance.org/phocadownload/odca-vision.pdf

PURPOSE

VM interoperability would significantly reduce the risks and effort when working with different hypervisors. It would greatly simplify the complexity of handling multiple cloud platforms and minimize the issues of managing workloads that are hosted on internal cloud platforms or within several different public cloud platform offerings. Actions could be clearly defined in terms of prerequisites, implied sub-activities, and possible results.

As the feature sets of the available hypervisors vary, there should be a common command set (such as create, start, stop and suspend), which all hypervisors have to provide. Additionally, the support of differentiating features has to be ensured and constantly reviewed to determine if any of these features have become standard practice and, therefore, are required to be part of the common command set.

Consistent management is necessary for any virtualized environment. Ensuring interoperability of hypervisors will allow all vendors to easily develop interoperable management solutions that lower management complexity and cost, especially in a heterogeneous, multi-vendor environment. For example, by supporting certain virtualization management standards, such as those being proposed by the Distributed Management Task Force (DMTF), VMs and their deployments can be managed in the same manner, independent of vendors. The entire virtualized environment can then be managed from a single management console.

This Usage Model assumes the usage of the DMTF Open Virtualization Format (OVF) specification². For related information, see the Open Data Center AllianceSM Usage: Carbon Footprint Values Rev. 1.1³.

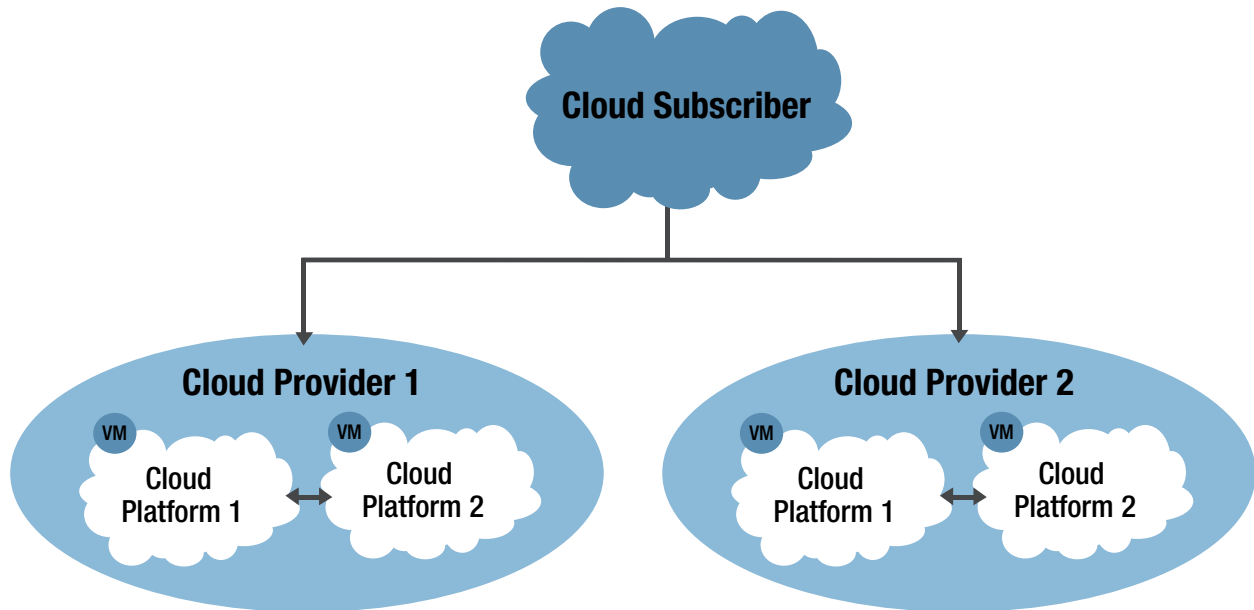
TAXONOMY

Actor	Description
Cloud Subscriber	A person or organization that has been authenticated to a cloud and maintains a business relationship with a cloud.
Cloud Provider	An organization providing network services and charging cloud subscribers. A (public) cloud provider provides services over the Internet.
Cloud Compliance Agency	An accredited entity that is responsible for ensuring compliance to cloud security standards. A Cloud Compliance Agency may also be a third party trusted by the cloud subscriber. They could then determine and monitor the security state of the cloud provider and respond to the cloud subscriber when requested.

² <http://www.dmtf.org/standards/ovf>

³ see the Open Data Center AllianceSM Usage: Carbon Footprint Values Rev. 1.1

USAGE MODEL DIAGRAM



USAGE MODEL DETAILS

Running a complex workload in a Hybrid Cloud environment is a significant undertaking which should become far simpler over time with standards allowing for open solutions that minimize complexity and lower cost. This usage model focuses specifically on running simple Compute IaaS workloads of few VMs across multiple hypervisors in a Hybrid Cloud model. Future Usage Models will delve into the specifics around complex workloads including detailed networking and storage components, and the addition of policy-based automation to control the status and usage of cloud providers programmatically. For the sake of this Usage Model, it should be clear that the cloud provider in many situations will be the Enterprise IT team providing services to their software developers as cloud subscribers.

USAGE SCENARIOS

Goal: Check Interoperability

Determine if a move/migration of a VM of a cloud subscriber from one cloud provider to another, or to a different hypervisor within the same cloud provider, is possible, and the potential limitations for the move, such as, "Can the move/migration be live?" An understanding of all of the requirements for moving between hypervisors and cloud providers should be clearly detailed.

Assumptions:

1. The cloud provider implements the Open Data Center Alliance Service Catalog Usage.
2. Technical details of the current workload are known:
 - Number of VMs
 - Amount and type of memory
 - Amount and type of CPU core
 - Amount and type of network interface card (NIC)
 - Amount and type of disk

- Amount of I/O required
 - Type and vendor of hypervisor
 - Backup services
 - Firewall policies and rules
 - Load Balancing services
3. The cloud subscriber has access to all details about the Service Level Agreement (SLA), Operating Level Agreement (OLA), and any specific controls:
 - Availability
 - Specific functions such as remote copy, disaster recovery
 - Security root of trust
 - Consistency of Input/Output management (IO controls)
 - Security and compliance (from compliance monitoring)
 - Carbon measurement
 - Geo Hosting Requirements
 4. The cloud provider is asked programmatically, through a user interface, if they can fulfill the requirements defined by the stated technical and operational specifications.

Success Scenario 1:

The cloud provider can answer “Yes” to the question of whether the clouds interoperate. The cloud subscriber is able to (automatically) decide to move the workload.

Failure Condition 1:

1. The cloud provider does not understand the question, is not able to answer it, or is unable to provide any details pertaining to the question.
2. Interoperability is not a given.

Failure Condition 2:

The cloud provider is not able to fulfill some requirements but can define the differences. The cloud subscriber can make a choice on whether migration is possible. If the migration is possible, then the interoperability can be created by following the goals discussed in “Leverage Common Operation/Interoperability.”

Goals:

Move or Copy between Two Hypervisors or Cloud Providers

3. After successful completion of Usage 1 (Check Interoperability), the cloud subscriber will be able to complete the copy of or move an existing VM from cloud platform 1 (hypervisor A) to cloud platform 2 (hypervisor B) from cloud provider 1 to cloud provider 2.
4. If performing a copy, the cloud subscriber will be able to bring VM B into a running state and start taking active workload and/or connections.
5. If performing a move, the cloud subscriber will be able to bring VM B into the running state to start taking active workloads and/or connections, and then shut down VM A.

Assumptions:

Usage 1 (Check Interoperability) has completed a successful return, showing that the source and destination VMs and/or cloud platforms are interoperable and therefore capable of handling a copy or move function.

Success Scenario 1:

The copy is completed successfully between cloud platform 1 and cloud platform 2, and both VMs are accepting active connections.

Success Scenario 2:

The move is completed successfully, VM A on cloud platform 1 is shut down successfully, and VM B on cloud platform 2 is able to start up and accept active connections.

Failure Condition 1:

The copy or move did not complete successfully, and therefore VM B is unable to enter the running state. The cloud provider will return an error code indicating the reason for failure. The cloud subscriber can then take corrective actions for subsequent retry of the operation.

Failure Condition 2:

The copy completed successfully; however, VM B is unable to enter the running state, due to various failure conditions. The Return Error code is expected, to allow for retry or failure event notice.

Failure Condition 3:

The move is completed successfully, but VM A is unable to shut down. The Return error code is expected, and usage scenarios should not continue with trying to bring VM B into an active running state until the issue is corrected.

Goal: Leverage Common Operation/Interoperability

Ensure that all operational activities can be conducted with the same syntax across both VM A and VM B, or between two cloud providers. Operational activities could include: start VM, stop VM, increase CPU of VM, decrease memory of VM, snapshot of VM, and other runtime functions. These should be possible using either identical syntax or identical methods. For this usage, we give the example of increased CPUs on the VM; however, we expect success and failure conditions to be met for all runtime operational management functions of the VM.

Assumptions:

1. Usage 1 (Check Interoperability) has completed a successful return.
2. Usage 2 (Move or Copy) has been utilized where there are VMs running on either multiple cloud provider platforms or multiple hypervisors within a single cloud platform.

Success Scenario 1:

The command for increased CPU of VM can be called with the same syntax and/or API to multiple cloud provider platforms or to multiple hypervisor solutions. The command is called as each platform completes the request and provides a return message.

Failure Condition 1:

The command is submitted; however, cloud platform 2 is not able to understand the cloud subscriber's request for increased CPU of VM and returns the syntax error.

Failure Condition 2:

The command is submitted; however, cloud platform 2 does not take similar operational requirements into account which can then impact the running operation of VM. For example, a previous requirement of "no reboot when CPU of VM has been increased" is not supported on cloud platform 2 and therefore an unexpected reboot occurs.

USAGE REQUIREMENTS

At a fundamental level, all usage requirements are expected to be multi-vendor and open. Key requirements need to be met across vendors and hypervisors.

The two categories of interoperability that will specifically need to be met for the usage requirements are:

1. **Packaging and distribution/deployment of VMs** – At a minimum, all hypervisor vendors need to support the DMTF's Open Virtualization Format (OVF). While OVF progresses as the standard, certain usage requirements may be met by the vendors in the interim. VM meta-data should include:
 - Existing OVF attributes, as defined in the OVF specification
 - Additional attributes to address cloud service requirements, including:
 - OVF + Disk Spec Requirement + Guestware or VM-specific drivers
 - Cloud service-level attributes beyond a single VM
 - SLA and Quality of Service (QoS) attributes
 - Security attributes (security zone restrictions, compliance requirements)
 - Performance-enhancing attributes (virtual queues, single root I/O virtualization)
 - Platform attributes (instruction sets and hardware-assisted features are needed)
 - Memory management attributes, including:
 - Memory overcommits – allowed/not allowed
 - Hardware-assisted memory virtualization
 - Configurable networking rules, such as:
 - Firewalls, load-balancers for VMs, VM startup rules
 - Security root of trust
 - Consistency of IO management (IO controls)
 - Security and compliance (for compliance monitoring)
 - Carbon measurement
 - Geo hosting requirements
 - For portability, cloud providers must also support the import and export of VM packages per OVF.
2. **Runtime Management** – Cloud providers must support standard and consistent ways of discovering, configuring, managing, and monitoring virtual systems in the cloud, including:
 - **Discovery and Inventory:** Provide consistent mechanisms for discovering VMs and their attributes (CPU, memory, NICs, storage, VM vendor).
 - **Lifecycle Management:** Consistent control and management of operational lifecycle of VMs across hypervisors. All hypervisors should provide mechanisms to create, modify, enable, disable, destroy, suspend, snapshot and monitor/query changes on a virtual computer system.
 - **Monitoring:** Detection and tracking of VMs.
 - **Diagnostics:** Consistent set of attributes and functions to provide correlation between virtual and physical resources.
 - **Workload-based Logical Collections:** Workload specific collections of VMs, networking, and storage components that can be managed as a whole, with policy based automation.

- **Live Migration of VMs:** Support non-disruptive scheduled maintenance and dynamic workload balancing across different hypervisors/clouds. This includes supporting:
 - Extended migration and flex migration, ensuring migration success across different hardware-assisted virtualization server platform generations
 - Simultaneous live migrations of multiple VMs
 - Consistent methods for initiating live migration
 - Consistent metric for physical host service level validation (e.g., Does the host have adequate resources to meet a VM's service level requirement?)
 - Prioritization on concurrent live migration jobs

RFP REQUIREMENTS

Following are requirements that the Alliance believes should be included in requests for proposal to cloud providers to ensure proposed solutions support VM interoperability of hypervisors and consistency among management solutions.

- **ODCA Principle Requirement** - Solution is open, works on multiple virtual and non-virtual infrastructure platforms, and is standards-based. Describe how the solution meets this principle and any limitations it has in meeting these goals.
- **ODCA VM Interoperability Usage Model 1.1** – Solution should be able to check if a cloud provider or a hypervisor can accept SLA requirements stated by subscriber through an API
- **ODCA VM Interoperability Usage Model 1.1** – Solution should be able to move/migrate VMs between hypervisors in a fully automated fashion through API and GUI controls
- **ODCA VM Interoperability Usage Model 1.1** – Solution should have the ability to control VM lifecycle management across multiple hypervisors and **cloud providers** (e.g. start / stop / grow / shrink / destroy / snapshot)
- **ODCA VM Interoperability Usage Model 1.1** – Solution should have the ability to discover attributes of VMs and monitor their status regardless of hypervisor and cloud provider

Click here for an online assistant to help you detail your RFP requirements. <http://www.opendatacenteralliance.org/ourwork/proposalengineassistant>

SUMMARY OF INDUSTRY ACTIONS REQUIRED

In the interest of giving guidance on how to create and deploy solutions that are open, multi-vendor, and interoperable, the ODCA has identified specific areas where the Alliance believes there should be open specifications, formal or de facto standards, or common IP-free implementations. Where the ODCA has a specific recommendation on the specification, standard or open implementation, it is called out in this Usage Model. In other cases, we will be working with the industry to evaluate and recommend specifications in future releases of this document.

The following industry actions are required to refine this Usage Model:

1. The ODCA needs to engage with DMTF to align this Usage Model with the DMTF's Virtualization Management (VMAN) specification efforts.
2. The solution providers need to propose solutions that are aligned with the VMAN specifications for implementing this Usage Model.