



OPEN DATA CENTER ALLIANCESM USAGE: VIRTUAL MACHINE (VM) INTEROPERABILITY

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EXECUTIVE SUMMARY

Managing systems, networks and storage is 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. According to Bain & Co, between 2010 and 2014 it is estimated that IT organizations will spend up to \$2 trillion in deployment and operations unless management practices can be automated and simplified.

Interoperability among the various VMs and hypervisor platforms is ideal. Customers would like to select any cloud vendor 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. Consistent management interfaces would help considerably in enabling interoperability among hypervisors.

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

PURPOSE

Interoperability would significantly reduce the risks and effort when working with different hypervisor platforms. 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 hypervisor platforms vary, there should be a common command set which all hypervisors have to provide (such as create, start, stop and suspend). Additionally, the support of differentiating features has to be ensured, as well as constantly reviewed to determine if any of these features have become standard practice and therefore required to be part of the common command set.

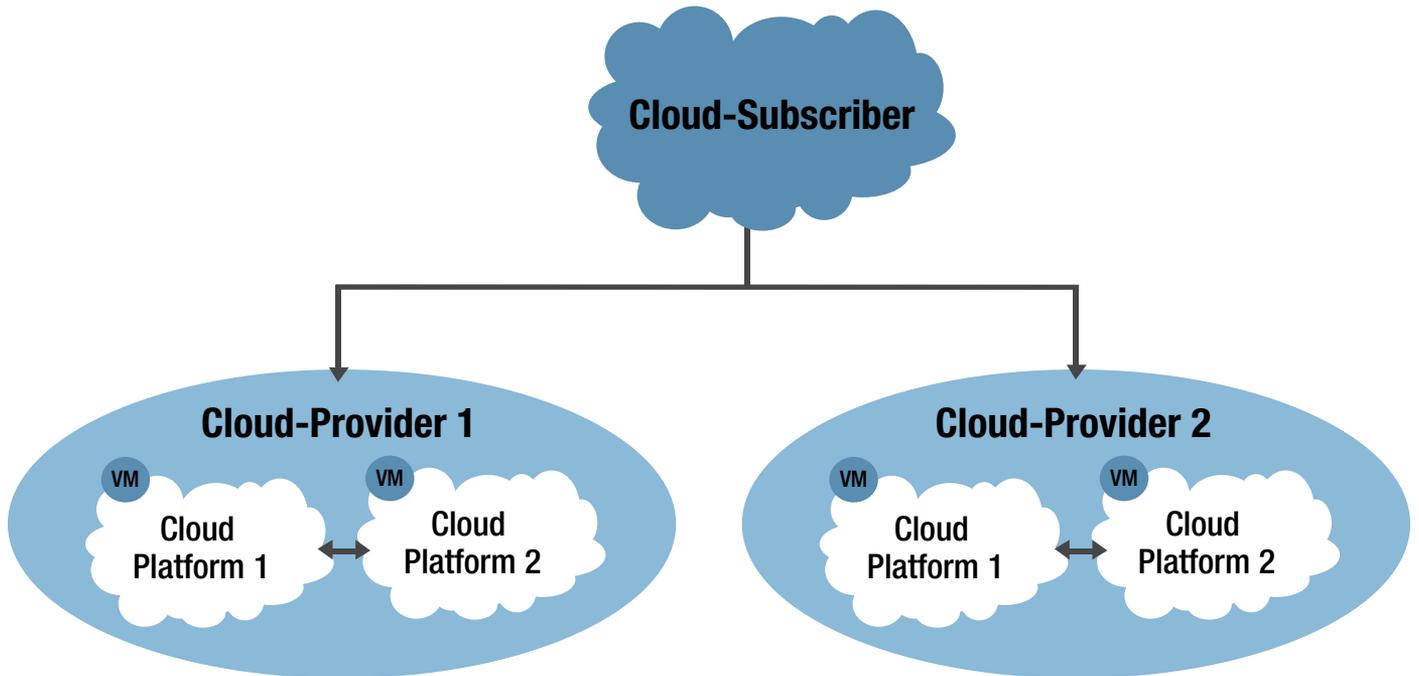
Consistent management is necessary for any virtualized environment. Ensuring interoperability of hypervisors will allow all vendors to easily develop interoperable management solutions that lower management complexity and cost, especially in a heterogeneous, multi-vendor environment. For example, by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

This Usage Model expects at minimum the usage of the DMTF Open Virtualization Format (OVF) specification as the foundation.

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.

CONTEXT DIAGRAM



INTEROPERABILITY OF HYPERVISORS USAGE MODEL

USAGE 1 – CHECK INTEROPERABILITY

Usage 1 Goal:

Confirm that 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.

Assumptions:

1. **Cloud-Provider** implements the Open Data Center Alliance Service Catalog Usage and the Open Data Center Alliance Common Infrastructure Objections Framework.
2. Known technical details of the current workload are as follows:
 - 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
 - Balancing services
3. Known details about the Service Level Agreement (SLA), Operating Level Agreement (OLA), and any specific controls, such as:
 - 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 required command set the **Cloud-Subscriber** used to operate the workload is defined (e.g., start, stop, pause, migrate).
5. The **Cloud-Provider** is asked programmatically, or through a user interface (UI), if they can fulfill the requirements defined by the stated technical and operational specifics.

Success Scenario:

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, or 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 and therefore Usage 3 (see p. 8) can be followed to create the interoperability.

USAGE 2 – MOVE OR COPY BETWEEN TWO HYPERVISORS

Usage 2 Goals:

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

Assumptions:

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

Success Scenario 1:

Copy is completed successfully between cloud platform 1 and cloud platform 2, and both hypervisors are accepting active connections.

Success Scenario 2:

Move is completed successfully, hypervisor A on cloud platform 1 is shut down successfully, and hypervisor 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 hypervisor B is unable to enter running state. Return Error code expected, to allow for retry or failure event notice.

Failure Condition 2:

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

Failure Condition 3:

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

USAGE 3 – LEVERAGE COMMON OPERATION/INTEROPERABILITY

Usage 3 Goal:

Ensure all operational activities can be conducted with the same syntax across both hypervisor A and hypervisor B, or between two **Cloud-Providers**. Operational activities could include: start VM, stop VM, increase CPU of VM, decrease memory of VM, snapshot VM, and other runtime functions. These should be possible using either identical syntax, or identical methods. For this usage, we will only give an example (increase CPU of VM); however, for all runtime operational management functions of the VM, we expect the success and failure conditions to be met.

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:

Command for increase CPU of VM can be called with the same syntax and/or API to multiple **Cloud-Provider** platforms or to multiple hypervisor solutions.

Command is called as each platform completes the request and provides a return message.

Failure Condition 1:

Command is submitted; however, cloud platform 2 is not able to understand **Cloud-Subscriber's** request for increase CPU of VM and returns syntax error.

Failure Condition 2:

Command is submitted; however, cloud platform 2 does not take similar workflow requirements into account and impacts the running

operation of VM with, for example, no reboot when CPU of VM has been increased.

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** – All hypervisor vendors need to support the DMTF's Open Virtualization Format (OVF) at a minimum. 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:
 - Cloud service-level attributes beyond a 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, hardware-assisted features 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 import and export of VM packages per OVF.

1. **Runtime Management – Cloud-Providers** must support standard and consistent ways of discovering, configuring, managing and monitoring virtual systems in the cloud. These include:
 - **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, 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.
 - **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 host have adequate resources to meet a VM's service level requirement?)
 - Prioritization on concurrent live migration jobs

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 Alliance 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 Alliance 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 are industry actions required to refine this Usage Model:

1. Open Data Center Alliance needs to engage with DMTF to align this Usage Model with the DMTF's Virtualization Management (VMAN) specification efforts.
2. Solution-Providers need to propose solutions that implement this Usage Model aligned with VMAN specification.