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SERIES Q: SWITCHING AND SIGNALLING, AND
ASSOCIATED MEASUREMENTS AND TESTS

Testing specifications – Testing specifications for Cloud
computing

Cloud computing infrastructure capabilities interoperability testing – part 1: Interoperability testing between the CSC and CSP

Recommendation ITU-T Q.4041.1

ITU-T

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Recommendation ITU-T Q.4041.1

Cloud computing infrastructure capabilities interoperability testing – part 1: Interoperability testing between the CSC and CSP

Summary

Recommendation ITU-T Q.4041.1 specifies the cloud computing infrastructure capabilities type interoperability testing between the CSC and CSP, including interoperability testing of computing services, storage services, network services and related management functions, based on the functional requirements specified in Recommendation ITU-T Y.3513. The test cases of cloud computing infrastructure capabilities type interoperability testing between the CSC and CSP have also been introduced.

History

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Recommendation ITU-T Q.4041.1

Cloud computing infrastructure capabilities interoperability testing – part 1: Interoperability testing between the CSC and CSP

1 Scope

This Recommendation specifies the cloud computing infrastructure capabilities type interoperability testing between the CSC and CSP, including interoperability testing of computing services, storage services, network services and related management functions, based on the functional requirements specified in [ITU-T Y.3513].

The scope of this Recommendation consists of:

- Overview of cloud computing infrastructure capabilities type interoperability testing between the CSC and CSP;
- computing service interoperability testing between the CSC and CSP;
- storage service interoperability testing between the CSC and CSP;
- network service interoperability testing between the CSC and CSP.

NOTE – This Recommendation is the first part of cloud computing infrastructure capabilities type interoperability testing, which focuses on validating the infrastructure capabilities type functions provided by the CSP to the CSC. The second part focuses on validating the interaction between CSPs in the inter-cloud environment.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

- [ITU-T Q.4040] Recommendation ITU-T Q.4040 (2016), *The framework and overview of cloud computing interoperability testing*.
- [ITU-T Y.101] Recommendation ITU-T Y.101 (2000), *Global Information Infrastructure terminology: Terms and definitions*.
- [ITU-T Y.3500] Recommendation ITU-T Y.3500 (2014) | ISO/IEC 17788:2014, *Information technology – Cloud computing – Overview and vocabulary*.
- [ITU-T Y.3502] Recommendation ITU-T Y.3502 (2014) | ISO/IEC 17789:2014, *Information technology – Cloud computing – Reference architecture*.
- [ITU-T Y.3513] Recommendation ITU-T Y.3513 (2014), *Cloud computing – Functional requirements of Infrastructure as a Service*.
- [ISO/IEC 19941] ISO/IEC 19941 (2017), *Information technology – Cloud computing – Interoperability and portability*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 activity [ITU-T Y.3502]: A specified pursuit or set of tasks.

3.1.2 cloud interoperability [ITU-T Q.4040]: The capability to interact between CSCs and CSPs or between different CPSs, including the ability of CSCs to interact with cloud services and exchange information, the ability for one cloud service to work with other cloud services, and the ability for CSCs to interact with the cloud service management facilities of the CSPs.

3.1.3 cloud interoperability testing [ITU-T Q.4040]: Verifying functions and interaction that realize the cloud interoperability.

3.1.4 cloud service [ITU-T Y.3500]: One or more capabilities offered via cloud computing invoked using a defined interface.

3.1.5 cloud service customer [ITU-T Y.3500]: Party which is in a business relationship for the purpose of using cloud services.

3.1.6 cloud service provider [ITU-T Y.3500]: Party which makes cloud services available.

3.1.7 cloud service user [ITU-T Y.3500]: Natural person, or entity acting on their behalf, associated with a cloud service customer that uses cloud services.

NOTE – Examples of such entities include devices and applications.

3.1.8 interoperability [ITU-T Y.101]: The ability of two or more systems or applications to exchange information and to mutually use the information that has been exchanged.

3.2 Terms defined in this Recommendation

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

CPU	Central Processing Unit
CSC	Cloud Service Customer
CSP	Cloud Service Provider
DHCP	Dynamic Host Configuration Protocol
FTP	File Transfer Protocol
HTTP	Hypertext Transfer Protocol
IaaS	Infrastructure as a Service
IOPS	Input/Output operations Per Second
I/O	Input/Output
IP	Internet Protocol
LUN	Logical Unit Number
NAT	Network Address Translation

NIC	Network Interface Card
OVF	Open Virtualization Format
QCOW2	QEMU Copy On Write version 2
QEMU	Quick Emulator
QoS	Quality of Service
SLA	Service Level Agreement
SSH	Secure Shell
VLAN	Virtual Local Area Network
VM	Virtual Machine
VMDK	Virtual Machine Disk
VNC	Virtual Network Computing

5 Conventions

In this Recommendation, the keywords "is recommended" indicate a requirement which is recommended but which is not absolutely required. Thus this requirement need not be present to claim conformance.

6 Overview of cloud computing infrastructure capabilities type interoperability testing between the CSC and CSP

Cloud interoperability is the ability of a CSC's system to interact with a cloud service, or the ability of one cloud service to interact with another cloud service, by exchanging information according to a prescribed method to obtain predictable results [ISO/IEC 19941]. The goal for cloud infrastructure capabilities type interoperability testing is to devise and implement testing methods and conduct a basic set of functional tests for infrastructure capabilities type interoperability in a hybrid cloud environment using both private and public clouds [ITU-T Q.4040].

The cloud computing infrastructure capabilities type interoperability testing can be divided into two parts; the first part focuses on validating the infrastructure capabilities type functions provided by the CSP to the CSC, and the second part focuses on validating the interaction between CSPs in the inter-cloud environment. The scope of this Recommendation is to validate the interaction between the CSC and CSP with infrastructure capabilities.

Infrastructure as a Service (IaaS) provides computing service functions, storage service functions and network service functions to the CSC [ITU-T Y.3513]. All the functional requirements specified in [ITU-T Y.3513] should be validated. It is recommended to consider the following for cloud computing infrastructure capabilities type interoperability testing:

- Computing service interoperability testing between the CSC and CSP
 - It is recommended to verify that the CSP provides a computing service to the CSC, including virtual machine (VM) configuration, VM migration, VM snapshot, VM clone, VM time synchronization, VM reservation, VM image, VM template, VM scaling and VM backup.
 - It is recommended to verify that the CSP provides computing service related management functions to the CSC, including life cycle management of the VM and physical machine, and VM and physical machine configuration inquiring.

- Storage service interoperability testing between the CSC and CSP
 - It is recommended to verify that the CSP provides a storage service to the CSC, including storage migration, storage snapshot, storage backup, storage resource reservation and I/O performance.
 - It is recommended to verify that the CSP provides storage service related management functions to the CSC, including storage life cycle management, storage utilization status inquiring.
- Network service interoperability testing between the CSC and CSP
 - It is recommended to verify that the CSP provides network service to the CSC, including network policy migration, network QoS, network address translation (NAT), network isolation, IP address allocation, IP address reservation, load balance, firewall and multipath routing.
 - It is recommended to verify that the CSP provides network service related management function to the CSC, including network information inquiring.

This Recommendation describes cloud computing infrastructure capabilities type interoperability testing from the functional perspective without distinguish five facets (transport, syntactic, semantic data, behavioural and policy) which were defines by [ISO/IEC 19941]. However, all the considerations described in [ISO/IEC 19941] are taking into account for better understanding of the cloud computing infrastructure capabilities type interoperability testing.

7 Computing service interoperability testing between the CSC and CSP

Computing service interoperability testing between the CSC and CSP valuates the interaction between the CSC and CSP for computing service and related management functions, which include VM configuration, VM migration, VM snapshot, VM clone, VM time synchronization, VM reservation, VM image, VM template, VM scaling, VM backup, life cycle management of the VM and physical machine, and VM and physical machine configuration inquiring. For a description of related functional requirements refer to [ITU-T Y.3513].

7.1 Interoperability testing of VM configuration between the CSC and CSP

The test object of VM configuration is to verify that the CSC configures the VM with processors, hard disks, memory and NIC parameters. The test case of VM configuration can be found in Appendix II.1.1.

7.2 Interoperability testing of VM migration between the CSC and CSP

The test object of VM migration is to verify that the CSC migrates the VM from a particular host to another host. The test case of VM migration can be found in Appendix II.1.2.

7.3 Interoperability testing of VM snapshot between the CSC and CSP

The test object of VM snapshot is to verify that the CSC captures the state (VM memory, settings, and virtual disks) of the VM by taking snapshots of it and rolling back to the previous VM state when needed. The test case of VM snapshot can be found in Appendix II.1.3.

7.4 Interoperability testing of VM clone between the CSC and CSP

The test object of VM clone is to verify that the CSC clones a particular VM and the cloned VM has identical configuration and CSP/CSC data as the original one. The test case of VM clone can be found in Appendix II.1.4.

7.5 Interoperability testing of VM time synchronization between the CSC and CSP

The test object of VM time synchronization is to verify that the CSC sets VM time synchronization manually or automatically. The test case of VM time synchronization can be found in Appendix II.1.5.

7.6 Interoperability testing of VM reservation between the CSC and CSP

The test object of VM reservation is to verify that the CSC reserves available computing resources (CPU, memory) for particular VM before it is initiated. The test case of VM reservation can be found in Appendix II.1.6.

7.7 Interoperability testing of VM image between the CSC and CSP

The test object of VM image is to verify that the CSC creates a new VM by VM image, which consists of infrastructure configuration and CSP data, CSC data or both. The test case of VM image can be found in Appendix II.1.7.

7.8 Interoperability testing of VM template between the CSC and CSP

The test object of VM template is to verify that the CSC creates VMs by VM template, including the open virtualization format (OVF). The test case of VM template can be found in Appendix II.1.8.

7.9 Interoperability testing of VM scaling between the CSC and CSP

The test object of VM scaling is to verify that the CSC changes the scale of VMs dynamically based on the scaling policies and monitored events of the VM; this includes configuration change (e.g., CPU, memory, network bandwidth increased or decreased) and components change (new VM added or removed). The test case of VM scaling can be found in Appendix II.1.9.

7.10 Interoperability testing of VM backup between the CSC and CSP

The test object of VM backup is to verify that the CSC obtains the configuration and data of a particular VM by making a backup and restoring the VM. The test case of VM backup can be found in Appendix II.1.10.

7.11 Interoperability testing of VM life cycle management between the CSC and CSP

The test object of VM life cycle management is to verify that the CSC manages the VM with various operations including start, shutdown, restart, suspend and resume VM. The test case of VM life cycle management can be found in Appendix II.1.11.

7.12 Interoperability testing of physical machine life cycle management between the CSC and CSP

The test object of physical machine life cycle management is to verify that the CSC manages the physical machine with various operations including start, shutdown, hibernate and wake-up. The test case of physical machine life cycle management can be found in Appendix II.1.12.

7.13 Interoperability testing of VM configuration inquiring between the CSC and CSP

The test object of VM configuration inquiring is to verify that the CSC inquires VM configuration with the CPU number, memory allocated, NIC number and IP address allocated. The test case of VM configuration inquiring can be found in Appendix II.1.13.

7.14 Interoperability testing of physical machine configuration inquiring between the CSC and CSP

The test object of physical machine configuration inquiring is to verify that the CSC inquires physical machine configuration with the number of CPU cores, memory size, disk size and NIC number. The test case of physical machine configuration inquiring can be found in Appendix II.1.14.

8 Storage service interoperability testing between the CSC and CSP

Storage service interoperability testing between the CSC and CSP evaluates the interaction between the CSC and CSP for storage service and related management functions; these include storage migration, storage snapshot, storage backup, storage resource reservation, I/O performance, storage life cycle management and storage utilization status inquiring. For a description of related functional requirements refer to [ITU-T Y.3513].

8.1 Interoperability testing of storage migration between the CSC and CSP

The test object of storage migration is to verify that the CSC migrates data of the VM to different storage media without any loss. The test case of storage migration can be found in Appendix II.2.1.

8.2 Interoperability testing of storage snapshot between the CSC and CSP

The test object of storage snapshot is to verify that the CSC preserves and recovers the state and data of storage. The test case of storage snapshot can be found in Appendix II.2.2.

8.3 Interoperability testing of storage backup between the CSC and CSP

The test object of storage backup is to verify that the CSC backs up and restores data when faulty or data loss occurs. The test case of storage backup can be found in Appendix II.2.3.

8.4 Interoperability testing of storage resource reservation between the CSC and CSP

The test object of storage resource reservation is to verify that the CSC reserves available storage resources (e.g., storage space and LUN) for the VM. The test case of storage resource reservation can be found in Appendix II.2.4.

8.5 Interoperability testing of I/O performance between the CSC and CSP

The test object of I/O performance is to verify that the CSC constrains the I/O traffic of a particular VM with a specified level. The test case of I/O performance can be found in Appendix II.2.5.

8.6 Interoperability testing of storage life cycle management between the CSC and CSP

The test object of storage life cycle management is to verify that the CSC manages storage with various operations including create, attach, detach, query and delete storage. The test case of storage life cycle management can be found in Appendix II.2.6.

8.7 Interoperability testing of storage utilization status inquiring between the CSC and CSP

The test object of storage utilization status inquiring is to verify that the CSC inquires storage utilization status information including used space and unused space of storage. The test case of storage utilization status inquiring can be found in Appendix II.2.7.

9 Network service interoperability testing between the CSC and CSP

Network service interoperability testing between the CSC and CSP evaluates the interaction between the CSC and CSP for network service and related management functions, which include network policy migration, network QoS, network address translation, network isolation, IP address allocation, IP address reservation, load balance, firewall, multipath routing and network information inquiring. For a description of related functional requirements refer to [ITU-T Y.3513].

9.1 Interoperability testing of network policy migration between the CSC and CSP

The test object of network policy migration is to verify that the CSC migrates the VM while the network policy (generally includes access control list, bandwidth limitation and priority policy) is consistent before and after VM migration. The test case of network policy migration can be found in Appendix II.3.1.

9.2 Interoperability testing of network QoS between the CSC and CSP

The test object of network QoS is to verify that the CSC configures network QoS for the VM, including bandwidth limitation, bandwidth reservation, traffic shaping, traffic classification and congestion avoidance. The test case of network QoS can be found in Appendix II.3.2.

9.3 Interoperability testing of network address translation between the CSC and CSP

The test object of network address translation is to verify that the CSC configures the mapping between an internal IP address and external IP address of a specific VM. The test case of network address translation can be found in Appendix II.3.3.

9.4 Interoperability testing of network isolation between the CSC and CSP

The test object of network isolation is to verify that the CSC's tenant network is isolated even though the network address is overlapped with another tenants' network. The test case of network isolation can be found in Appendix II.3.4.

9.5 Interoperability testing of IP address allocation between the CSC and CSP

The test object of IP address allocation is to verify that the CSC allocates an IP address to the VM statically or dynamically. The test case of IP address allocation can be found in Appendix II.3.5.

9.6 Interoperability testing of IP address reservation between the CSC and CSP

The test object of IP address reservation is to verify that the CSC reserves an IP address or a range of IP addresses for specific VM(s). The test case of IP address reservation can be found in Appendix II.3.6.

9.7 Interoperability testing of load balance between the CSC and CSP

The test object of load balance is to verify that the CSC deploys a load balance mechanism for multiple VMs in order to achieve scalability and fault tolerance of an application. The test case of load balance can be found in Appendix II.3.7.

9.8 Interoperability testing of firewall between the CSC and CSP

The test object of firewall is to verify that the CSC monitors and controls incoming and outgoing VM traffic based on predetermined security rules. The test case of firewall can be found in Appendix II.3.8.

9.9 Interoperability testing of multipath routing between the CSC and CSP

The test object of multipath routing is to verify that the CSC accesses cloud services through multiple network paths. The test case of multipath routing can be found in Appendix II.3.9.

9.10 Interoperability testing of network information inquiring between the CSC and CSP

The test object of network information inquiring is to verify that the CSC inquires network information from the CSP with network device(s) specification, network traffic performance (in terms of throughput, jitter, loss, delay) and network topology. The test case of network address inquiring can be found in Appendix II.3.10.