

## Cloud Classic Security Patterns

### Cloud Reference Architecture \*

Concept / individual	Axioms	Description
<b>CloudConsumer</b> comp_CloudConsumer	<b>SubclassOf</b> CloudActor <b>suggestsInteraction</b> some Portal <b>interacts</b> value comp_Portal	
<b>CloudAdministrator</b> comp_CloudAdministrator	<b>SubclassOf</b> CloudActor <b>suggestsInteraction</b> Portal <b>interacts</b> value comp_Portal	
<b>Portal</b> comp_Portal	<b>SubclassOf</b> CloudComponent <b>suggestsInteraction</b> Cloud <b>interacts</b> value comp_Cloud <b>suggestsInteraction</b> some CloudConsumer <b>suggestsInteraction</b> some CloudAdministrator	"The way to access cloud services"
<b>Cloud</b> comp_Cloud	<b>SubclassOf</b> CloudComponent <b>suggestsPart</b> some CloudService <b>suggestsPart</b> some Cluster <b>suggestsPart</b> some SupportService  <b>hasPart</b> value comp_CloudService <b>hasPart</b> value comp_Cluster <b>hasPart</b> value comp_SupportService  <b>suggestsInteraction</b> some Portal	
<b>CloudService</b> comp_CloudService	<b>SubclassOf</b> CloudComponent	
<b>SaaSService</b> comp_SaaSService	<b>SubclassOf</b> CloudService <b>suggestsProduction</b> some SaaSApplication <b>produces</b> value comp_SaaSApplication	
<b>PaaSService</b>	<b>SubclassOf</b> CloudService	

<b>comp_PaaSService</b>	<b>suggestsProduction some VirtualEnvironment produces value comp_VirtualEnvironment</b>	
<b>IaaSService comp_IaaSService</b>	<b>SubclassOf CloudService suggestsProduction some VirtualMachine produces value comp_VirtualMachine  suggestsInteraction some VMImageRepository interacts value comp_VMImageRepository</b>	
<b>VMImageRepository comp_VMImageRepository</b>	<b>SubclassOf CloudComponent suggestsProduction some VMImage produces value comp_VMImage suggestsInteraction some IaaSService</b>	Image repository produces VMImages and interacts with IaaSService
<b>VMImage comp_VMImage</b>	<b>SubclassOf CloudComponent suggestsProduction some VirtualMachine produces value comp_VirtualMachine</b>	
<b>VirtualEnvironment comp_VirtualEnvironment</b>	<b>SubclassOf CloudComponent suggestsProduction some SaaSApplication produces value comp_SaaSApplication  suggestsPart some VirtualMachine hasPart value comp_VirtualMachine</b>	
<b>VirtualMachine comp_VirtualMachine</b>	<b>SubclassOf CloudComponent</b>	
<b>Cluster comp_Cluster</b>	<b>SubclassOf HardwareComponent suggestsPart some Node hasPart value comp_Node</b>	
<b>Zone comp_Zone</b>		
<b>Node comp_Node</b>	<b>SubclassOf HardwareComponent suggestsPart some VMM hasPart value comp_VMM</b>	also known as Hypervisor

	<b>suggestsPart some Hardware</b> <b>hasPart value comp_Hardware</b>	
<b>VMM</b> <b>comp_VMM</b>	<b>SubclassOf CloudComponent</b> <b>suggestsPart some VirtualMachine</b> <b>hasPart value comp_VirtualMachine</b>  <b>interacts value comp_Hardware</b> <b>suggestsInteraction some Hardware</b>  <b>suggestsFunction some VMMFunction</b>  <b>hasFunction value func_VMMigration</b>	
<b>Hardware</b> <b>comp_Hardware</b>	<b>SubclassOf HardwareComponent</b> <b>suggestsPart some Network</b> <b>hasPart value comp_Network</b>  <b>suggestsPart some Server</b> <b>hasPart value comp_Server</b>  <b>suggestsPart some Storage</b> <b>hasPart value comp_Storage</b>  <b>suggestsInteraction some VMM</b>	
<b>Server</b> <b>comp_Server</b>	<b>SubclassOf HardwareComponent</b>	
<b>Network</b> <b>comp_Network</b>	<b>SubclassOf HardwareComponent</b>	
<b>Storage</b> <b>comp_Storage</b>	<b>SubclassOf HardwareComponent</b>	
<b>SupportService</b> <b>comp_SupportService</b>	<b>SubclassOf CloudComponent</b>	

<b>BusinessService</b> <b>comp_BusinessService</b>	<b>SubclassOf SupportService</b>	
<b>OperationalService</b> <b>comp_OperationalService</b>	<b>SubclassOf SupportService</b>	
<b>NonFunctionalService</b> <b>comp_NonFunctionalService</b>	<b>SubclassOf SupportService</b>	
<b>SaaSApplication</b>	<b>SubclassOf CloudComponent</b>	

### Functional model

Concept / individual	Axioms	Description
<b>CloudFunction</b>	<b>SubclassOf SoftwareFunction</b>	
<b>VMMFunction</b>	<b>SubclassOf CloudFunction</b>	
<b>VMMigrationFunction</b> <b>func_VMMigration</b>	<b>SubclassOf VMMFunction</b>	

### Misuse patterns

Concept / individual	Axioms	Description
<b>pattern_MaliciousVirtualMachineMigrationProcess *</b>	<b>subclassOf MisusePattern</b> <b>hasAffectedFunction func_VMMigration</b> <b>hasAffectedComponent comp_VMM</b>  <b>hasThreat threat_Interception</b> <b>hasThreat threat_ManInTheMiddle (UC 1)</b> <b>hasThreat threat_ExcessiveAllocation (UC 2)</b>  <b>relatesTo</b> <b>pattern_SecureVirtualMachineImageRepository</b>	
<b>pattern_ResourceUsageMonitoringInferenceinCloudComputing **</b>	<b>subclassOf MisusePattern</b> <b>hasAffectedComponent comp_VMM</b>	

	<b>hasThreat threat_SharedDataManipulation</b> <b>hasThreat threat_Interception</b>	
<b>pattern_MaliciousVirtualMachineCreation **</b>	<b>subclassOf MisusePattern</b> <b>hasAffectedComponent comp_VMImageRepository</b> <b>hasAffectedComponent comp_VMM</b> <b>hasThreat threat_Malware</b>	*

## Security patterns

Concept / individual	Axioms	Description
<b>pattern_SecureVirtualMachineImageRepository *</b>	<b>subclassOf SecurityPattern</b> <b>hasAffectedComponent comp_VMImageRepository</b> <b>hasThreat threat_Malware</b> <b>hasSecurityConcern concern_AccessControl</b> <b>hasSecurityConcern concern_Accountability</b>	

\* Fernandez, E. B., Monge, R., & Hashizume, K. (2016). Building a security reference architecture for cloud systems. *Requirements Engineering*, 21(2), 225-249. <https://link.springer.com/article/10.1007/s00766-014-0218-7>

\*\* Hashizume, K. (2013). *A reference architecture for cloud computing and its security applications*. Florida Atlantic University.  
[https://fau.digital.flvc.org/islandora/object/fau/%3A4099/datastream/OBJ/view/reference\\_architecture\\_for\\_cloud\\_computing\\_and\\_its\\_security\\_applications.pdf](https://fau.digital.flvc.org/islandora/object/fau/%3A4099/datastream/OBJ/view/reference_architecture_for_cloud_computing_and_its_security_applications.pdf)

subclassOf  
hasAffectedFunction  
hasAffectedComponent  
hasThreat  
hasSecurityConcern  
relatesTo