



PMCA506L: Cloud Computing

Module 6 : Automation

Automation

- Automation focuses on making tasks easier and faster for humans to perform.
- Cloud automation mechanisms have been developed for three categories of users.

Individual customers

Large cloud customers

Cloud providers



Individual customers

- Individual subscribers often use SaaS apps, such as a document editing system that allows a set of users to share and edit documents cooperatively.
- To make such services convenient, providers typically offer access through a web browser or a dedicated app that the user downloads.
- The interfaces presented to individuals hide details, allowing a user to focus on using the services.
- The point is that when an individual uses a point-and-click interface to access a service, the interface must be backed by underlying automated systems that handle many chores on behalf of the individual. (Websites)



Large cloud customers

- Two types of automated tools are available for large cloud customers.
- One type, available from the provider or a third party, allows a customer to download and run the tools to deploy and manage apps.
- The other type consists of tools offered by a provider that allow large customers to configure, deploy, and manage apps and services without downloading software.



Cloud providers

- Cloud providers have devised some of the most sophisticated and advanced automation tools, and use them to manage cloud data centers.
- Tools to configure, monitor, and manage the underlying cloud infrastructure.
- A provider also creates tools that handle requests from cloud customers automatically.
- Tools are available that accommodate requests from both individual customers and large organizational customers.



Need For Automation In A Data Center

- After installing a raised floor, air conditioning facilities, and thousands of racks, equipment must be loaded into each rack.
- Each piece of equipment must be connected to both a power source and to the data center network.
- However, such installation is only the beginning.
- Each piece of equipment must be assigned a network address, and the switches must be configured to forward packets along a shortest path from any source to any destination, including destinations outside the data center.
- Each server must be configured to run appropriate software.
- After all the facilities have been installed and configured, operating a data center is much more complex than operating IT facilities for a single organization.
 - Extreme scale
 - Diverse services
 - Constant change
 - Human error



Need For Automation In A Data Center

- To understand data center operations, consider a simplistic example: deploying a VM.

Step	Action Taken
1.	Choose a server on which to run the VM
2.	Configure the hypervisor on the server to run the VM
3.	Assign an IP address to the VM
4.	Configure the network to forward packets for the VM, which may involve configuring the tenant's virtual network (e.g., VXLAN)
5.	Choose a remote disk server and allocate storage for the VM, according to the tenant's specification
6.	Configure the hypervisor to send requests from the VM to the storage server

What Can Be Automated?

- Creation and deployment of new virtual resources.
- Workload monitoring and accounting.
- Optimizations.
- Safety and recovery.
- Software update and upgrade.
- Administration of security policies

“lights-out” approach



Levels Of Automation

Level	Description
5	Automated remediation of problems
4	Automated identification of root causes
3	Automated analysis of trends and prediction
2	Automated monitoring and measurement
1	Automated preparation and configuration
0	No automation (manual operation)



Level 1: Automated preparation and configuration

- Level 1 refers to the automation of tasks that are performed before installation occurs.
- Industry sometimes uses the term *offline* to refer to such tasks because they can occur before computation begins.



Level 2: Automated monitoring and measurement

- Level 2 automation refers to monitoring a data center and making measurements available to human operators.
- The items that can be monitored include both physical and virtual resources.
- Monitoring often focuses on performance, and includes the load on each server, the traffic on each link in the network, and the performance of storage systems.
- Level 2 monitoring often includes mechanisms to alert a data center operator when an outage occurs or when the load on a given resource exceeds a specified level.



Level 3: Automated analysis of trends and prediction

- Analytic software used at level 3 makes it possible to monitor thousands of links without missing long-term trends.
- From a data center owner's point of view, the key advantage of level 3 analysis lies in the ability to predict needs, allowing the data center owner to plan ahead rather than waiting for a crisis to occur.



Level 4: Automated identification of root causes

- Level 4 automation uses data gathered from monitoring along with knowledge of both the data center infrastructure and layers of virtualization that have been added to deduce the cause of problems.
- As an example of level 4, consider a situation in which three events occur at the same time: communication between a container and its remote file storage (e.g., a file stored on NAS) suddenly stops working, a tenant's application can no longer access the tenant's database, and a newly created VM cannot access a SAN disk to boot an operating system



Level 5: Automated remediation of problems

- Level 5 automation extends the ideas of a level 4 system by adding automated problem solving.
- Remedial actions may be straightforward (e.g., restarting a VM that has crashed or rebooting a storage server) or complicated (e.g., running a program to reconfigure network forwarding for a particular destination or a set of destinations).



Alops (Artificial Intelligence operations)

- Industry uses the term *Alops* (Artificial Intelligence operations) to describe an automation system that uses AI and can operate a datacenter without human intervention.
- Higher levels of automation require sophisticated software systems. For example, Levels 3 and above may use *machine learning (ML)* software.



Automation Of Manual Data Center Practices

Step	Action
1	A tenant signs a contract for a new VM and a new work order (i.e., a “ticket”) is created
2	A human from the group that handles VMs configures a new VM and passes the ticket on
3	A human from the group that handles networking configures the network and passes the ticket on
4	A human from the group that handles storage configures a SAN server and passes the ticket on
5	The tenant is notified that the VM is ready

An example workflow for manual configuration of a VM.



Evolution Of Automation Tools

- Automation tools and technologies continue to evolve.
- Operating a data center is complex, providers have multiple, conflicting goals.
- Even with automation, it may be impossible to satisfy all goals simultaneously.
- Dozens of automation tools and technologies have been created that each handle one small task.
- For example, consider container deployment and networking.
- Kubernetes , Dockers

Automation Tools

- **Microsoft System Center:** This suite of management tools from Microsoft includes components like Virtual Machine Manager (VMM) and Operations Manager (SCOM) for managing virtualized data center environments.
- **NetBox:** NetBox is an open-source IP address management (IPAM) and data center infrastructure management (DCIM) tool. It helps in documenting and managing network infrastructure.
- **vRealize Automation:** VMware's vRealize Automation is a cloud automation platform that enables the automated delivery of infrastructure and applications.
- **Prometheus:** Prometheus is an open-source monitoring and alerting toolkit designed for reliability and scalability. It's commonly used to monitor containerized applications and microservices.
- **Grafana:** Grafana is an open-source analytics and monitoring platform that integrates with various data sources, including Prometheus. It provides a customizable and feature-rich dashboard for visualizing data.



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Automation Tools

- **Jenkins:** Jenkins is a popular open-source automation server used for building, testing, and deploying software. It supports continuous integration and continuous delivery (CI/CD) pipelines.
- **Puppet:** Puppet is a configuration management tool that helps automate the provisioning and management of infrastructure. It allows you to define infrastructure as code and enforce desired system states.
- **Terraform:** Terraform is an Infrastructure as Code (IaC) tool that enables you to define and provision infrastructure using a declarative configuration language. It supports multiple cloud providers and on-premises infrastructure.
- **SaltStack:** SaltStack, or Salt, is a configuration management and remote execution tool. It uses a client-server architecture and excels at handling complex infrastructures.



Summary

- Automation in Data Center
- Levels of Automation
- Automation of Manual Data Center
- Evolution of automation tools

