# Create and configure IBM Cloud Services



Unit 1. Introduction to cloud computing

and IBM Cloud

**This unit covers the following topics:**

i. _ Cloud computing overview

ii. _ IBM Cloud overview

**2 Essentials of Application Development on IBM Cloud**

1.1 What you should be able to do

After completion of this unit, you should be able to:

i. _ Define cloud computing

ii. _ Describe the factors that lead to the adoption of cloud computing

iii. _ Describe the choices that are available to developers when creating cloud applications

iv. _ Describe infrastructure as a service, platform as a service, and software as a service

v. _ Describe IBM Cloud

vi. _ Describe the architecture of IBM Cloud

vii._ Identify the runtimes and services that IBM Cloud offers

viii._ Describe how Cloud Foundry works with IBM Cloud

ix. Unit 1. Introduction to cloud computing and IBM Cloud 3

## 1.3 What is cloud computing?

Notes:

The term cloud is used as a metaphor for the internet and a virtualized set of hardwareresources. The term also is an abstraction for the complex infrastructure it conceals. The

generally accepted definition of cloud computing comes from the National Institute ofStandards and Technology (NIST). The NIST definition runs to several hundred words but essentially says that:

“Cloud Computing is a model for enabling convenient, on-demand network access to ashared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction.”

Examples of computing resources include:

i. _ Networks

ii. _ Servers

iii. _ Storage

iv. _ Applications

**v. _ Services**

# 1.4 Traditional on-premises computing model

**Notes:**

Cloud computing as a deployment model is replacing an older approach where each

application that a user interacts with had its own custom built services, networking, data

storage, and computing power.

The ability to reuse and repurpose hardware rapidly, and to host multiple applications and

systems within a single set of hardware in an isolated fashion, are some of the main

characteristics driving the adoption of cloud computing.

In the old approach, the IT staff needs to manage the entire stack, from hardware all the way

to the latest software changes. This model does not scale as well as today's businesses and

organizations require

## 1.5 Factors contributing to growth of cloud

**Notes:**

One factor contributing to the growth of cloud computing is that today's applications must bedelivered quickly. Developers are pressured to get their product to market as soon as

possible. They want to get feedback quickly, and then iterate on the idea to make the product better and faster. Cloud makes hardware resources readily available and quick to configure, which shortens the

time required for developers to show a working version of their products. Also, cloud allows the reuse of the same resources for multiple successive projects, which is more cost-efficient.

Another factor contributing to the growth of cloud computing is that developers expect to use many languages and interact with predefined services. Cloud computing provides

prepackaged language support, which enables the support of many more languages than the traditional do-it-yourself environment. Cloud

computing can also make available shared services that provide an externally managed way of delivering frequently-used functions. Another factor driving the adoption of cloud computing is that developers want to be able to add resources to a specific application (scaling up, or vertical scaling), or add duplicate

instances of an application (scaling out, or horizontal scaling) to handle increased customer load. Cloud platforms provide standardized methods to scale applications. Developers expect the pay-as-you-go utility computing billing method that cloud provides

# 1.6 Cloud and mobile computing ar changing traditional IT

**Cloud and mobile computing are changing traditional IT**

• Cloud computing is a disruptive change in the IT industry:

• New computing model, different from traditional IT computing models

• Enables ubiquitous computing

• Mobile device access

• Demand for dynamic and responsive IT infrastructure requires new

methodologies:

• Development processes

• Application design

• Development tools

• Virtualization and high-speed internet connectivity are the foundation

for cloud computing:

• Ability to represent a physical machine with software-defined machines

**Notes:**

Cloud and mobile computing are changing traditional IT. Cloud computing is a disruptive change in the IT industry that represents anew model for the IT infrastructure that is different from the traditional IT computing models. Cloud computing enables ubiquitous computing, where computing is made to appear anytime and everywhere, using any device, in any location, and in any format. The surge of mobile devices is greatly

contributing to this model. This new model demands a dynamic and responsive IT infrastructure due to short application lifecycles. To support this model, new development processes, application design, and development tools are required.

Virtualization and high-speed internet connectivity provided the foundation that enables cloud computing. Virtualization is key to cloud computing. It is the enabling technology that allows the creation of an intelligent abstraction layer that hides the complexity of underlying hardware or software. Virtualization provides the ability to represent physical hardware with software-defined and managed systems.

# 1.7 Cloud service models

**Cloud service models**

**IaaS**: Infrastructure as a service

• Virtual computer at the click of a button

• Configurable software-defined networks

• Variety of available storage types

**SaaS**: Software as a service

• Applications and services delivered over an internet-accessible

machine

**PaaS**: Platform as a service

• Runtime executable (for example, Java) and dependencies

provided automatically

• User focuses on application capabilities (code)

• Backend services (for exam

**Notes:**

In the infrastructure as a service (IaaS) cloud service model, a set of physical assets, such as servers, network devices, and storage disks, are offered as dedicated and privately accessible to consumers. The services in this model support application infrastructure.

Platform as a service (PaaS) is a cloud service model in which application framework and runtime is a self-service, shared, virtualized entity. The goal of PaaS is to enable the developer or team to focus on the application business functions, code, and data, rather than worrying about infrastructure. Most everyday web users are familiar with software as a service (SaaS), although they might

not know it. Applications in the SaaS model are provided on-demand to users through the internet, as opposed to desktop applications. Examples of SaaS applications include Salesforce.com, Google Apps, and Facebook

# 1.8 Infrastructure as a service architecture

**Infrastructure as a service (IaaS) architecture**

• An infrastructure provider (IP) makes either a physical or virtual (through a

hypervisor) computing infrastructure available “as a service.”

• Manages a pool of shared (sometimes isolated) computing resources.

• Uses virtualization to assign and dynamically resize customer resources

according to their requirements.

• Customers use internet-accessible endpoints to rent computing power,

memory, data storage, and networking resources.

**Notes:**

Infrastructure as a service (IaaS) is a way of delivering cloud computing infrastructure (including servers, storage, network, and operating systems) on-demand and by using self-service tools. Rather than purchasing servers, software, data center space, or network equipment, organizations instead buy or reserve these resources through an application or

API that automatically provisions or reserves the resources and makes them available. IaaS offerings are built on top of a standardized, secure, and scalable infrastructure. Virtualizing the hardware is performed by a program known as hypervisor. A hypervisor manages virtual machines or virtual servers, which are multiple operating system instances

that are running on a specific physical machine. Each operating system appears to have the host's processor, memory, and other resources all to itself, but in reality the hypervisor is controlling and provisioning access. Finally, self-service is an important attribute of IaaS. Users do not have to contact support to perform common tasks, such as creating their own server and setting up basic networking.

# 1.9 Platform as a service (PaaS) architecture

**Platform as a service (PaaS) architecture**

• Service provider (SP) supplies the runtime executables and

frameworks to which new applications are automatically deployed.

• Service user is responsible for creating, updating, and maintaining

the application.

• PaaS provider can provide external services, URL management,

ability to scale, and built-in application monitoring.

**Notes:**

PaaS can be defined as a computing platform that allows the creation of cloud-based applications quickly and easily, and without the complexity of configuring the required hardware and software resources. PaaS typically entails the developer uploading the

application code, or pointing to it and letting the PaaS complete the following tasks:

1. Obtain the runtime binaries and dependencies for the application.

2. Structure their application bits into the proper directory tree for containerization.

3. Provision a container (or set of containers) on which the application can run.

4. Automatically generate simple and basic networking configuration for access to the

application.

5. Provide automatic and built-in monitoring of the application.

6. Allow you to update and redeploy the application with zero downtime.

PaaS typically involves sacrificing some level of fine-grained control over the application's environment to gain convenience, ease of use, and rapid deployment by using a predefined

deployment process. PaaS also makes use of external services or APIs that allow rapid composition of applications by reusing pieces of infrastructure (for example, a database) that PaaS also gives the developer some automatic method for scaling. For example, consider

situation where the developer wants more hardware resources dedicated to an application (scaling up or vertical scaling) or more instances of the application to handle the load application monitoring. For example, the

platform sends notifications to inform developers when their application crashes.

## 1.10 Software as a service (SaaS) architecture

**Software as a service (SaaS) architecture**

• Service provider (SP) is responsible for creating, updating, and

maintaining the runtime software and applications.

• Service user accesses the service through Internet-based interfaces.

**Notes:**

SaaS is a delivery model that provides access to capabilities through web-based services.

SaaS enables organizations to access business functionality, typically at a lower cost than

paying for licensed applications. SaaS pricing is often based on a monthly fee. Because

software is hosted remotely, organizations do not need to invest in new hardware to run the

application. Saas removes the need for organizations to handle installation, setup, and

maintenance.

Sometimes SaaS applications are free and providers generate revenue; for example, from

web ads. Alternatively, SaaS application providers generate revenue directly from the use of

the service. These scenarios might sound familiar because this cloud service model is

ubiquitous. If you use a tax preparation service to file your income taxes

online, or use an

email service to check your mail, you are familiar with this cloud service model. These types

of applications are just two examples. Thousands of SaaS applications are available, and the

number grows daily, primarily because of Web 2.0 technologies.

Under the SaaS model, the software provider is responsible for creating, updating, and

maintaining software, including the responsibility for licensing the software. Customers

usually rent the software on a per-usage basis, or buy a subscription to access it that includes

a separate license for each person who uses the software.

In this model, the service user needs only to access the service and not the platform or the

infrastructure on which the service is running. The service is usually accessed as a web

application, or invoked by using REST or other web-based APIs.

## 1.11 Provider and client responsibilities

**Notes:**

Figure 1-9 shows the split between the provider and client responsibilities when dealing with

on-premises or “as a service” scenarios.

Typically, the cost decreases as you move to the right in the scenarios that are shown in

Figure 1-9; however, the flexibility also is reduced.

Organizations or departments within an organization make their own cost-based decision

about which delivery model to use for individual applications or projects.

Most enterprises end up using some combination of all of the models that are shown in

Figure 1-9Figure 1-9 shows the split between the provider and client responsibilities when dealing with

on-premises or “as a service” scenarios.

Typically, the cost decreases as you move to the right in the scenarios that are shown in

Figure 1-9; however, the flexibility also is reduced.

Organizations or departments within an organization make their own cost-based decision

about which delivery model to use for individual applications or projects.

Most enterprises end up using some combination of all of the models that are shown in

Figure 1-9

# 1.12 Cloud computing: Benefits for developers

Cloud computing: Benefits for developers

• Readily available sandbox and production environments:

• Free trials offered with most products

• Pre-built templates help developers get started fast

• Easier to understand the application lifecycle

• Environment set up in minutes instead of days

• Choices:

• Programming languages and frameworks

• Services

• APIs

• Integrated development and debugging:

• The new model is to integrate development and operations teams

into DevOps

• Build engine for compilation and testing

**Notes:**

- Cloud computing brings the following benefits to developers:
- _ Provides readily available sandbox and production environments. These environments
- offer the following capabilities that are attractive for developers:
- – Free trials that are offered with most products
- – Pre-built templates and examples that help developers to get started fast
- – Easier to understand the application lifecycle
- – The environment to run an application is set up in minutes instead of days
- _ Brings a wide range of choices to developers in the following areas:
- – Programming languages and frameworks
- – Services

- – APIs
- _ Facilitates integrated development, test, and debugging:
- – New model is to integrate development and operations teams into DevO

# 1.14 What is IBM Cloud?

• An open, standards-based cloud

computing platform

• Combines platform as a service

(PaaS) with infrastructure as a service

(IaaS)

• Includes a catalog of diverse platform

and infrastructure services

• Used to rapidly build, deploy, and run

business applications, infrastructure,

or both

**Notes:**

IBM Cloud is an open cloud computing platform that combines platform as a service (PaaS)

with infrastructure as a service (IaaS), and includes a catalog of diverse cloud services, which

can be used to rapidly build and deploy business applications or infrastructure.

As a PaaS, it provides developers access to IBM software for integration, security,

transactions, and other key functions, and software from IBM Business Partners.

The application types can range from web, mobile, big data, and smart devices to the Internet

of Things.

As an IaaS, it allows developers fine-grained control over the infrastructure on which their

apps are deployed. Developers can deploy high-performance, bare-metal servers, virtual

servers, containers, and cloud storage, in IBM Cloud data center locations around the world

# 1.15 IaaS from IBM Cloud

**IaaS from IBM Cloud**

• Allows you to deploy high-performance infrastructure in IBM Cloud Data

Center locations around the world:

• Bare metal servers, virtual servers, containers, storage, and networking

• Provides services to deploy, access and manage the infrastructure

**Notes**:

IBM Cloud enables you to deploy high-performance compute and storage infrastructure in

nearly 60 IBM Cloud data centers around the world that are automated and standardized to

provide a seamless global platform for cloud resources.

In addition to virtual servers, IBM Cloud offers bare metal servers,

which provide the raw

horsepower that many organizations require for processor-intensive and disk I/O-intensive

workloads. Many organizations favor IBM Cloud because of the easy access it provides to

bare metal servers.

IBM Cloud also allows you to deploy containers, storage, and networking resources across

the world-wide data centers.

A catalog of services enables you to deploy, access, and manage the deployed infrastructure.

# 1.16 PaaS from IBM Cloud, Part 1

**PaaS from IBM Cloud**

- Enables you to build, manage, andrun applications
- Uses Cloud Foundry, an opensource PaaS:

Extends Cloud Foundry with services

from IBM and IBM partners

IV

Provides a scriptable command-line

interface (CLI)

IV

Integrates with development tools, such

as Eclipse, to ease the deployment

process

- Runs on IBM Cloud data center

locations around the world

**Notes:**

As a PaaS provider, IBM Cloud allows you to build, manage, and run applications, such as

web, mobile, big data, smart devices, and Internet of Things.

IBM Cloud uses Cloud Foundry, which is an open platform as a service offering that provides

a choice of clouds, frameworks, and application services.

Cloud Foundry provides the monitoring, deployment, and logging tools for hosting apps.

IBM Cloud also adds the following enhancements to Cloud Foundry:

_ Extends Cloud Foundry with services from IBM and IBM partners.

_ Provides a scriptable command-line interface (CLI)

_ Provides integration with development tools to ease the deployment process. DevOps

services provide an online code editor, a build pipeline, and a version control system.

IBM Cloud runs on IBM Cloud data centers locations around the world.

# 1.17 PaaS from IBM Cloud, Part 2

PaaS from IBM Cloud

• The following resources are provided on the Cloud:

• Runtimes on which to run applications

• Services that can be used to build applications

• Ability to integrate with data and traditional workloads in on-premises systems

• DevOps capabilities and tools

Infrastructure

services

SDK for

Node.js

Runtime for

Swift Go

Liberty for

Java

Runtimes + more...Ruby

Applications Web Mobile Big Data Smart devices Int

# Notes:

IBM Cloud enables application developers to focus on application capabilities by providing the

following resources on the cloud:

_ Runtimes on which to run applications

_ A catalog of selectable services, such as databases, mobile support, analytics, artificial

intelligence, and security, which are used to build applications

_ Ability to integrate with data from the organization and traditional workloads that are

running in on-premises systems

_ DevOps capabilities and tools, including code-editors, version control, deployment

pipelines, and hosting, monitoring, and scaling apps

Integration services allow applications to access traditional workloads that are running in the

organization’s on-premises environment.

**Note:** The available runtimes in IBM Cloud can change.



PaaS from IBM Cloud

• The following resources are provided on the Cloud:

• Runtimes on which to run applications

• Services that can be used to build applications

• Ability to integrate with data and traditional workloads in on-premises systems

• DevOps capabilities and tools

Infrastructure

services

SDK for

Node.js

Runtime for

Swift Go

Liberty for

Java

Runtimes + more...Ruby

Applications Web Mobile Big Data Smart devices Internet of Things + more...

Watson Integration

Data &

Analytics

Platform

Services DevOps + more...Mobile IoT Security

Traditional

workloads

Traditional

workloads

Customer

data

Customer

data

# 1.18 IBM Cloud: Choice of runtimes

**IBM Cloud: Choice of runtimes**

• IBM Cloud enables you to run your app by using a particular runtime,

without the need to manage the underlying infrastructure.

• A runtime is a set of resources that is used to run an application:

• You can choose the runtime on which to run your application (for example,

Node.js or Swift)

• For each runtime, an IBM or community buildpack provides the scripts to

prepare your code to run on IBM Cloud

Notes:

With IBM Cloud, developers are given a choice of runtimes on which to run their applications.

A runtime is a set of resources that is used to run an application. Each runtime features an

associated buildpack, which is a collection of scripts that prepare your code to run on IBM

Cloud.

Runtimes are provided by IBM or through Community Buildpacks. Consider the following

points:

_ The IBM runtimes include Liberty for Java, SDK for Node.js, and Runtime for Swift.

_ IBM Cloud and Cloud Foundry support more runtimes through the Community Buildpacks.

This open-source community features written buildpacks for other runtimes, such as Go,

PHP, Python, Ruby, and Tomcat. For more information, see Using community buildpacks,

which is available at the following website:

https://console.bluemix.net/docs/cfapps/byob.html

The following runtimes are available for Java:

_ Tomcat: An open source Java web application server.

_ Liberty for Java: IBM WebSphere Liberty is a Java EE application server which can deploy

any Tomcat application. It also offers support for more Java web features; for example,

Message Beans and JMX



1.18 IBM Cloud: Choice of runtimes

Figure 1-16

Notes:

With IBM Cloud, developers are given a choice of runtimes on which to run their applications.

A runtime is a set of resources that is used to run an application. Each runtime features an

associated buildpack, which is a collection of scripts that prepare your code to run on IBM

Cloud.

Runtimes are provided by IBM or through Community Buildpacks. Consider the following

points:

_ The IBM runtimes include Liberty for Java, SDK for Node.js, and Runtime for Swift.

_ IBM Cloud and Cloud Foundry support more runtimes through the Community Buildpacks.

This open-source community features written buildpacks for other runtimes, such as Go,

PHP, Python, Ruby, and Tomcat. For more information, see Using community buildpacks,

which is available at the following website:

https://console.bluemix.net/docs/cfapps/byob.html

The following runtimes are available for Java:

_ Tomcat: An open source Java web application server.

_ Liberty for Java: IBM WebSphere Liberty is a Java EE application server which can deploy

any Tomcat application. It also offers support for more Java web features; for example,

Message Beans and JMX.

**Note:** The available runtimes in IBM Cloud can change.

# 1.19 IBM Cloud: Services

**BM Cloud: Services**

Pre-built services provide building blocks for feature-rich applications

**Notes**:

IBM Cloud provides a broad range of pre-built services (from IBM and third-party providers)

that can be used when assembling your application.

Watson services enable you to add the power of artificial intelligence to your application with

speech, vision, and natural language processing APIs.

Data & Analytics services help you to get data from integrated cloud databases, build

data-driven applications, and analyze your data.

In addition, services in the following categories help you to develop key features within your

application:

_ Integration services:

– APIs: Create, manage, enforce, and run APIs

– Integrate: Access traditional workloads running in the organization's on-premises

environment

_ Mobile: Use mobile backend infrastructure to build, monitor, and test mobile apps.

_ Internet of Things: Communicate with connected devices, sensors, and gateways.

_ Functions: Execute in response to incoming events (based on Apache OpenWhisk).

_ Application Services: Many application services, such as Blockchain. Message Hub,

WebSphere Application Server, Business Rules, and other application services on the

cloud

DevOps: Tools to help innovate new applications faster and cheaper.

_ Security: Build security into your application design.

Infrastructure services help you to manage the underlying infrastructure your application runs

on.

**Note:** The services available in IBM Cloud can change.

# 1.20 IBM Cloud: Regions and locations

**IBM Cloud: Regions and locations**

• IBM Cloud is hosted worldwide

• A region is a geographic area where your application is hosted.

• Locations are data centers in a region, where the hardware is deployed.

• Select a region to deploy your application:

• The region nearest to users can provide better performance

• A specific region can meet data security requirements

• Multiple regions provide high availability

**Notes:**

A region is a defined geographical territory to which you can deploy your applications.

Locations are data centers within the region in which hardware is deployed. Locations are not

specified during application deployment.

You can choose to deploy your application to a single region or multiple regions. Consider the

following points:

_ For low application latency, select the region that is nearest to your users.

_ To meet certain countries' data security requirements, select the region where you are

required to store the application data.

_ For high availability, select multiple regions. If your application fails in one region, it is still

available on another region

**Note:** Use similar criteria when choosing a location to deploy infrastructure.

Within the IBM Cloud console, the region is automatically set to the closest healthy region. To

switch to another region, click the user account link, expand the Region menu and select the

region. If you use a Lite Account (For more information about IBM Cloud account types, see

Unit 2), you can use only one region for your applications and services

IBM Cloud offers a command line tool that is called IBM Cloud Command Line Interface (CLI).

When this tool is used, use the second column that is shown in Figure 1-18 on page 21 “Point

your CLI here” to specify the target region.

**Note:** Not all IBM Cloud services are available in all regions.