Fundamentals of Cloud Computing

(Course code WS009 / VS009)

Student Notebook

ERC 1.0

WebSphere Education

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Contents

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Course description

Fundamentals of Cloud Computing

Duration: 1 day

Purpose

This one-day, instructor-led course is designed to teach students the basic concepts and terminology of cloud computing.

After establishing the definition of cloud computing, this course describes the various service delivery models of a cloud computing architecture, and the ways in which clouds can be deployed as public, private, hybrid, and community clouds. Students also learn about the security challenges that cloud deployments experience, and how these are addressed. The course also describes IBM cloud computing architecture and offerings, the IBM WebSphere CloudBurst appliance, and the IBM WebSphere Hypervisor edition software product.

A number of self-running and hands-on demonstrations in simulation mode enable students to experience how to sign onto and use cloud-based instances. The hands-on demonstrations include applying for a contract to use the IBM Smart Business Development and Test Cloud. Students sign onto the IBM Smart Business Development and Test Cloud, create an instance of the cloud, and connect to it. Other self-running demonstrations focus on getting started with cloud computing using the IBM WebSphere CloudBurst appliance. In the final exercise, students complete a crossword puzzle on what they have learned.

Audience

This introductory course is designed for software architects and developers of cloud systems, as well as application and enterprise software engineers. It is also appropriate for business professionals who would like to gain a comprehensive understanding of cloud computing.

Prerequisites

Before taking this course, students should be familiar with enterprise application architecture, distributed computing paradigms, and browser-based access.

Objectives

After completing this course, you should be able to:

- Define cloud computing
- Identify the key characteristics of cloud computing
- List the benefits of using clouds
- Describe some of the challenges to adopting a cloud architecture
- Describe key cloud computing concepts and terminology
- Describe the service delivery models in cloud computing:
  - Identify the software as a service (SaaS) delivery model
  - Identify the platform as a service (PaaS) delivery model
  - Identify the infrastructure as a service (IaaS) delivery model
- List the various cloud deployment scenarios:
  - Describe the features of private, public, hybrid, and community clouds
  - List some additional cloud deployment types
  - Select the most appropriate deployment model based on a set of business and technical requirements
- Review the integration of security into the cloud reference model
- Describe security considerations in cloud computing
- Identify security options available in cloud computing
- Identify the top security threats to cloud computing
- Describe the architecture of IBM cloud computing and IBM cloud computing offerings:
  - Position the various vendors in the service delivery model of cloud computing
  - Illustrate an IBM example cloud architectural configuration
  - Describe some of the IBM cloud offerings
- Describe the capabilities of WebSphere CloudBurst and WebSphere Hypervisor Edition

Curriculum relationship

- N/A

Agenda

Day 1

Course introduction
Unit 1. Overview of cloud computing
Unit 2. Cloud computing concepts
Unit 3. Cloud service delivery models
Unit 4. Cloud deployment scenarios
Demonstration 1. Requesting contract forms for the IBM Smart Business Development and Test Cloud
Demonstration 2. Reviewing a contract for the IBM Smart Business Development and Test Cloud
Unit 5. Security in cloud computing
Unit 6. IBM cloud computing architecture and offerings
Demonstration 3. Instance creation on the IBM Smart Business Development and Test Cloud
Demonstration 4. Connecting to an instance on the IBM Smart Business Development and Test Cloud
Demonstration 5. Getting a fixed IP address, storage, and keys on the IBM Smart Business Development and Test Cloud
Unit 7. IBM WebSphere CloudBurst and IBM WebSphere Hypervisor edition
Demonstration 6. Showing WebSphere CloudBurst
Unit 8. Course summary
Final exercise: Cloud computing crossword

Unit 1. Overview of cloud computing

What this unit is about

This unit provides you with an introduction to cloud computing.

What you should be able to do

After completing this unit, you should be able to:

- Define cloud computing
- Describe the key characteristics of cloud computing
- Describe the benefits of using clouds
- Describe some driving factors towards using cloud computing
- Describe some of the concerns related to cloud computing
- Compare grid computing with cloud computing
- Provide authentic examples of cloud computing

How you will check your progress

- Checkpoint

References

http://csrc.nist.gov/groups/SNS/cloud-computing/

Unit objectives

After completing this unit, you should be able to:

- Define cloud computing
- Describe the key characteristics of cloud computing
- Describe the benefits of using clouds
- Describe some driving factors towards using cloud computing
- Describe some of the concerns related to cloud computing
- Compare grid computing with cloud computing
- Provide authentic examples of cloud computing

Figure 1-1. Unit objectives WS009 / VS0091.0

Notes:

What is a cloud?

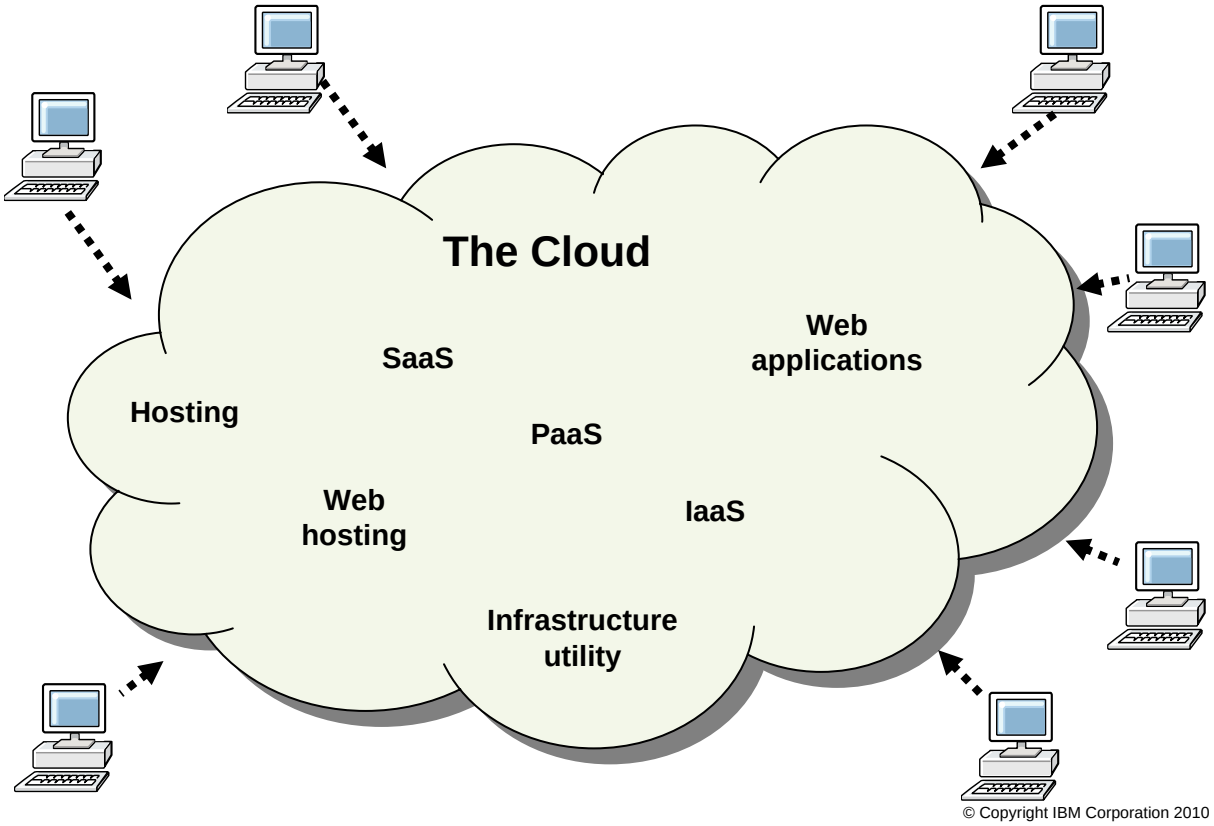

Figure 1-2. What is a cloud? WS009 / VS0091.0

Notes:

The term *cloud* is used as a metaphor for the Internet, based on how the Internet is depicted in computer network diagrams and is an abstraction for the complex infrastructure it conceals.

- Hosting refers to fixed, dedicated resources.
- Web hosting refers to hosted and dedicated web applications and web content.
- SaaS are shared applications accessed as a service (more on this in a later unit).
- PaaS refers to platform provided as a service (more on this in a later unit)
- IaaS is infrastructure provided as a service (as well....more on this in a later unit)
- Infrastructure utility is industrialized computing resources (or those resources that have been commoditized).
- Web applications are provider dedicated web applications and web content.

Definition of cloud

- cloud (noun)
  - A network that delivers requested virtual resources as a service

Figure 1-3. Definition of cloud WS009 / VS0091.0

Notes:

This slide simply gives the definition of cloud as it relates to cloud computing:

cloud (noun): a network that delivers requested virtual resources as a service.

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Definition of cloud computing

- Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction
  - From the National Institute of Standards and Technology definition of cloud computing V15 at **`http://csrc.nist.gov/groups/SNS/cloud-computing/`**

Figure 1-4. Definition of cloud computing WS009 / VS0091.0

Notes:

The definition of cloud computing is taken from the National Institute of Standards and Technology definition of cloud computing V15, dated 10-7-2009.

Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (for example, networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.

Irving Wladawsky-Berger, consultant and emeritus Vice President IBM technology, provides this definition:

“I view cloud computing as a broad array of web-based services aimed at allowing users to obtain a wide range of functional capabilities on a ‘pay-as-you-go’ basis that previously required tremendous hardware and software investments and professional skills to acquire. Cloud computing is the realization of the earlier ideals of utility computing without the technical complexities or complicated deployment worries.”

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Key characteristics of cloud computing (1 of 2)

- On-demand self-service
  - Focuses on delivering IT services driven by user requests
  - No human interaction with the cloud provider
  - Cloud computing provides a means of delivering computing services that makes the underlying technology, beyond the user device, almost invisible
- Ubiquitous network access
  - Focuses on delivering IT services anytime, anywhere, and through user-chosen devices
  - Users accessing services via Internet technologies expect a secure, “always-on” computing infrastructure that delivers as easily and reliably as electricity from a wall outlet

Figure 1-5. Key characteristics of cloud computing (1 of 2) WS009 / VS0091.0

Notes:

On-demand self-service focuses on delivering IT services driven by user requests.

Users accessing services via Internet technologies expect a secure, “always-on” computing infrastructure that delivers as easily and reliably as electricity from a wall outlet, requiring a fundamental change in how services are delivered.

Key characteristics of cloud computing (2 of 2)

- Pool of virtualized resources
  - Focuses on delivering IT services through resource pools that can expand and contract based on the requirements of the underlying workload and the usage characteristics
- Utility-based pricing
  - Focuses on delivering IT services that can be metered for usage and charged for (if needed) through pricing models including subscription, usage pricing
  - Service level agreements (SLAs)

Figure 1-6. Key characteristics of cloud computing (2 of 2) WS009 / VS0091.0

Notes:

Another key characteristic is elasticity of resources. IT services are delivered through resource pools that can expand and contract based on the requirements of the underlying workload and the usage characteristics.

Flexible pricing models allow for subscription and usage-based pricing. Using the cloud, you can rent the hardware and software you need rather than purchasing them outright.

The quality of service when using clouds is negotiated and measured against service level agreements, or SLAs.

Why use clouds?

- Better capital utilization
  - Pay-as-you-go
  - The unit cost of on-demand capacity may be higher than the unit cost per time unit of fixed capacity; offset by no charge when capacity is not being used
- Accelerate software development, deployment, and testing
  - Fast provisioning of resources
- Elasticity of resources
  - Scalable and flexible use of resources
- Access to complex infrastructure and resources without internal resources
- Support for geographically distributed users
- New business opportunities

Figure 1-7. Why use clouds? WS009 / VS0091.0

Notes:

Here you see some of the reasons why you may consider migrating to a cloud computing model.

- **Better capital utilization**:

  In the traditional model you provision for peak loads, or the maximum utilization. With cloud computing you are charged on a usage basis.

  Note: The unit cost of on-demand capacity may be higher than the unit cost per time unit of fixed capacity. This is offset by not having to pay for the resource when not in use.

  If:

  - Unit cost per time unit of fixed capacity = C
  - Utility premium (multiplier for utility) = U

  Then:

  - Unit cost of on-demand capacity = U * C

- **Accelerate software development, deployment, and testing**:
  Faster provisioning of resources is a key benefit in using clouds. Instead of taking weeks to set up the environment, it can be provisioned in minutes.
- **Elasticity of resources**:
  With cloud computing you have access to a pool of virtualized resources that can expand and contract on demand.
- **Access to complex infrastructure and resources without internal resources**:
  Provisioning of infrastructure and application services can be outsourced to cloud providers.
- **Support for geographically distributed users**:
  Access to resources in the cloud are based on standard Internet transports and protocols.
- **New business opportunities**:
  There are new business opportunities for providers to host cloud services and vendor applications.

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How clouds are changing industry

An enabler of business transformation
Creating new business models
Enabling innovation
Reengineering of business processes
Support for new levels of collaboration

Figure 1-8. How clouds are changing industry WS009 / VS0091.0

Notes:

Clouds are enablers for business transformation by changing industries in the following ways:

- **Creating new business models**:
  The use of clouds changes how resources are procured, sourced, and delivered. Hardware and software can be rented on a pay-per-use basis.
- **Enabling innovation**:
  Cloud computing uses the power of the Internet and grid computing to move towards a virtual enterprise that is not limited by hardware constraints.
- **Reengineering of business processes**:
  Applications need to be built to be machine independent, container-managed, with small memory footprints.
- **Support for new levels of collaboration**:
  Collaboration using the cloud is not restricted to a single geographical location.

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How clouds are changing IT

An evolution of information technology
Changing the economics of IT
Automating service delivery
Exploiting standardization
Rapidly deploying new capabilities

Figure 1-9. How clouds are changing IT WS009 / VS0091.0

Notes:

Clouds are enablers for IT transformation by changing IT in the following ways:

- **Changing the economics of IT**:
  Cloud computing is driving operational efficiencies in IT through better use of resources.
- **Automating service delivery**:
  The term *self service* means that developers and testers can directly procure the resources they need to complete their tasks without going through lengthy procurement chains. This results in a significantly shortened procurement period, and it means that developers and testers can quickly get to the task at hand.
- **Exploiting standardization**:
  Access to clouds is through standard Internet transports and protocols, providing access to a range of user devices.
- **Rapidly deploying new capabilities**:
  Test and operation teams may have different conventions and configurations from development teams, and this can lead to unintended application behavior and delays in

service delivery. Cloud computing offers a potential solution to this problem by offering *prebuilt solution stacks*. These solution stacks are ready to deploy configurations, which include the application and entire environment, including the operating system. The stack can be captured as an image (for example, OVF image or Amazon Machine Image). The image can be transferred between each team along the delivery cycle. Administrators can see the exact environment in which the application was designed and unit tested, and they can balance needed changes to that environment against a known, working solution.

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Driving factors towards cloud computing (1 of 2)

- Poorly utilized resources driving up hardware and labor costs
  - Setting up a new environment is expensive; there is an incentive to hold on to them “just in case”
  - Each new project requisitions new hardware instead of recycling unused hardware; this takes time and money
- Takes too long to create middleware infrastructures
  - Average lead time to get a new application environment is 4–6 weeks
  - Approvals, procurement, shipment, hardware installation, license procurement, OS installation, configuration, application installation
- Creating middleware infrastructures is a manual process and error prone
  - Minor differences in configurations can introduce errors or bugs that are difficult to detect
  - Often only emerge when moving from test to production

Figure 1-10. Driving factors towards cloud computing (1 of 2) WS009 / VS0091.0

Notes:

These are some of the factors driving the adoption of cloud computing:

- **Poorly utilized resources driving up hardware and labor costs**

  Setting up a new environment is expensive; there is an incentive to hold on to them “just in case.”

  Each new project requisitions new hardware instead of recycling unused hardware; this takes time and money.

- **Takes too long to create middleware infrastructures**

  The average lead time to get a new application environment is 4–6 weeks.

  Approvals, procurement, shipment, hardware installation, license procurement, OS installation, configuration, and application installation need to be considered.

- **Creating middleware infrastructures is a manual process and error-prone**

  Minor differences in configurations can introduce errors or bugs that are difficult to detect. These often only emerge when moving from test to production.

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Driving factors towards cloud computing (2 of 2)

- Each application must be sized to support peak load
  - Idle resources during non-peak times
- Inability to use idle resources to handle extra load
  - Quality of service may suffer during periods of exceptional load

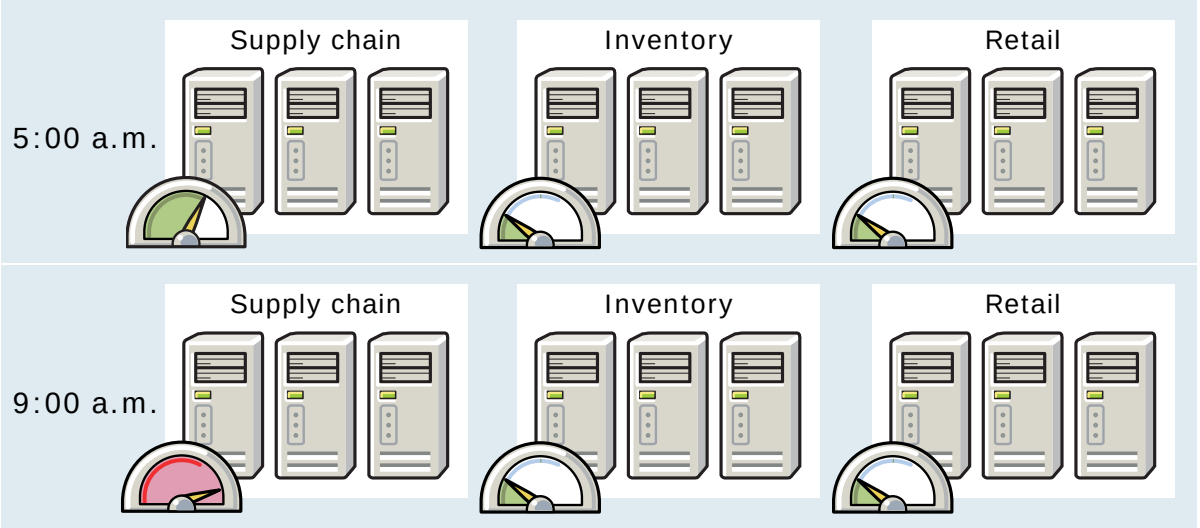

Figure 1-11. Driving factors towards cloud computing (2 of 2) WS009 / VS0091.0

Notes:

In this example, the supply chain, inventory, and retail applications have been sized to support their respective peak loads. This leads to under-utilized hardware and software during off-peak periods.

In addition, during peak periods, quality of service may be degraded during periods of exceptional load.

It would be better to have a pool of shared resources that can be managed as a single logical entity that can be provisioned and deprovisioned on demand.

Concerns related to cloud computing

- Maturity
  - Is the technology ready for production-level deployment?
- Standards
  - Still being developed
- Security concerns
  - Multiple customers sharing the same resources
- Interoperability
  - Many different vendor APIs
- Control of data
  - Organizational level of comfort with data being outside traditional IT

Figure 1-12. Concerns related to cloud computing WS009 / VS0091.0

Notes:

The question arises: Is cloud ready for prime-time? Beyond the hype, many vendors are investing and competing in this space. Competition among vendors drives innovation in cloud computing.

Open Cloud Manifesto (**`http://www.opencloudmanifesto.org`**) is a statement of the principles for maintaining the openness of cloud computing. It has over 250 organizations signed on as supporters.

The security concerns of customers sharing the same resources can be mitigated through techniques such as encryption. Only making public-domain data available in public clouds is another way of tackling this issue.

Interoperability is the ability to write code that is supported across a number of cloud providers, as well as the ability to move to a different cloud provider.

In the majority of cases, organizations want to be in control of their own data. This requirement is addressed through the use of private clouds, which are covered in a later unit.

Other technologies that can be used in cloud computing

- Grid technology
- Service-oriented architectures
- Web 2.0
- Open source software
- Autonomic systems

Figure 1-13. Other technologies that can be used in cloud computing WS009 / VS0091.0

Notes:

A number of complementary technologies may be used in delivering cloud-based solutions, but are not required in every situation. These include:

- **Grid technology**
  There are several situations where grid technology and cloud can be used together. Grids provide automatically scalable resources that are made available over a network, and from this perspective, there is a convergence with clouds.
- **Service-oriented architectures**
  SOA is an architecture, not a software product. Cloud computing does not prerequisite a service-oriented architecture, and you can make use of cloud technology without first adopting an SOA. However, there are some service models of clouds that can make use of web services that have been defined in SOA. Notably, this is the software as a service model (SaaS) of cloud computing. The various cloud service models are covered in a later unit.
- **Web 2.0**
  Web 2.0 is based on a collection of architectural styles and technologies. Web 2.0

introduced a more collaborative approach to the use of web resources. It describes an architectural style in which service consumers and service providers interact in a RESTful way. REST is the abbreviation for Representational State Transfer.

- **Open source software**
  Open source software is often used in cloud computing to reduce the rental cost of cloud resources.
- **Autonomic systems**
  Autonomic systems are complex computer environments that manage themselves.

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Comparing grid with cloud computing

Feature	Grid	Cloud
Architecture	Service-oriented	User-specified
Platform awareness	Client software must be grid-enabled	Works in a customized environment provided by the service provider
Scalability	Nodes	Nodes and infrastructure
Standardization	Interoperability and standards	Lack of standards for interoperability

Figure 1-14. Comparing grid with cloud computing WS009 / VS0091.0

Notes:

The slide provides some of the capability comparisons between grid and cloud computing.

Grid computing involves applying the resources of many computers in a network, working in concert or parallel, to solve a single problem at the same time. Cloud computing provides resources for many independent tasks.

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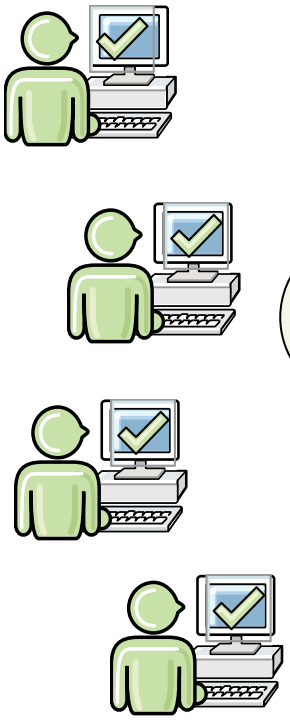
Public clouds (commercial)



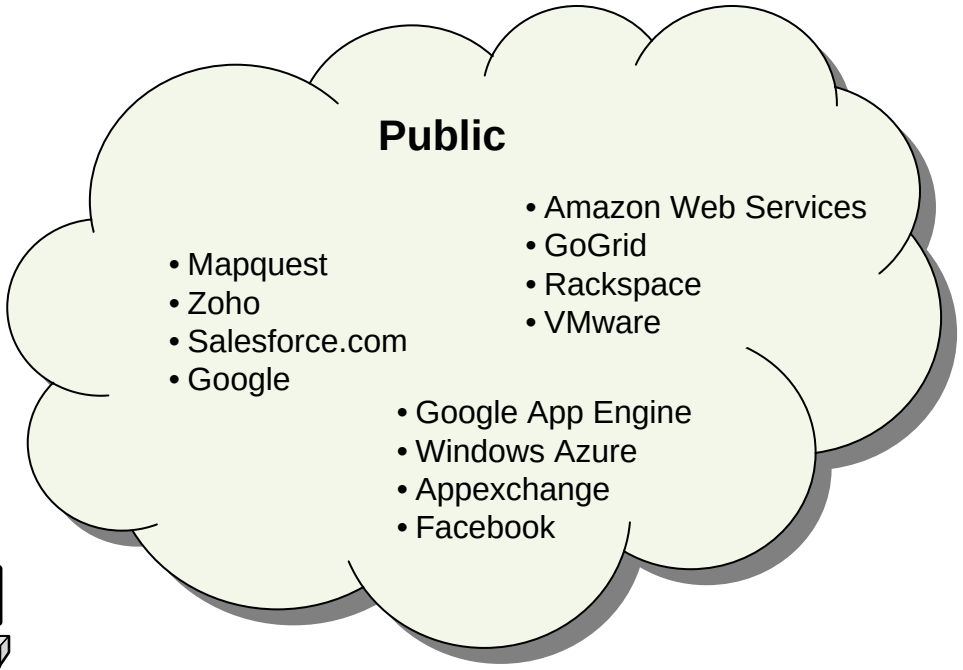


Figure 1-15. Public clouds (commercial) WS009 / VS0091.0

Notes:

There are generally two types of clouds: public (commercial) and private clouds. Often depicted as being available to users from a third-party provider, public clouds are typically made available via the Internet and may be free or inexpensive to use. There are many examples of these types of clouds, providing services across open, public networks today. One example is Amazon Web Services, where IBM has made available new Amazon Machine Images (AMIs) for development and test purposes, enabling software developers to build preproduction applications based on IBM software within the Amazon Elastic Compute Cloud (EC2) environment.

In later units the different cloud deployment models (public and private clouds) are covered in more detail.

Unit summary

Having completed this unit, you should be able to:

- Define cloud computing
- Describe the key characteristics of cloud computing
- Describe the benefits of using clouds
- Describe some driving factors towards using cloud computing
- Describe some of the concerns related to cloud computing
- Compare grid computing with cloud computing
- Provide authentic examples of cloud computing

Figure 1-16. Unit summary WS009 / VS0091.0

Notes:

Checkpoint

1. True or False: A pay-per-usage solution makes sense if the unit cost of cloud services is *lower* than the equivalent unit cost of dedicated owned capacity.

2. Match the following descriptions with the best definition:

Description	Definition
1) Developers and testers can procure resources on demand	A. Virtualization
2) Diverse resource pool can be viewed as a single logical entity	B. Prebuilt solution stack
3) Provides a consistent deployment configuration	C. Self-service

Figure 1-17. Checkpoint WS009 / VS0091.0

Notes:

Write your answers here:

1.

2. 1)
   2)
   3)

Checkpoint answers

1. True or False: A pay-per-usage solution makes sense if the unit cost of cloud services is *lower* than the equivalent unit cost of dedicated owned capacity.
   Correct answer: True

2. Match the following descriptions with the best definition:

Description	Definition
1) Developers and testers can procure resources on demand	C. Self-service
2) Diverse resource pool can be viewed as a single logical entity	A. Virtualization
3) Provides a consistent deployment configuration	B. Prebuilt solution stack

Figure 1-18. Checkpoint answers WS009 / VS0091.0

Notes:

Unit 2. Cloud computing concepts

What this unit is about

This unit covers cloud computing concepts and terminology.

What you should be able to do

After completing this unit, you should be able to:

- Describe how cloud computing leverages the Internet
- Describe elasticity and scalability
- Define virtualization
- List the characteristics of virtualized environments
- Define hypervisors
- Compare virtualized and nonvirtualized systems
- Describe the types of hypervisors
- Explain provisioning and deprovisioning
- Describe multitenancy
- Describe management in cloud computing, including governance, tooling, and automation

How you will check your progress

- Checkpoint

Unit objectives

After completing this unit, you should be able to:

- Describe how cloud computing leverages the Internet
- Describe elasticity and scalability
- Define virtualization
- List the characteristics of virtualized environments
- Define hypervisors
- Compare virtualized and nonvirtualized systems
- Describe the types of hypervisors
- Explain provisioning and deprovisioning
- Describe multitenancy
- Describe management in cloud computing, including governance, tooling, and automation

Figure 2-1. Unit objectives WS009 / VS0091.0

Notes:

Topics

- Concepts of cloud computing
- Management, tooling, and automation in cloud computing

Figure 2-2. Topics WS009 / VS0091.0

Notes:

2.1. Concepts of cloud computing

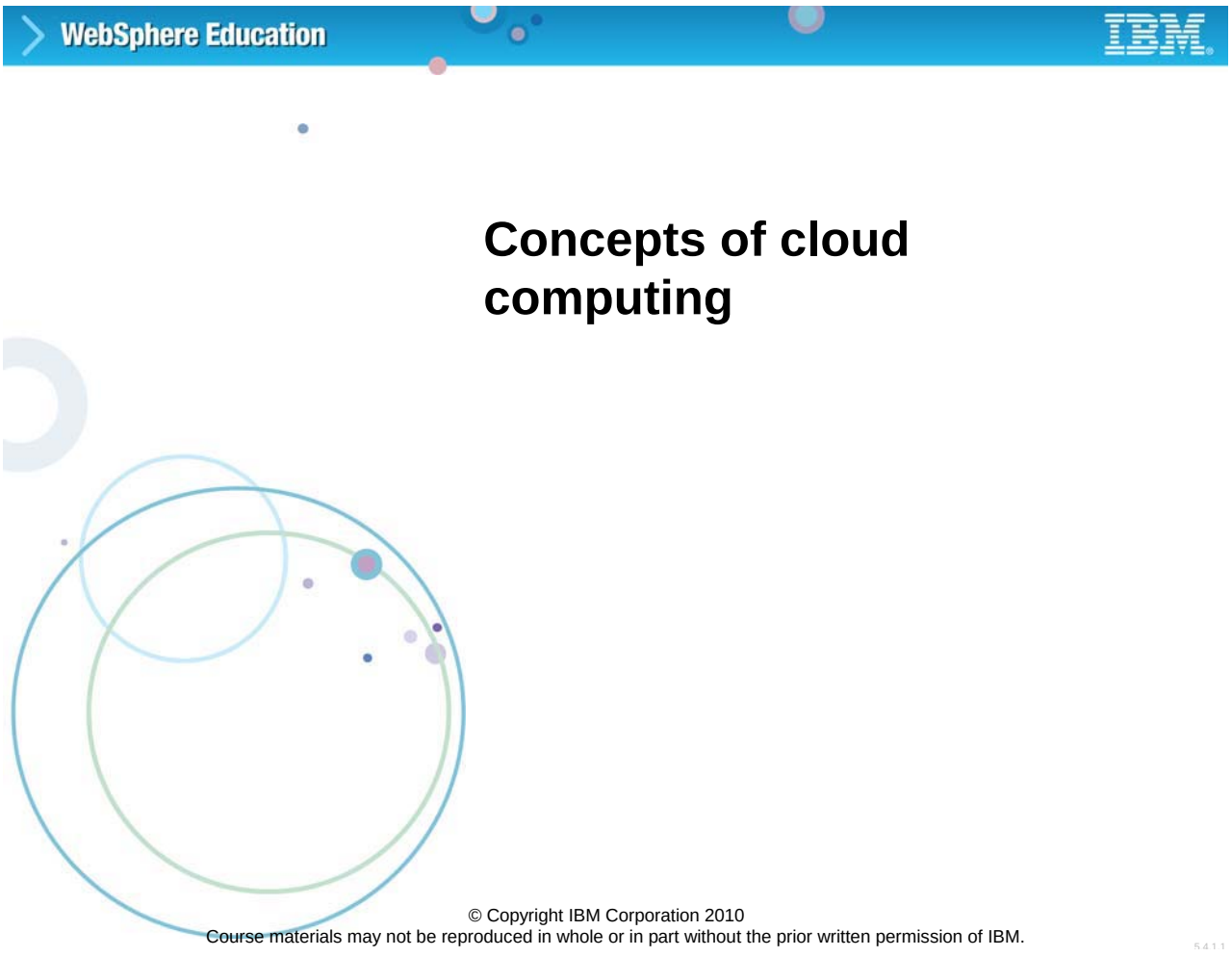


Figure 2-3. Concepts of cloud computing WS009 / VS0091.0

Notes:

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Cloud computing leverages the Internet

- Cloud computing is the next stage of evolution of the Internet.
- Cloud computing is Internet-based computing, whereby shared resources, software and information are provided to computers (hardware) and other devices on-demand, like the electricity grid.
- Cloud is a new consumption and delivery model inspired by consumer Internet services
- Cloud enables:
  - Self-service
  - Sourcing options
  - Economies of scale

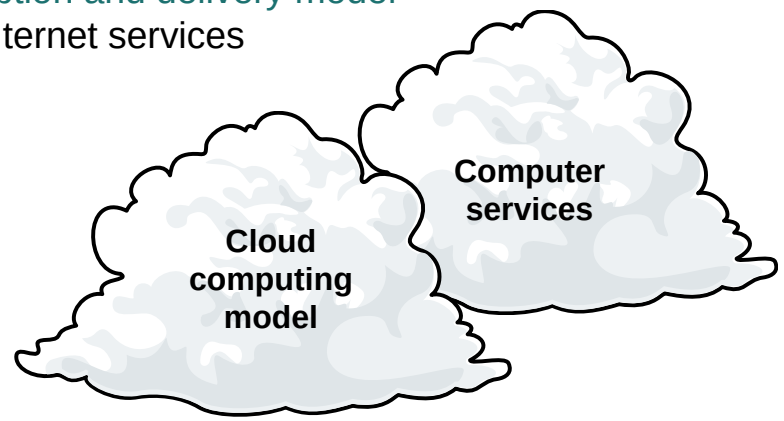

Figure 2-4. Cloud computing leverages the Internet WS009 / VS0091.0

Notes:

Simply put, a cloud is an online environment for access to computer resources, such as:

- Computing power
- Storage
- Management
- Applications

The availability of broadband access to the Internet has opened new opportunities for delivering services to consumers or clients via the Internet. Benefits from other areas such as service-oriented architectures, virtualization of resources, fine-grained metering, and flexible billing, have brought about a new business model of cloud computing. Cloud computing is a model for enabling convenient, on-demand network access to a shared IT infrastructure. A company may outsource its technologies to independent service providers (ISP) who host the services and rent them back to the company on a per-usage basis.

Positioning cloud to a grid infrastructure

- Grid computing links disparate computers to form one large (virtual) infrastructure, leveraging unused resources
- Grid computing is one vehicle that allows the cloud to scale up, or down, to meet the demand
- Grid sizes vary, from forming a “super virtual computer” composed on many networked loosely coupled computers to form a single task, to a smaller redundant dual computer system

Figure 2-5. Positioning cloud to a grid infrastructure WS009 / VS0091.0

Notes:

For further information refer to the article “Cloud computing versus grid computing” by Judith Myerson at: **http://www.ibm.com/developerworks/web/library/wa-cloudgrid/**

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Elasticity and scalability

- Elasticity is the ability to expand or shrink a computing resource in real time, based on the user's computing requirements
  - The ability to scale
  - Sometimes referred to as "right-sizing"
- Cloud service providers provide services based on usage
- This usage must meet service level agreements (SLA) while minimizing cost
- Elasticity and scalability are used to achieve this
  - Cloud services scale up to meet demand
  - Cloud services scale down when higher demand is not required
  - Customers only pay for services used
- An example of when elasticity is valuable is during load testing

Figure 2-6. Elasticity and scalability WS009 / VS0091.0

Notes:

Customers who retain cloud services from a cloud services provider have processing demands, which must be met. These demands are identified in service level agreements. The cloud provider cannot predict when customers require peak demands. To meet these demands, the cloud infrastructure has the ability to scale upward, stretching like a rubber band. When customers use a cloud infrastructure that utilizes more resources, they pay for this. However, when the peak load is over, the cloud infrastructure shrinks, or scales down, to the required resources. At this point in time, the customer is only paying the reduced infrastructure cost. The elastic nature of cloud computing offers customers the resource power when required, without forcing them to pay for peak performance infrastructure costs the entire time. Instead, they pay only for the resources they use. Elasticity is a major benefit to cloud computing.

Elastic use of resources

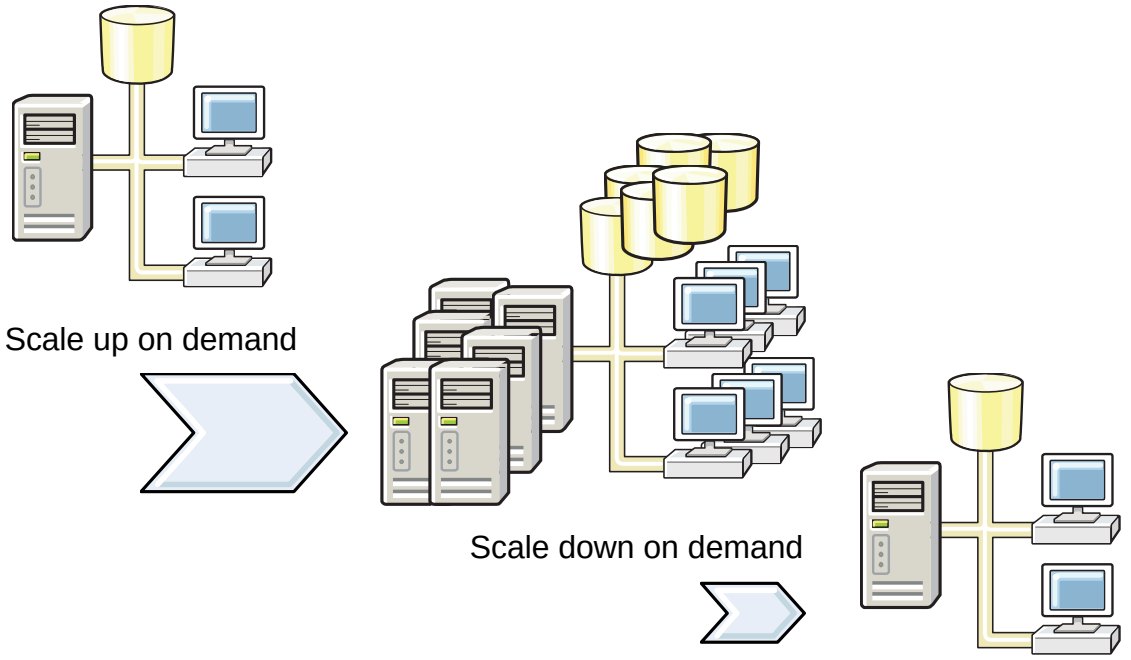

Figure 2-7. Elastic use of resources WS009 / VS0091.0

Notes:

This slide depicts the elastic use of resources in cloud computing.

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Virtualization

- Virtualization involves a shift in thinking from physical to logical
  - Treating IT resources as logical resources rather than separate physical resources
- With virtualization, you can consolidate the following resources into a virtual environment:
  - Processors
  - Storage
  - Networks
- With virtualization, one physical resource can be made to look like multiple virtual resources
  - Virtual resources can have functions or features that are not available in their underlying physical resources.

Figure 2-8. Virtualization WS009 / VS0091.0

Notes:

Virtualization improves IT resource utilization by:

- Treating your company's physical resources as pools from which virtual resources can be dynamically allocated

Virtualization involves a shift in thinking from physical to logical:

- Treating IT resources as logical resources rather than separate physical resources

With virtualization, you can consolidate the following resources into a virtual environment:

- Processors
- Storage
- Networks

With virtualization, you can make one physical resource look like multiple virtual resources.

- Virtual resources can have functions or features that are not available in their underlying physical resources.

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What can be virtualized?

- Virtualization may refer to:
  - Hardware
  - Networks
  - Storage
  - Operating systems
  - Applications
  - Desktop
  - Data
- The main advantage of virtualization in cloud computing is that the software is decoupled from the hardware
  - Decoupling allows hosting an individual application in an environment that is isolated from underlying operating system

Figure 2-9. What can be virtualized? WS009 / VS0091.0

Notes:

Decoupling changes the software from being dependent on the underlying hardware to being independent of the hardware.

Characteristics of virtualization

- Partitioning
  - Run multiple application and operating systems in a single physical machine by partitioning the available resources
- Isolation
  - Virtual machines are completely isolated from hosts and other virtual machines
- Encapsulations
  - Encapsulate the entire state of a virtual machine in hardware-independent files

Figure 2-10. Characteristics of virtualization WS009 / VS0091.0

Notes:

The characteristics of a virtualized environment can be summed up as being partitioned, isolated, and encapsulated.

Partitioning

- Run multiple application and operating systems in a single physical machine by partitioning the available resources.
- Allocation of resources to virtual machines intelligently based on user needs.
- Support high availability by clustering virtual machines.

Isolation

- Virtual machines are completely isolated from hosts and other virtual machines.
- Crash of a virtual machine does not affect other virtual machines.
- Data is not shared between virtual machines.

- Virtual machines can only communicate through specifically configured network connections.

Encapsulations

- Encapsulate the entire state of a virtual machine in hardware-independent files.
- These files contain the operating system and application files plus the virtual machine configuration.

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Benefits of virtualization

- Consolidation to reduce hardware cost
  - Enables you to have a single server function as multiple virtual servers
- Optimization of workloads
  - Can increase the use of existing resources by enabling dynamic sharing of resource pools
- IT flexibility and responsiveness
  - Enables you to have a single, consolidated view of, and easy access to, all available resources in the network, regardless of location

Figure 2-11. Benefits of virtualization WS009 / VS0091.0

Notes:

The benefits of virtualization can be summarized as follows:

Consolidation to reduce hardware cost

- Enables you to efficiently access and manage resources to reduce operations and systems management costs while maintaining needed capacity
- Enables you to have a single server function as multiple virtual servers

Optimization of workloads

- Enables you to respond dynamically to the application needs of its users
- Can increase the use of existing resources by enabling dynamic sharing of resource pools

IT flexibility and responsiveness

- Enables you to have a single, consolidated view of, and easy access to, all available resources in the network, regardless of location

- Enables you to reduce the management of your environment by providing emulation for compatibility, improved interoperability, and transparent change windows

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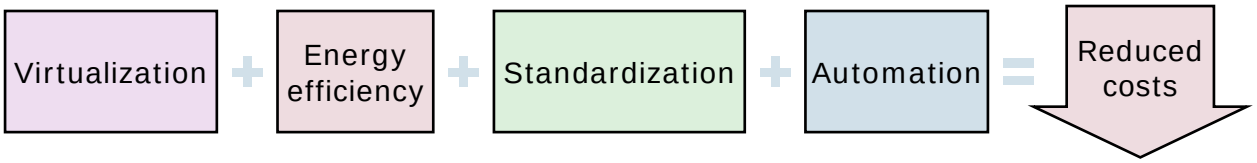
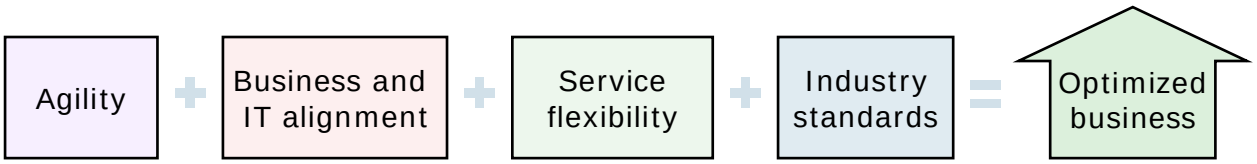
Virtualization in cloud computing



…leverages virtualization, standardization and service management to free up operational budget for new investment



…allowing you to optimize new investments for direct business benefits

Figure 2-12. Virtualization in cloud computing WS009 / VS0091.0

Notes:

An effective cloud computing deployment is built on a dynamic application infrastructure and is highly optimized to achieve more results with fewer resources.

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Hypervisors

- Virtualization software that allow multiple operating systems to run on the same computer concurrently
- Use a thin layer of code in software or firmware to achieve fine-grained, dynamic resource sharing
- Provide the greatest level of flexibility in how virtual resources are defined and managed
- Primary technology of choice for system virtualization
- May mediate access to:
  - Memory
  - Data storage,
  - Processing capacity
  - Network connections
- An example of a hypervisor is VMware ESX

Figure 2-13. Hypervisors WS009 / VS0091.0

Notes:

In the early days of computing, the operating system was called the ***supervisor***. With the ability to run operating systems on other operating systems, the term ***hypervisor*** resulted.

Hypervisors are virtualization software that allow multiple operating systems to run on the same computer concurrently.

Hypervisors use a thin layer of code in software or firmware to achieve fine-grained, dynamic resource sharing.

Because hypervisors provide the greatest level of flexibility in how virtual resources are defined and managed, they are the primary technology of choice for system virtualization.

Hypervisor might mediate access to:

- Memory
- Data storage
- Processing capacity
- Network connections

An example of a **hypervisor** is VMware ESX.

VMware ESX are “bare-metal” hypervisor architectures, meaning that they install directly on top of the physical server and partition it into multiple virtual machines that can run simultaneously, sharing the physical resources of the underlying server. Each virtual machine represents a complete system, with processors, memory, networking, storage and BIOS, and can run an unmodified operating system and applications.

For more information see:
http://www.vmware.com/products/vsphere/esxi-and-esx/index.html, Sept. 28, 2010

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Comparing non-virtualized versus virtualized systems

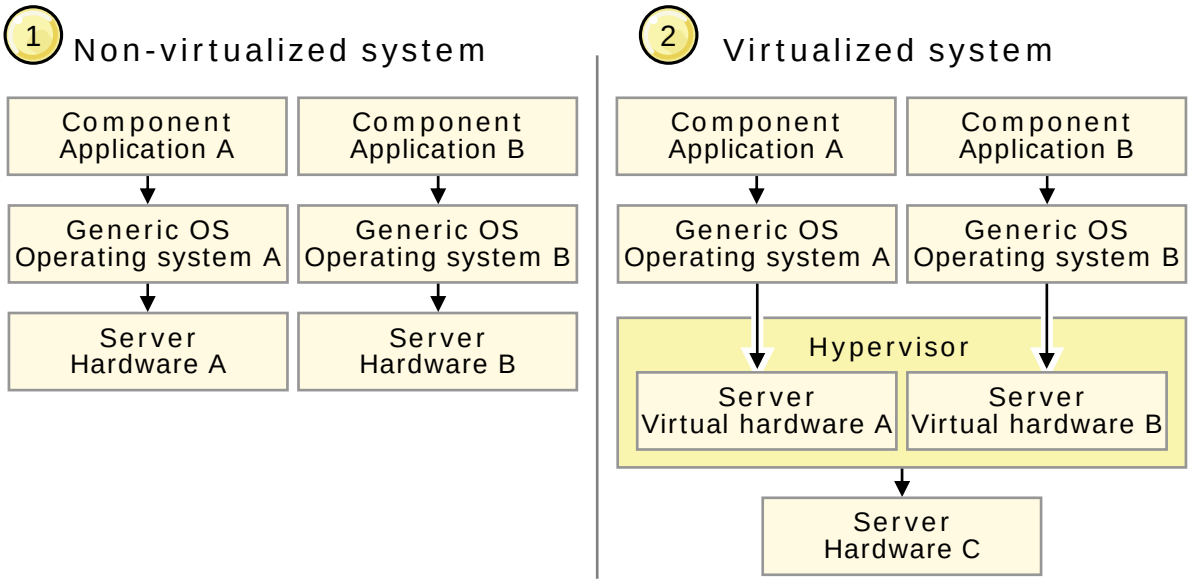

Figure 2-14. Comparing non-virtualized versus virtualized systems WS009 / VS0091.0

Notes:

1. **Non-virtualized system:**

   Because each system has its own separate hardware, the amount of processing power that is available to each application is fixed.

   If application A comes under heavy use, it might run slowly, while application B might be idle. Thus, the processing capacity on hardware B might be underused.

2. **Virtualized system**:

   By running both applications on the same hardware through a **hypervisor**, you can direct resources to the system that needs them.

   With systems A and B virtualized on the same hardware, the hypervisor can provide more processing capacity and memory to the application that is being used more heavily.

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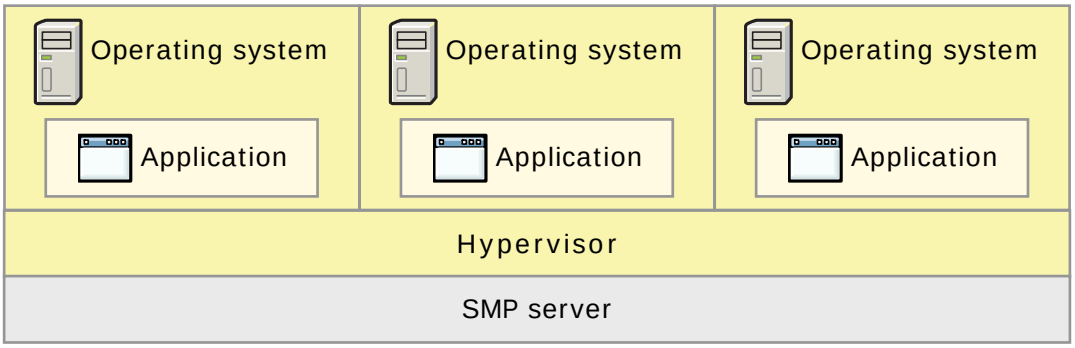
Type 1 hypervisors

- Type 1 (native or bare metal) hypervisors run directly on the system hardware



The figure shows one physical system with a type 1 hypervisor running directly on the system hardware, and three virtual systems using virtual resources provided by the hypervisor.

Figure 2-15. Type 1 hypervisors WS009 / VS0091.0

Notes:

Type 1 (native or bare metal) hypervisors run directly on the system hardware.

Type 1 hypervisors are typically the preferred approach because they can achieve higher virtualization efficiency by dealing directly with the hardware.

Type 1 hypervisors provide higher performance efficiency, availability, and security than type 2 hypervisors.

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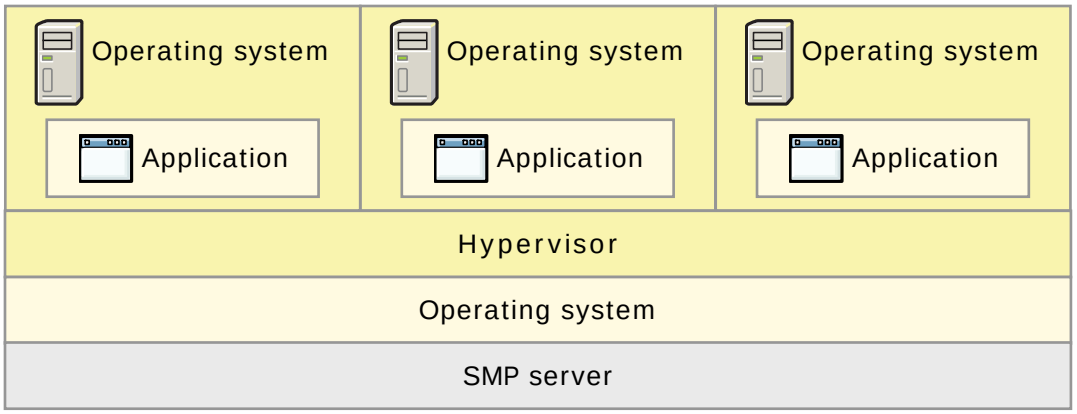
Type 2 hypervisors

- Type 2 (or hosted) hypervisors run on a host operating system that provides virtualization services, such as I/O device support and memory management



The figure shows one physical system with a type 2 hypervisor running on a host operating system and three virtual systems using the virtual resources provided by the hypervisor.

Figure 2-16. Type 2 hypervisors WS009 / VS0091.0

Notes:

Type 2 (or hosted) hypervisors run on a host operating system that provides virtualization services, such as I/O device support and memory management.

Type 2 hypervisors are used mainly on client systems where efficiency is less critical.

Type 2 hypervisors are also used mainly on systems where support for a broad range of I/O devices is important and can be provided by the host operating system.

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Provisioning and deprovisioning

- Provisioning provides resources availability to users and software
  - A provisioning system controls applications available to users
  - And controls servers resources available to applications
- Deprovisioning provides resources reduction to users and software, while deallocating back-end resources
  - Hardware
  - Software
- Self-service provisioning allows customers to request the amount of computer services without going through a lengthy process.
  - Computing
  - Storage
  - Software
  - Process
  - Other resources
- Eliminates many time delays

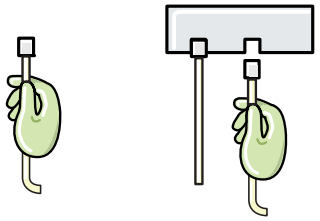

Figure 2-17. Provisioning and deprovisioning WS009 / VS0091.0

Notes:

Mature virtualization technologies enable hosting providers to provision new environments for their customers very rapidly, and decommission them immediately when no longer required.

Multitenancy

- Cloud services must enable multitenancy — different companies sharing the same underlying resources
- Software as a service modes of multitenancy:
  - Simple multitenancy — each customer has his own resources, which are segregated from other customers
  - This form of multitenancy is relatively inefficient
  - Fine grain multitenancy — all resources are shared, but the customer data and access capabilities are segregated within the application
  - This form of multitenancy is much more efficient offering superior economies of scale
- Platform as a service modes of multitenancy:
  - This delivery model architecture allows multiple customers to run their copy separately from other customers through virtualization
  - Each customers code is isolated from each other
- The key technical challenge of multitenancy is how to support multiple client organizations from shared instances of the software solution

Figure 2-18. Multitenancy WS009 / VS0091.0

Notes:

Multitenancy is the ability to deliver an application to multiple client organizations from a single instance of software. When building software as a service applications, or platforms as a service, organizations should design applications with multitenancy in mind to minimize the per-tenant cost of delivery. Technical challenges associated with building a multitenant application include access control, customization (data, user interface, and business logic) and isolation of data.

Note: The software as a service (SaaS) and platform as a service (PaaS) delivery models are covered in a later unit.

Types of tenancy

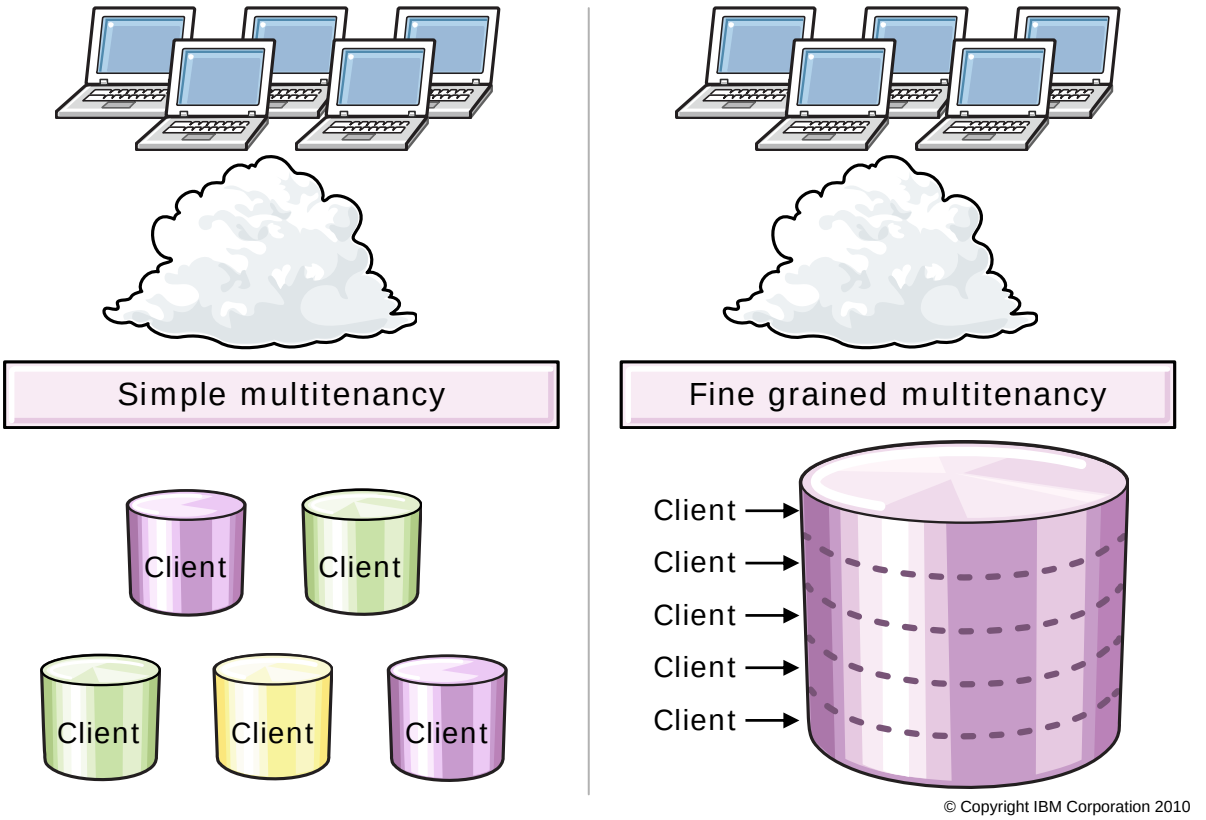

Figure 2-19. Types of tenancy WS009 / VS0091.0

Notes:

Simple multitenancy is also referred to as *single-tenancy*. Fine grained multitenancy is sometimes referred to as *multitenancy*.

In the diagram, the simple multitenancy architecture has five customers leveraging a cloud which directs each customer to their own database. The fine grained multitenancy has five separate customers using a cloud that leverages a single database partitioned into five instances.

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Application programming interfaces (API)

- Cloud services should have standardized application programming interfaces (API)
- The interface defines how two or more applications and data sources can communicate with each other
  - Multiple applications communicating
  - Multiple data sources communicating
- The cloud API allows customers (companies) infrastructure or application to plug into the cloud
- Currently, different cloud vendors are developing different APIs
- Cloud APIs have not been standardized yet
  - Beware of vendor API lock-in
  - API integration may include SOAP and REST APIs

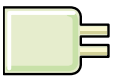

Figure 2-20. Application programming interfaces (API) WS009 / VS0091.0

Notes:

APIs are a collection of programming interfaces that provide access from one computer system into another computer system's software.

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Billing and metering of services

- To calculate the customer charge, cloud usage is tracked via metered services
  - The billing service is automated
  - Customer should be able to monitor usage
- Billing services normally track:
  - Number of users
  - Capacity used
  - Services leveraged
- Metered services normally provide:
  - A dashboard providing insight into application and services running in the cloud
  - SLA being met in the cloud

Figure 2-21. Billing and metering of services WS009 / VS0091.0

Notes:

Cloud environments have built-in services that bill customers.

To calculate the customer charge, cloud usage is tracked via metered services.

- The billing service is automated.
- Customers should be able to monitor usage.

Billing services normally track:

- Number of users
- Capacity used
- Services leveraged

Metered services normally provide:

- A dashboard providing insight into application and services running in the cloud
- SLA being met in the cloud

Potential problems may arise if service level agreements (SLA) are not clear up front and cloud providers add too many incidental charges.

Economies of scale

- Economies of scale refers to the cost advantages that an IT organization obtains due to expansion
  - The average cost per unit decreases as the scale of output increases
  - Reductions in unit cost as the size of a facility and the usage levels of other inputs increase
  - The more computer resources being used, the cheaper the price per resource
- Cloud computing economies of scale promises to dramatically reduce the cost of computing over time and inevitably lead to greater adoption of the technology

Figure 2-22. Economies of scale WS009 / VS0091.0

Notes:

Economies of scale refers to the cost advantages that an IT organization obtains due to expansion.

- The average cost per unit decreases as the scale of output increases.
- Reductions in unit cost as the size of a facility and the usage levels of other inputs increase.
- The more computer resources being used, the cheaper the price per resource.

Cloud computing economies of scale promises to dramatically reduce the cost of computing over time and inevitably lead to greater adoption of the technology.

Better communication prices: large data centers are positioned to negotiate better prices with communication providers, purchasing a great deal of bandwidth without paying such a high rate per gigabyte for a guaranteed service.

Network virtualization is gained if the network is tailored to support the networking hardware. For example, Google designs its own switches.

2.2. Management, tooling, and automation in cloud computing

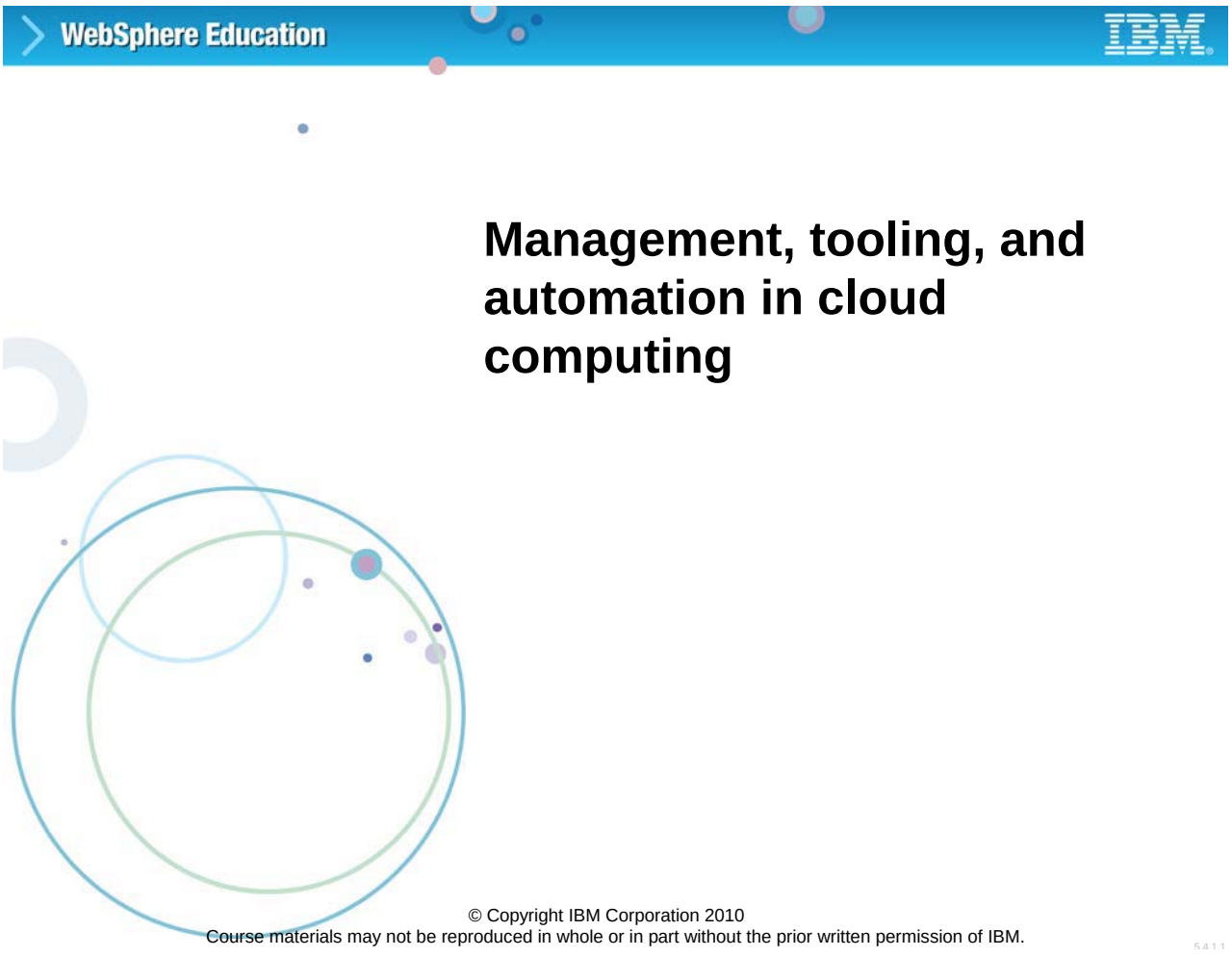

Figure 2-23. Management, tooling, and automation in cloud computing WS009 / VS0091.0

Notes:

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Management: Governance

- Governance is the process of applying policies relating to using services
- Governance normally contains the principles and rules in which an organization should act
  - This includes automatic and manual processes, and the procedures for implementing these processes
- Cloud governance is the shared responsibility between the user of the cloud services and the cloud provider
  - Understanding the boundaries of the user and cloud is critical to ensuring success

Figure 2-24. Management: Governance WS009 / VS0091.0

Notes:

IT governance does the following:

- Ensures that IT assets are implemented and used in accordance with agreed upon procedures and policies
- Ensures that IT assets are properly maintained and controlled
- Ensures that IT assets are providing the proper value — that is, supporting the organizations strategy and business goals

Cloud governance is the shared responsibility between the user of the cloud services and the cloud provider.

- Understanding the boundaries of the user and cloud is critical to ensuring success.

Governance: Risk list

Considerations when moving into a cloud environment include:

- Audit and compliance risk as to data access control, data jurisdiction, and maintaining an audit trail
- Billing risks: ensuring the cloud provider has a solid process to ensure accurate billing
- Contract risks: what if the cloud provider goes out of business?
- Security risks: data confidentiality, data integrity, and privacy
- Information risks: protection of intellectual property
- Interoperability risks: multiple services must interoperate
- Performance and availability risk: are service levels being met and key performance indicators being maintained?

Figure 2-25. Governance: Risk list WS009 / VS0091.0

Notes:

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Management: Desktops in the cloud

- In a virtualized desktop (desktop in the cloud), the applications, data, files, and graphics are separate from the physical desktop and stored in the data center (the cloud)
- The most widely-used approach is virtual desktop infrastructure (VDI):
  - The virtual client is created on the server
  - Users have what appears to be a complete client desktop with access to all applications, data, and files, but they are actually just a virtual session on the server
  - However, the graphics are being sent to the client

Figure 2-26. Management: Desktops in the cloud WS009 / VS0091.0

Notes:

The four types of client virtualized desktops are:

- **Session-based computing**: the user is running a session on the server.
- **Operating system streaming**: the client operating system software is passed to the device — but only as much as needed. Some of the processing is occurring on local disk and in memory; the application, data, files and graphics are split between the client and server, streamed to the client when needed.
- **Virtual desktop infrastructure (VDI)**: the virtual client is created on the server. The user has what appears to be a complete client desktop with access to all applications, data, and files, but they are actually just a virtual session on the server. However, the graphics are being sent to the client. Today, this is the most widely used approach. Quite possibly, this class is using this approach with student ESX images. VMware and Citrix both provide these capabilities.

- **PC blade**: A server blade is an entire computer contained on a single blade slotted into a blade cabinet. A server blade can contain a number of PC blades. The desktop is a thin client used to access the PC blade.

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Management: Managing devices in the cloud (1 of 2)

- Managing assets
  - Establish a detailed hardware asset register: a record itemizing all hardware assets
  - Establish a software register: a record itemizing all software assets
  - Control software licensee: track all software licenses
  - Manage device costs: retire unused devices
- Monitoring services
  - Application monitoring
  - Clarify service level agreements
  - Automated client backup
  - Remote management and maintenance
  - Client recovery
  - Failure analysis

Figure 2-27. Management: Managing devices in the cloud (1 of 2) WS009 / VS0091.0

Notes:

These are the management issues that need to be dealt with when running virtualized client desktops in the cloud:

- Managing assets:
  - Establish a detailed hardware asset register: a record itemizing all hardware assets.
  - Establish a software register: a record itemizing all software assets.
  - Control software licensee: track all software licenses.
  - Manage device costs: retire unused devices.
- Monitoring services
  - Application monitoring: monitor client, network and application to identify poor performance. And map costs to actual application usage.
  - Service level maintenance: unclear service level agreements (SLA) are hard to monitor.

- Automated client backup: reduce the risk of data lost and shorten recovery time.
- Remote management and maintenance, reduce costs by allowing for remote management and maintenance; especially on global assets.
- Client recovery: restore client system and upgrades.
- Root-cause analysis: gather information on failures, both hardware and software; this information may lead to faster recoveries, and reduce the probability of a similar future problem.

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Management: Managing devices in the cloud (2 of 2)

- Change management
  - Hardware provisioning
  - Software distribution and upgrade
  - Patch management
  - Configuration management
- Security
  - Secure access control
  - Identity management
  - Integrated threat management
  - Automated security policy

Figure 2-28. Management: Managing devices in the cloud (2 of 2) WS009 / VS0091.0

Notes:

These are further management issues that need to be dealt with when running virtualized client desktops in the cloud:

- Change management:
  - Hardware provisioning: rapid deployment of devices minimizes the time needed to support staff changes.
  - Software distribution and upgrade: the ability to distribute software to device throughout the cloud.
  - Patch management: automated patch management reduces the risk associated with bug fixes (patches are fixes to bugs).
  - Configuration management: automate the configuration settings in the desktop or cloud environment.
- Security:
  - Secure access control: password protection, authentication, and access control.

- Identity management: global content in all authorized resources in the cloud.
- Integrated threat management: includes three types of threat management:
    1) Virtual private networks
    2) Intruder-detection systems
    3) While-listing programs that are allowed to run
- Automated security policy: technology and process can be used to manage some aspects of security with policy.

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Tooling

- Tooling should aid application development, packaging, and deployment in a way that makes the finished project portable across multiple cloud infrastructures
- Tools can assist with:
  - Allocation of physical resources, internal and external
  - Asset management
  - Resource virtualization
- Tools should guide users through the physical makeup of the cloud based on the expected demand characteristics of the system

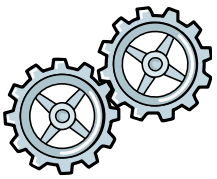

Figure 2-29. Tooling WS009 / VS0091.0

Notes:

Each layer of the cloud environment (infrastructure, platform, and application) contains tools:

- Look for tools that are open, not necessary tied to the cloud provider.
- If you switch cloud providers, do you need to learn all new tools?
- Open standards may be key to providing more flexibility.

Tooling should aid application development, packaging, and deployment in a way that makes the finished project portable across multiple cloud infrastructures.

In the infrastructure layer, tools help the cloud provider build out the infrastructure.

Tools can assist with:

- Allocation of physical resources, internal and external
- Asset management
- Resource virtualization

Tools should guide users through the physical makeup of the cloud based on the expected demand characteristics of the system.

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Automation

- Automation is required for:
  - Scale and speed of deployment
  - Dynamics of the environment
  - Cost of deployment

- Automation goes hand-in-hand with virtualization
  - A cloud environment implies dynamic scaling based on demand
  - Implementing a manual process for this is too time consuming
  - Applications are structured in “independent blocks” that can be easily added or removed
  - Implementing virtualization assists with automation
  - Automation realizes the value of virtualization: dynamic scaling
- Service automation used for security:
  - An automated way to analyze and manage security flows and processes in support of security compliance audits
  - Reporting any events which violate security policies or customer licensing issues

Figure 2-30. Automation WS009 / VS0091.0

Notes:

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Security

- Cloud computing presents an added level of risk because essential services are often outsourced to a third party
  - The *externalized* aspect of outsourcing makes it harder to maintain data integrity and privacy, support data and service availability, and demonstrate compliance
- Cloud computing shifts much of the control over data and operations from the client organization to its cloud provider
  - Clients must establish a trust relationship with the providers and understand the risks
  - A *trust but verify* relationship is critical
- Security areas to focus on include:
  - Recognizing security risks
  - Carrying out required security tasks
  - Managing user identity
  - Using detection and forensics programs
  - Encrypting data
  - Creating a security plan

Figure 2-31. Security WS009 / VS0091.0

Notes:

Security will be covered in much greater detail in the unit on security. This slide only highlights some major areas of focus for security.

Unit summary

Having completed this unit, you should be able to:

- Describe how cloud computing leverages the Internet
- Describe elasticity and scalability
- Define virtualization
- List the characteristics of virtualized environments
- Define hypervisors
- Compare virtualized and nonvirtualized systems
- Describe the types of hypervisors
- Explain provisioning and deprovisioning
- Describe multitenancy
- Describe management in cloud computing, including governance, tooling, and automation

Figure 2-32. Unit summary WS009 / VS0091.0

Notes:

Checkpoint

1. True or False: Cloud computing is a new delivery model inspired by the Internet.
2. True or False: Cloud computing reduces the level of risk for the customer.
3. Match the following description with its correct definition:

Description	Definition
1) The ability to expand and shrink resources	A. Hypervisor
2) Make one physical resource appear as multiple virtual resources	B. Economies of scale
3) The ability to run an Operating System on another Operating System	C. Multitenancy
4) Provide resource availability to users and software	D. Virtualization
5) Different companies sharing the same underlying resource	E. Elasticity
6) Cost advantages that a IT organization obtains due to expansion	F. Provisioning

Figure 2-33. Checkpoint WS009 / VS0091.0

Notes:

Write your answers here:

1.

2.

3. 1)
   2)
   3)
   4)
   5)
   6)

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Checkpoint answers

1. **True** or False: Cloud computing is a new delivery model inspired by the Internet.
2. True or **False**: Cloud computing does not normally reduce the level of risk for the customer. Cloud computing introduces new security threats as it introduces an additional layer of complexity. With additional layers come additional risks.
3. Match the following description with its correct definition:

Description	Definition
1) The ability to expand and shrink resources	E. Elasticity
2) Make one physical resource appear as multiple virtual resources	D. Virtualization
3) The ability to run an Operating System on another Operating System	A. Hypervisor
4) Provide resource availability to users and software	F. Provisioning
5) Different companies sharing the same underlying resource	C. Multitenancy
6) Cost advantages that a IT organization obtains due to expansion	B. Economies of scale

Figure 2-34. Checkpoint answers WS009 / VS0091.0

Notes:

Unit 3. Cloud service delivery models

What this unit is about

This unit covers the delivery models used in cloud computing.

What you should be able to do

After completing this unit, you should be able to:

- Describe the service delivery models of cloud computing
- Explain software as a service (SaaS)
- Explain platform as a service (PaaS)
- Explain infrastructure as a service (IaaS)
- Describe additional cloud services
- Illustrate a reference architecture for the PaaS cloud computing model

How you will check your progress

- Checkpoint

References

http://csrc.nist.gov/groups/SNS/cloud-computing/

Unit objectives

After completing this unit, you should be able to:

- Describe the service delivery models of cloud computing
- Explain software as a service (SaaS)
- Explain platform as a service (PaaS)
- Explain infrastructure as a service (IaaS)
- Describe additional cloud services
- Illustrate a reference architecture for the PaaS cloud computing model

Figure 3-1. Unit objectives WS009 / VS0091.0

Notes:

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Cloud service models

- Software as a service (SaaS)
  - Use of software or applications that are delivered via a network
- Platform as a service (PaaS)
  - The middleware platform and solution stack are accessible on the cloud
- Infrastructure as a service (IaaS)
  - Provision servers, storage, and networking resources

- To be considered a “cloud service model” these models must be deployed on top of an infrastructure that has the key characteristics of clouds

Figure 3-2. Cloud service models WS009 / VS0091.0

Notes:

Software as a service (SaaS):

In the software as a service model, the same software or applications are provided to different customers, or consumers via a network, usually the Internet. The software no longer resides on the consumer’s workstation. Instead, the consumer accesses the provider’s applications running on a cloud infrastructure using various client devices through a thin-client interface such as a web browser. A good example could be web-based email running on a cloud infrastructure.

Platform as a service (PaaS):

In this model, the computing platform and solution stack are made available as a service. Customers can develop, test, and deploy their applications on the cloud.

Infrastructure as a service (IaaS):

In the infrastructure as a service model, the consumer can provision fundamental computer resources such as processors, storage, and networking resources.

Middleware is defined as: “Software that acts as an intermediate layer between applications or between client and server. It is used most often to support complex, distributed applications in heterogeneous environments.”

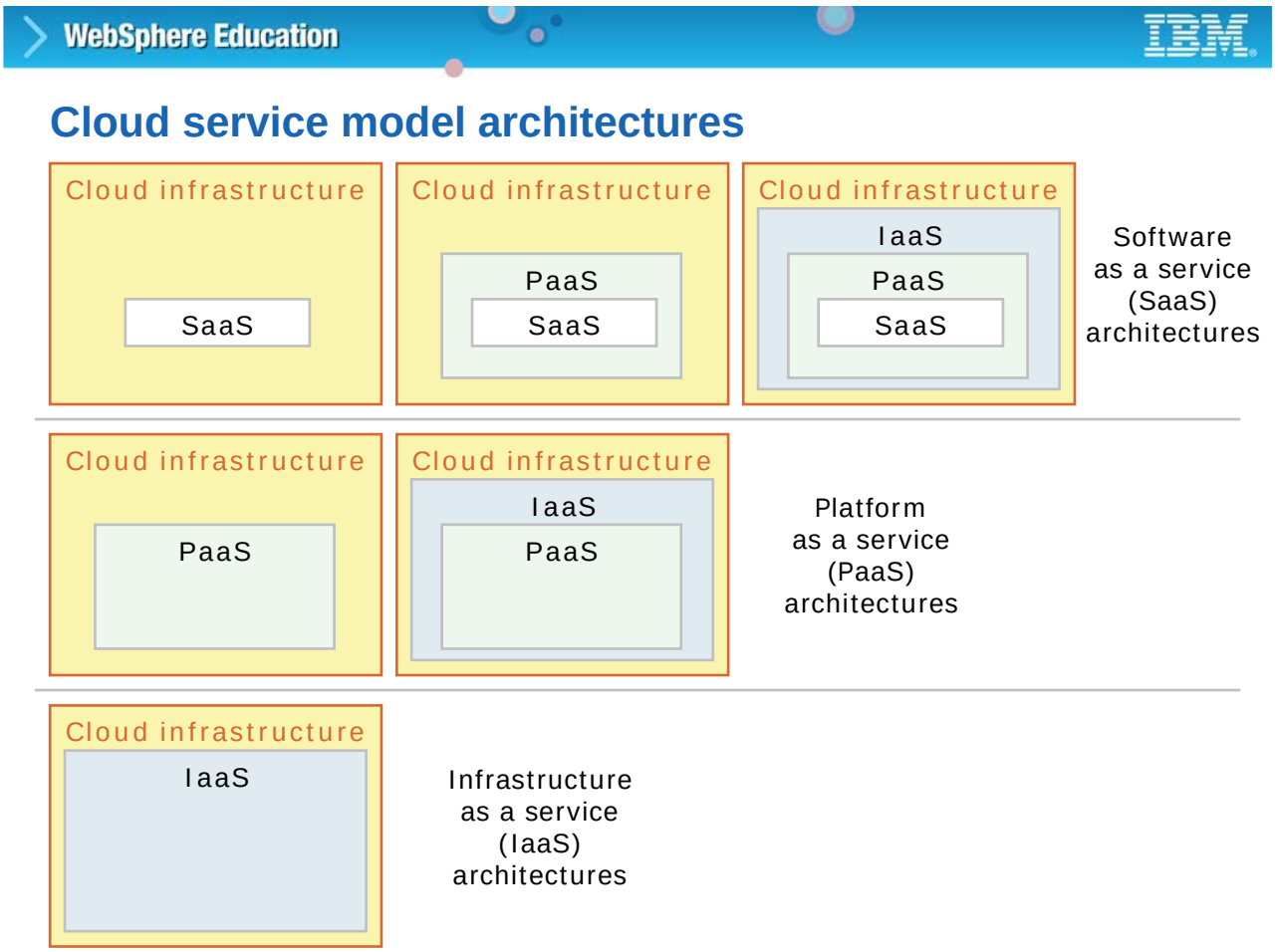

Figure 3-3. Cloud service model architectures WS009 / VS0091.0

Notes:

SaaS = application as a service

PaaS = platform as a service

IaaS = infrastructure as a service

Notice that each service model builds on the cloud infrastructure, and each service model higher up on the slide is more restrictive in the resources it makes available to the client.

Recall that to be considered a “cloud service model” these models must be deployed on top of an infrastructure that has the key characteristics of clouds. This is depicted by the box labeled “cloud infrastructure” in the diagram.

These services model architectures can be used together, in which case, the client has access to all resources of the service model stack that have been provided.

The SaaS model delivers only applications to the user. It may conceivably be used as part of a PaaS or IaaS architecture, in which case the user has access to the platform and the infrastructure, respectively.

On its own, the SaaS model is the least flexible — you only get to use the application. If you add PaaS, you can create, deploy, and test the application, so you have more flexibility in how the application performs. Finally, adding IaaS gives the ability to add or remove system resources such as servers, data storage, firewalls, and so forth. Having access to all three service models gives you the most flexibility for optimizing your environment.

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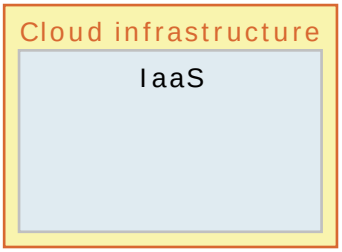
Infrastructure as a service (IaaS) architecture



- An infrastructure provider (IP) makes an entire computing infrastructure available “as a service”
- IPs manage a large pool of computing resources and use virtualization to assign and dynamically resize the resources required by customers
- Customers rent processing capacity, memory, data storage, and networking resources that are provisioned over a network

Figure 3-4. Infrastructure as a service (IaaS) architecture WS009 / VS0091.0

Notes:

An infrastructure provider (IP) makes an entire computing infrastructure available “as a service”. The IP uses the cloud to outsource the provision of the computing infrastructure required to host services.

Rather than purchasing servers, data storage, and networking equipment, customers rent these resources provisioned over a network.

The ability to support an IaaS architecture is through a combination of some of the special characteristics of cloud computing. They include dynamic provisioning, fine-grained measurement and metering, virtualization, broadband access, and flexible billing.

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Infrastructure as a service (IaaS) details

- IaaS →

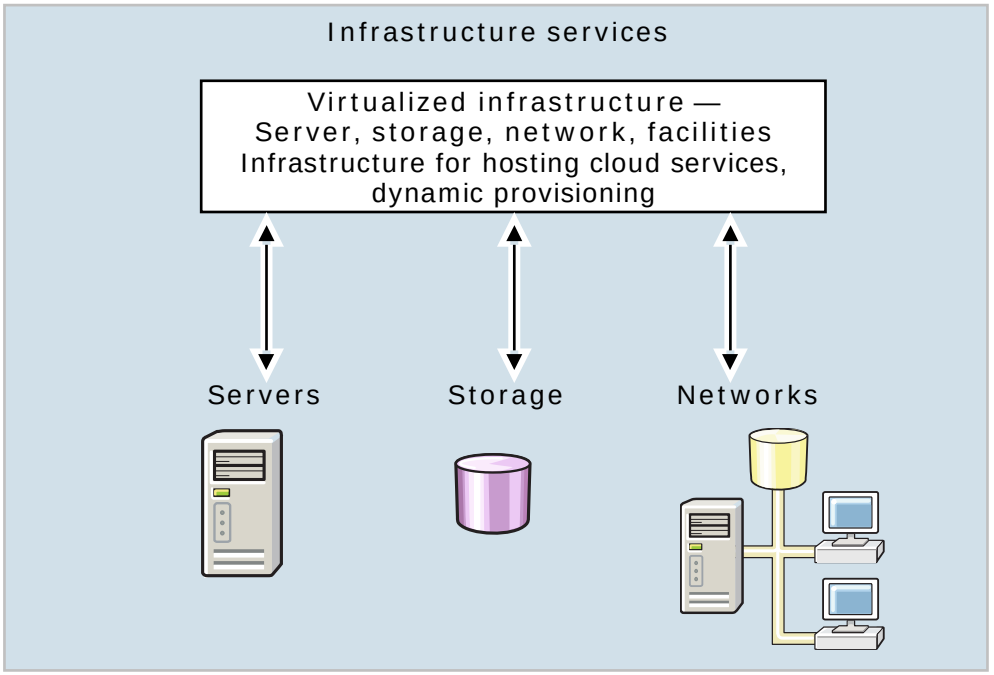

Figure 3-5. Infrastructure as a service (IaaS) details WS009 / VS0091.0

Notes:

Infrastructure services are built on top of a standardized, secure, and scalable infrastructure. Some level of redundancy needs to be built into the infrastructure to ensure the high availability and elasticity of resources.

Next, it must be virtualized. Virtualized environments make use of server virtualization, typically from VMware, XEN, and others, as the basis of running services. These services need to be readily provisioned and deprovisioned using software automation.

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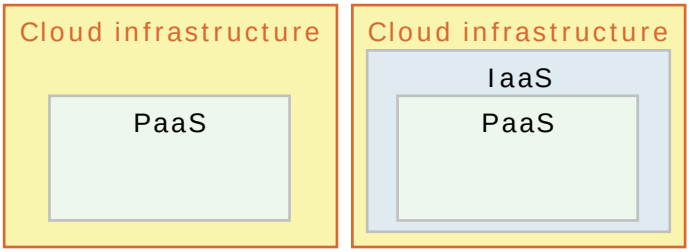
Platform as a service (PaaS) architecture



- Service provider (SP) supplies the software platform or middleware where the applications run
- Service user is responsible for the creation, updating, and maintenance of the application
- The sizing of the hardware required for the execution of the software is made in a transparent manner
- Google App Engine is an example of PaaS
- IBM Smart Business Development and Test Cloud is an example of PaaS

Figure 3-6. Platform as a service (PaaS) architecture WS009 / VS0091.0

Notes:

Under the PaaS model, the service provider (SP) supplies the software platform or middleware on which the applications run. The user of the service is responsible for the creation, updating, and maintenance of the application.

Platforms in the cloud are an interesting offering that takes the pain away from having to set up and configure the software platform or middleware.

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Platform as a service (PaaS) details

- PaaS →

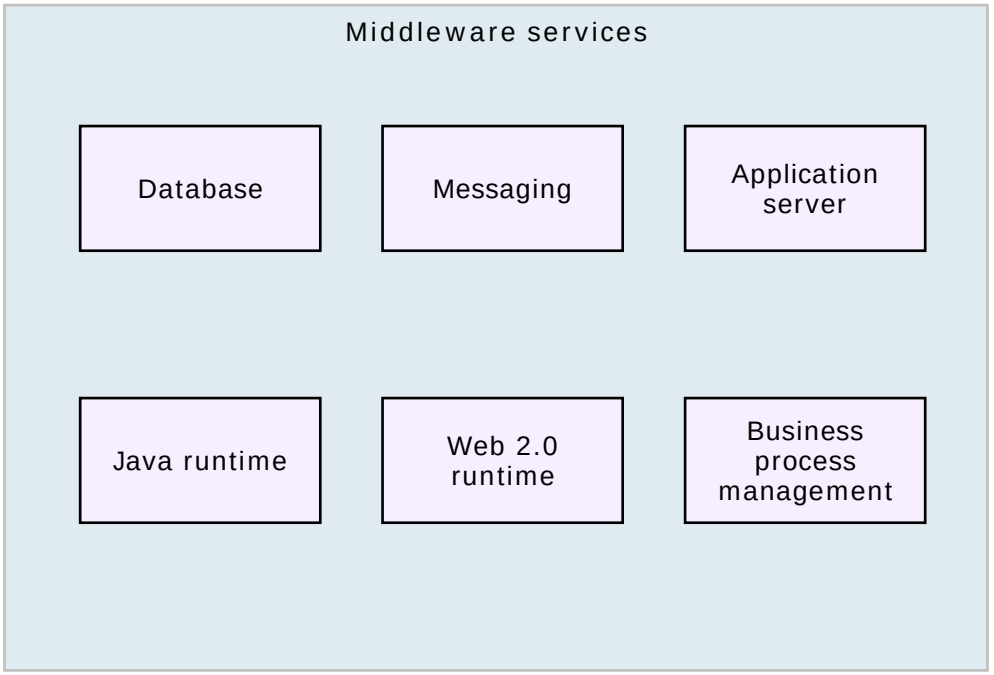

Figure 3-7. Platform as a service (PaaS) details WS009 / VS0091.0

Notes:

As with infrastructure services, PaaS should be a self-managed platform.

A provisioning engine is used to deploy the middleware services, as well as tearing them down and freeing resources for reuse.

Platforms may offer additional functions to support developers, such as:

- **Development and testing environments**
  - Support for integrated development environments (IDEs) and runtimes
  - Support for advanced workflow software and tools
- **Integration services**
  - Tools and runtimes that support integration, such as connectors, or an enterprise service bus
- **Source code management**
  - Tools and services that support version control and change management

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Platform as a service (PaaS) patterns

- Patterns are reusable elements that solve recurring business problems
- Pattern-based middleware is optimized for automatically assembling software components into dynamic middleware services

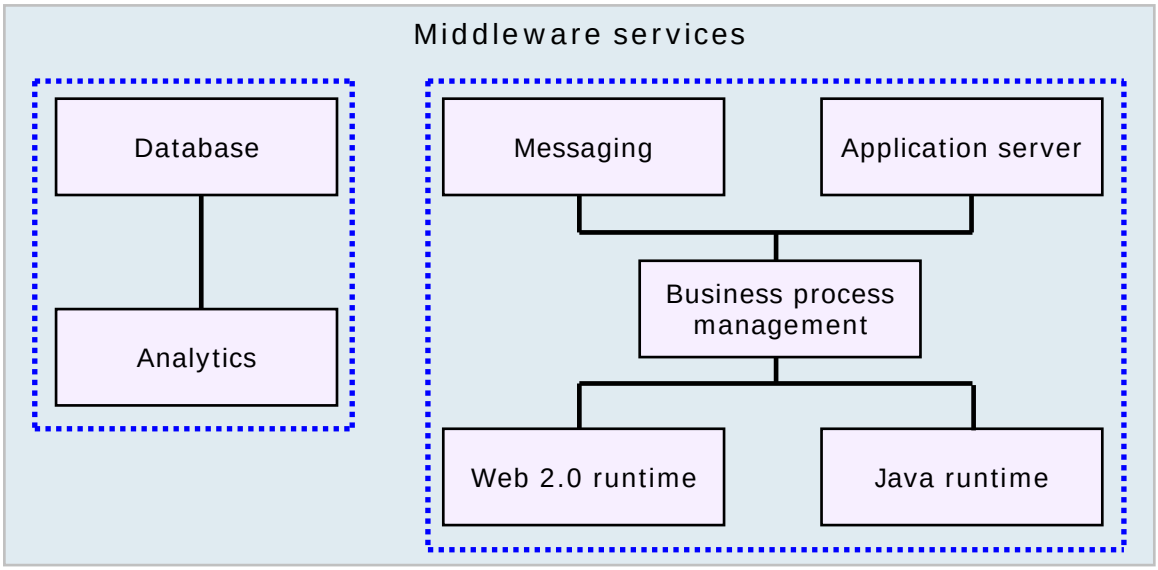

Figure 3-8. Platform as a service (PaaS) patterns WS009 / VS0091.0

Notes:

A design pattern can be described as “a named description of a proven design solution to a recurring problem, within a given context.”

Pattern-based middleware is a grouping of middleware products and runtimes that can be automatically assembled into dynamic middleware services.

Examples of PaaS software

- WebSphere software
  - Configured middleware topology
  - Clusters, high availability, extreme scale

WebSphere software

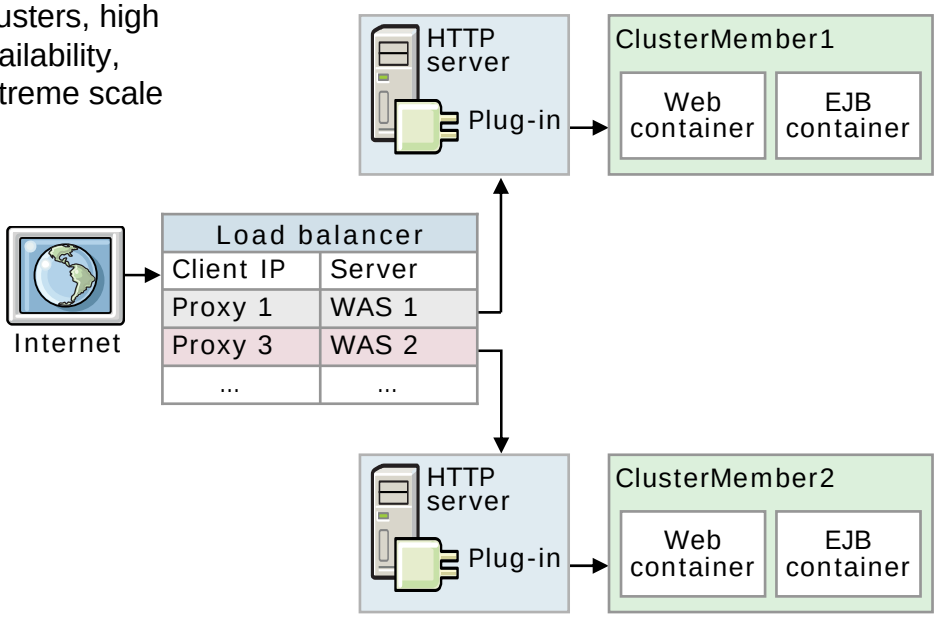

Figure 3-9. Examples of PaaS software WS009 / VS0091.0

Notes:

IBM delivers many products in the WebSphere brand as PaaS middleware-aware topology patterns.

An example of the use and deployment of these PaaS patterns is provided in the unit on IBM WebSphere CloudBurst and IBM WebSphere Hypervisor Edition.

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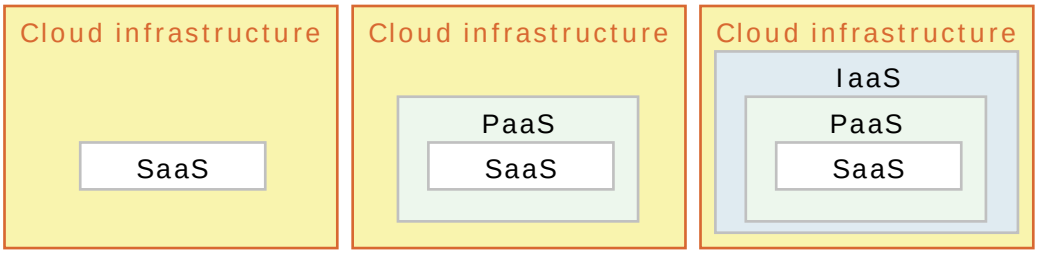
Software as a service (SaaS) architecture



- Service provider (SP) is responsible for the creation, updating, and maintenance of software and application
- Service user accesses the service through Internet-based interfaces

Figure 3-10. Software as a service (SaaS) architecture WS009 / VS0091.0

Notes:

Under the SaaS model, the software provider is responsible for the creation, updating, and maintenance of 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, which includes a separate license for each person that uses the software.

In this model, the service user only needs to access the service itself, and not the platform or the infrastructure the service is running on. The service is usually accessed as a web application or as a wrappered web services application invoked using web services APIs.

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Software as a service (SaaS) details

- SaaS →

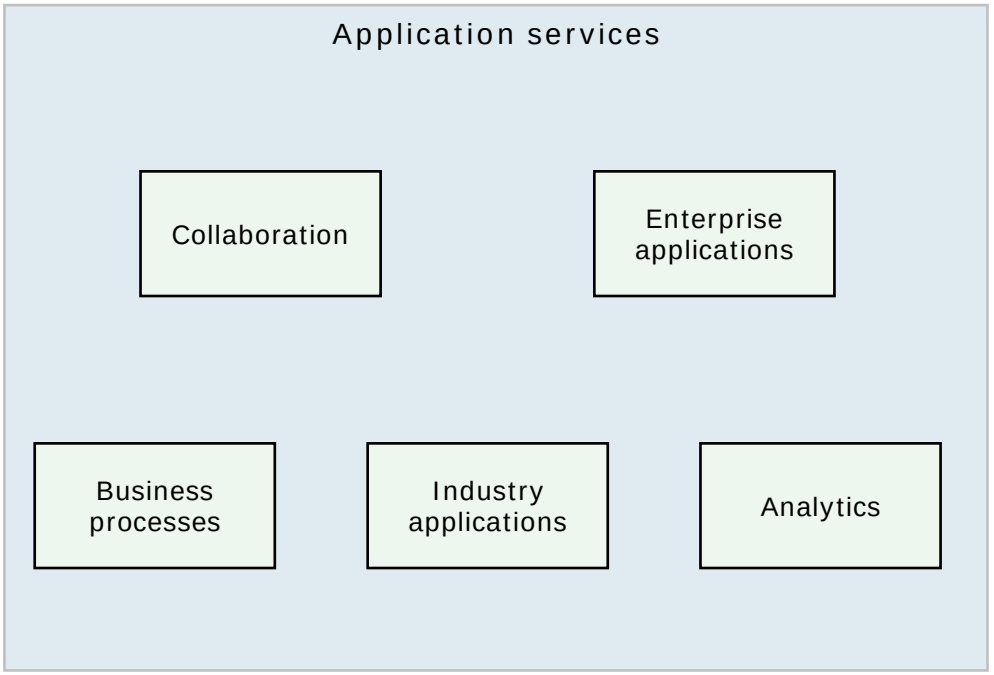

Figure 3-11. Software as a service (SaaS) details WS009 / VS0091.0

Notes:

With SaaS, users can access function-rich, prebuilt applications designed specifically around their service.

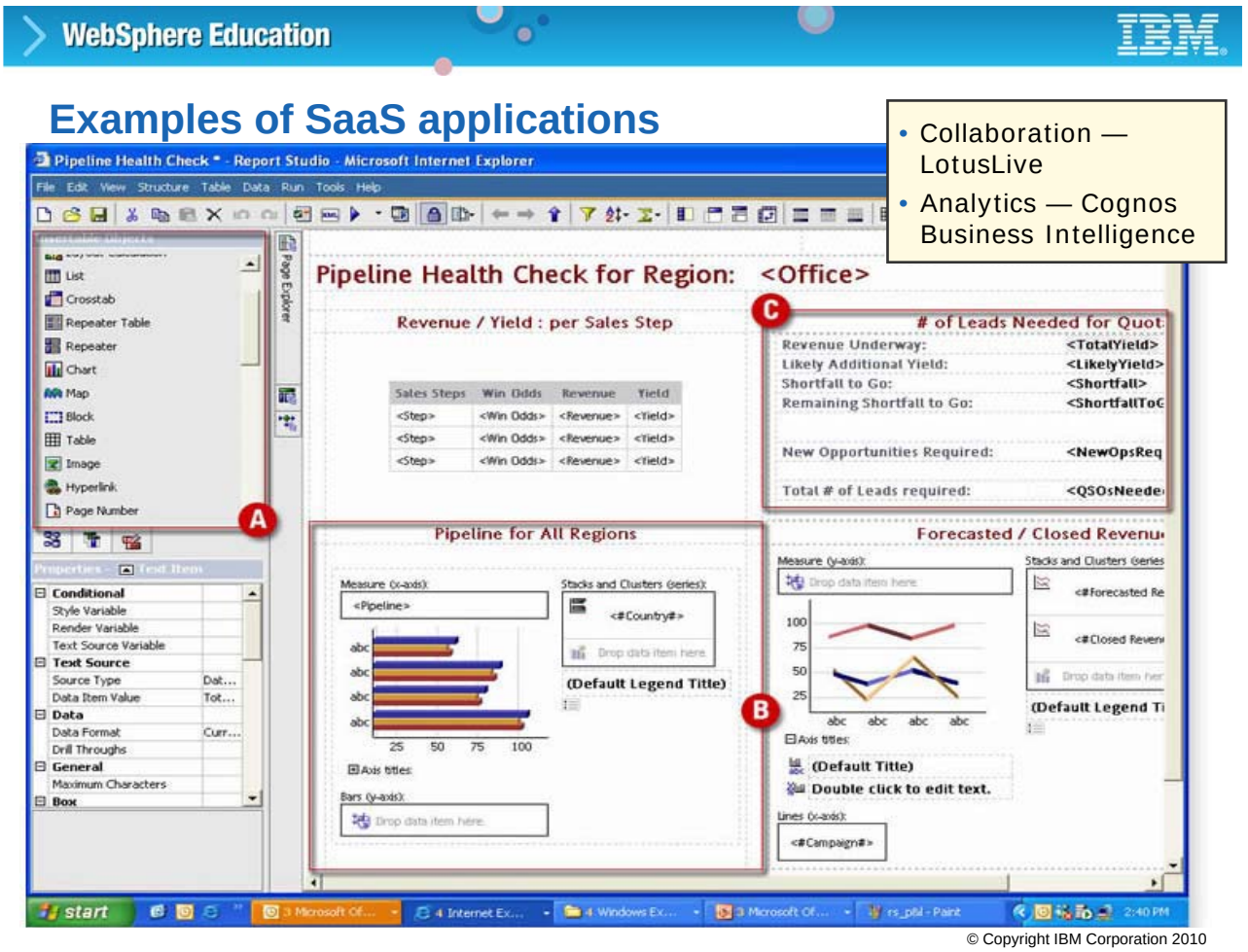

Figure 3-12. Examples of SaaS applications WS009 / VS0091.0

Notes:

An example of software as a service cloud application for collaboration is IBM LotusLive; an example for analytics is the Cognos Business Intelligence reporting and analytic software.

Further information on these SaaS applications is provided in the unit on IBM cloud computing architecture and offerings.

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Trade-off in cost to install versus flexibility

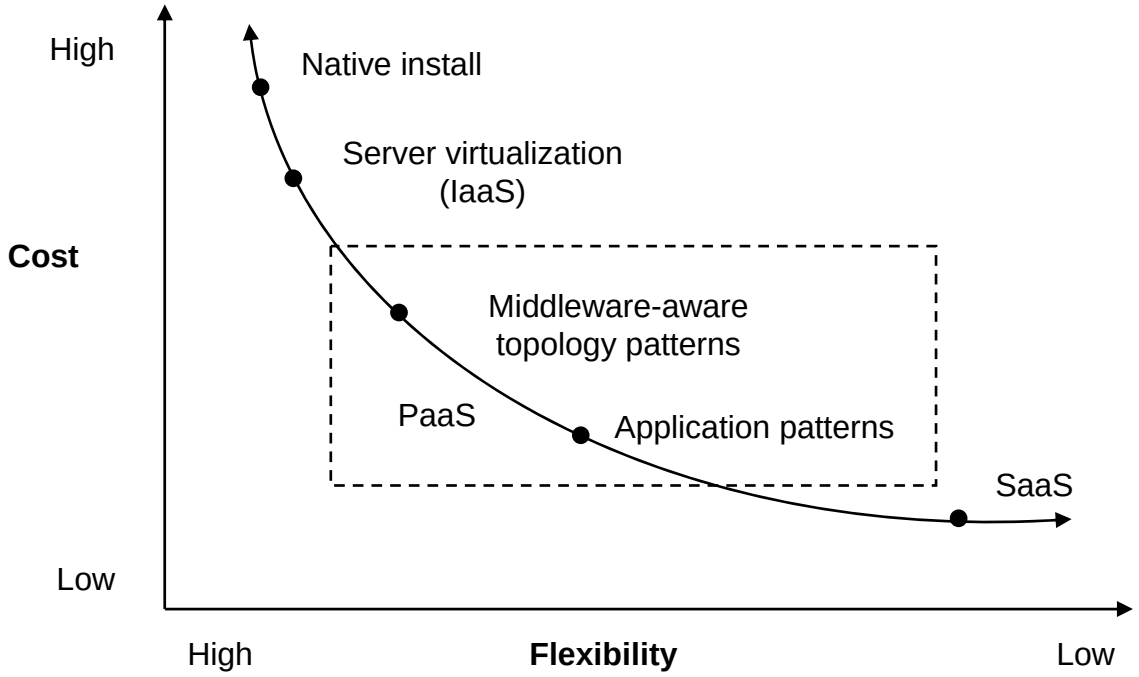

Figure 3-13. Trade-off in cost to install versus flexibility WS009 / VS0091.0

Notes:

This diagram shows the trade-off between cost and savings in using standardized services (on the lower right) and the higher cost (although greater flexibility) of building your own custom environment (upper left of the diagram).

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Other cloud service models

- Data as a service
  - Google Public Data Explorer lets you create your own visuals from Google App data
  - Assumes some public data already exists in the Cloud
- Testing as a service
  - Within IBM, the Integrated Test Enablement (ITE) cloud has been created to provide a common automation and test strategy for developers across the various IBM product brands
  - Used to create reusable test assets
- Integration as a service
  - Cast Iron (now part of IBM)
  - Boomi

Figure 3-14. Other cloud service models WS009 / VS0091.0

Notes:

A number of other service candidates have identified by market trends. These include such models as data as a service, testing as a service, and integration as a service.

Data as a service:

Google Public Data Explorer lets you create your own visuals from Google App data

Assumes some public data already exists in the cloud.

Testing as a service:

Within IBM, the Integrated Test Enablement (ITE) cloud has been created to provide a common automation and test strategy for developers across the various IBM product brands.

However, for the most part, these models could just as well fall into the SaaS or PaaS models.

In fact, the ITE cloud positions itself as a PaaS.

Cast Iron positions itself as a leading integrator of SaaS applications.

Boomi's Atmosphere product is marketed as connecting any combination of SaaS.

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Common cloud management platform reference architecture: Architecture overview diagram

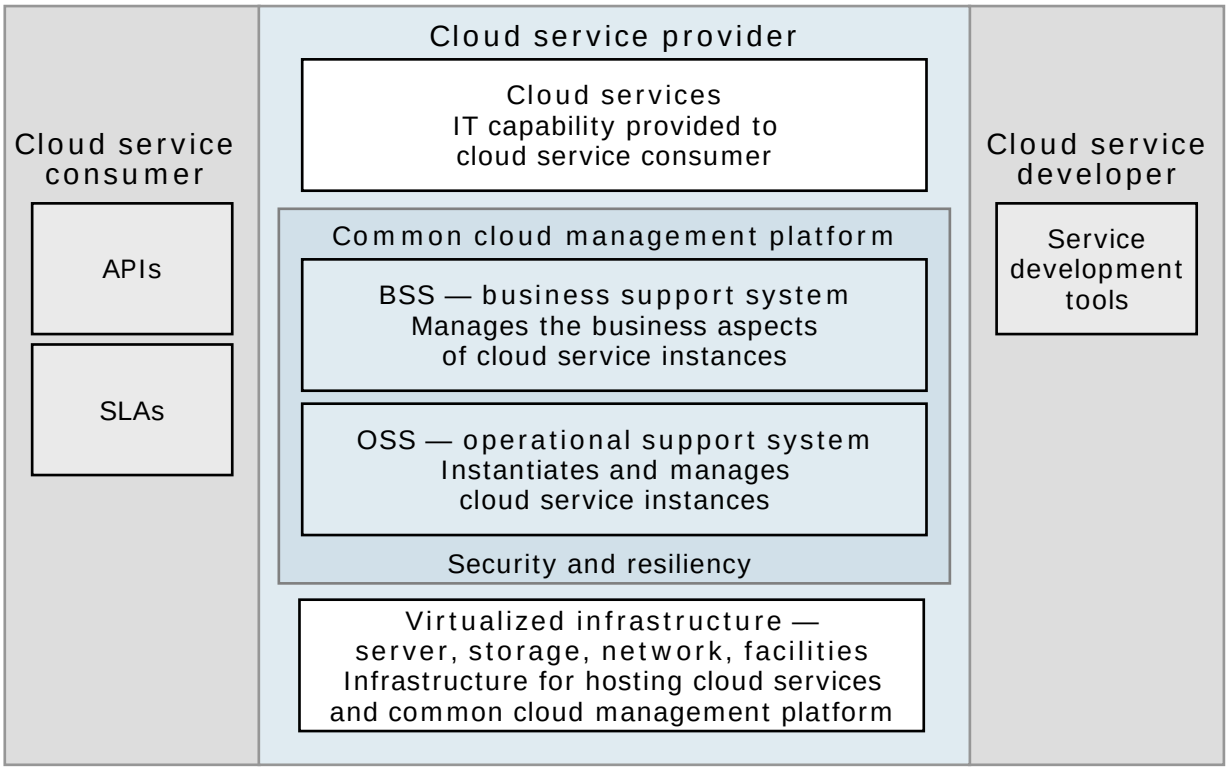

Figure 3-15. Common cloud management platform reference architecture: Architecture overview diagram WS009 / VS0091.0

Notes:

This slide shows the common cloud management architecture in the context of the PaaS service delivery model.

The business support system (BSS) enables capabilities such as subscription services for a pay-per-usage model.

The OSS layer is responsible for making resources available on demand, and for the security of the environment.

The cloud service provider makes cloud services available through its application programming interfaces (APIs) to the cloud service consumer.

To instantiate a new cloud instance, the service consumer sends a request to the cloud provider. The request is delegated to the operational support system or OSS that initiates and manages cloud service instances. Once a new instance of the cloud has been created and the response has been sent to the user

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Common cloud management platform

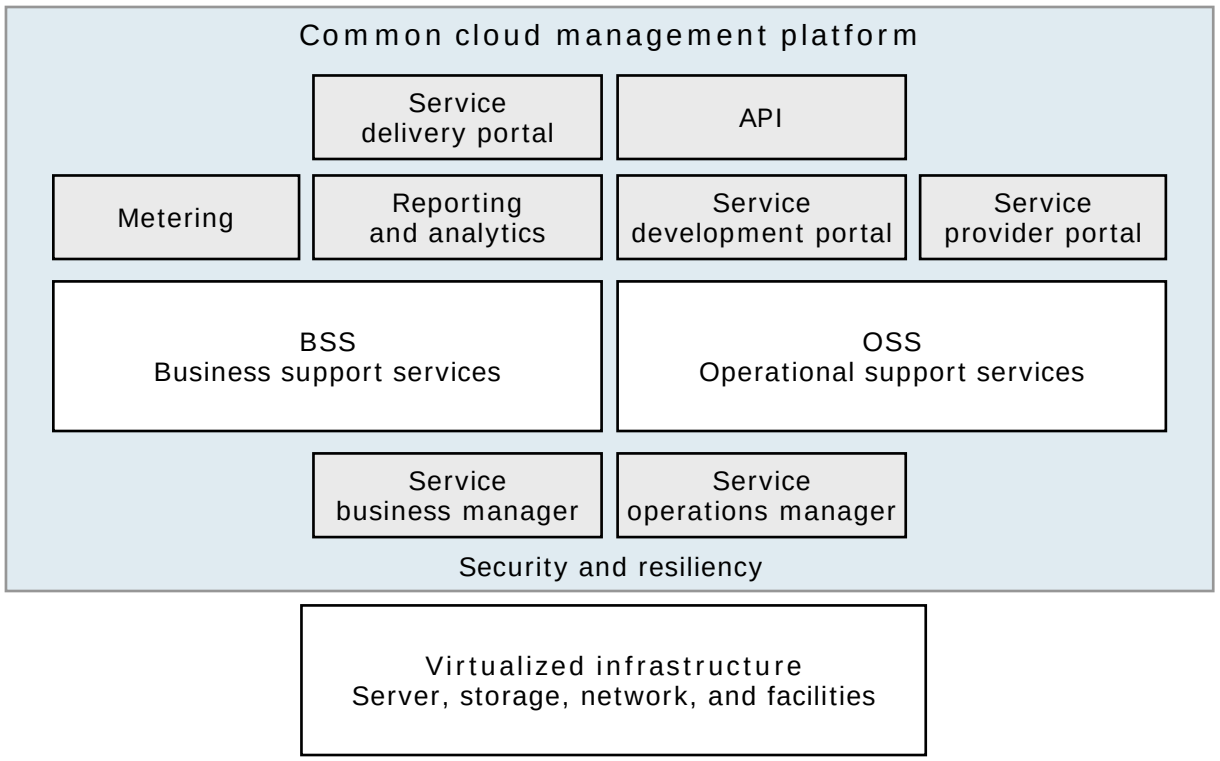

Figure 3-16. Common cloud management platform WS009 / VS0091.0

Notes:

The cloud management platform enables you to manage, deploy, and automate business applications on the cloud. The operational support services manages the creation of cloud service instances. The business support services manages the business aspects of cloud service instances, including things like measuring and metering, reporting, and analytics.

Depending on the environment, the user interface to the cloud management platform can be anything from a comprehensive portal interface, to a simple API. These programming interfaces manage the virtual machine images and the virtualized infrastructure.

Unit summary

Having completed this unit, you should be able to:

- Describe the service delivery models of cloud computing
- Explain software as a service (SaaS)
- Explain platform as a service (PaaS)
- Explain infrastructure as a service (IaaS)
- Describe additional cloud services
- Illustrate a reference architecture for the PaaS cloud computing model

Figure 3-17. Unit summary WS009 / VS0091.0

Notes:

Checkpoint

1. True or false: A design pattern can be described as “a named description of a proven design problem to a recurring solution, within a given context”.

2. True or false: Using a prebuilt SaaS component gives you the most flexibility in tailoring the software.

3. Match the following descriptions with the best definition:

Description	Definition
1) Service provider supplies the software or middleware where the applications run on	A. Platform as a service
2) An entire computing environment is made available as a service	B. Software as a service
3) Service provider is responsible for the creation and maintenance of the application	C. Infrastructure as a service

Figure 3-18. Checkpoint (objective only) WS009 / VS0091.0

Notes:

Write your answers here:

1.

2.

3. 1)
   2)
   3)

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Checkpoint answers

1. True or false: A design pattern can be described as “a named description of a proven design problem to a recurring solution, within a given context”.
   Correct answer: False.
   A design pattern can be described as: “A named description of a proven design *solution* to a recurring *problem*, within a given context”
2. True or false: Using a prebuilt SaaS component gives you the most flexibility in tailoring the software.
   Correct answer: False.
3. Match the following descriptions with the best definition:

Description	Definition
1) Service provider supplies the software or middleware where the applications run on	A. Platform as a service
2) An entire computing environment is made available as a service	C. Infrastructure as a service
3) Service provider is responsible for the creation and maintenance of the application	B. Software as a service

Figure 3-19. Checkpoint answers WS009 / VS0091.0

Notes:

Unit 4. Cloud deployment scenarios

What this unit is about

This unit describes the various cloud deployment models. These include the private, public, community and hybrid cloud models.

What you should be able to do

After completing this unit, you should be able to:

- List the four major cloud deployment types
- Describe the features of private, public, hybrid, and community clouds
- List some additional cloud deployment types
- Select the most appropriate deployment model based on a set of business and technical requirements

How you will check your progress

- Checkpoint

References

http://csrc.nist.gov/groups/SNS/cloud-computing/index.html

Unit objectives

After completing this unit, you should be able to:

- List the four major cloud deployment types
- Describe the features of private, public, hybrid, and community clouds
- List some additional cloud deployment types
- Select the most appropriate deployment model based on a set of business and technical requirements

Figure 4-1. Unit objectives WS009 / VS0091.0

Notes:

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Cloud deployment models

The National Institute of Standards and Technology (NIST) defines four cloud deployment types:

- Public cloud
  - Service provider lets clients access the cloud via the Internet
  - Made available to the general public or a wide industry group
- Private cloud
  - The cloud infrastructure is used solely by the organization that owns it
  - May reside in-house or off premises
- Hybrid cloud
  - Composed of two or more clouds (private, public, or community) that remain unique entities, but that can interoperate using standard or proprietary protocols
- Community cloud
  - Shared by several organizations that have a common mission

Figure 4-2. Cloud deployment models WS009 / VS0091.0

Notes:

The National Institute of Standards and Technology (NIST) defines four cloud deployment types: public, private, hybrid, and community clouds.

Public cloud:

- Service provider lets clients access the cloud via the Internet
- Made available to the general public or a wide industry group

Private cloud:

- The cloud infrastructure is used solely by the organization that owns it
- May reside in-house or off premises

Hybrid cloud:

- Composed of two or more clouds (private, public, or community) that remain unique entities, but that can interoperate using standard or proprietary protocols

Community cloud:

Shared by several organizations that have a common mission

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Public clouds

- Multitenant infrastructure
- Anyone may use
- Functions vary
- Fee arrangements vary

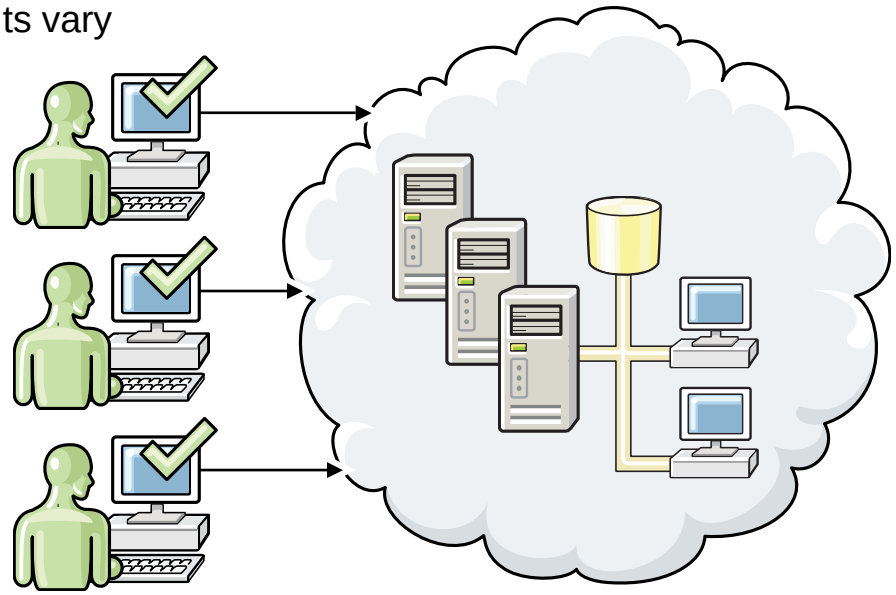

Figure 4-3. Public clouds WS009 / VS0091.0

Notes:

A public cloud is one in which a third-party provider makes resources, such as applications and other computing resources, to the general public via the Internet. A public cloud does not necessarily mean that it is free, although it can be free or inexpensive to use. It may be offered on a pay-per-usage model.

The cloud service provider is responsible for setting up the hardware, software, applications, and networking resources.

Public clouds do not imply that the user's data is public. In many cases, access control mechanisms are required before the user can make use of cloud resources.

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Private clouds

- Secure, dedicated infrastructure
- User buys or leases the cloud

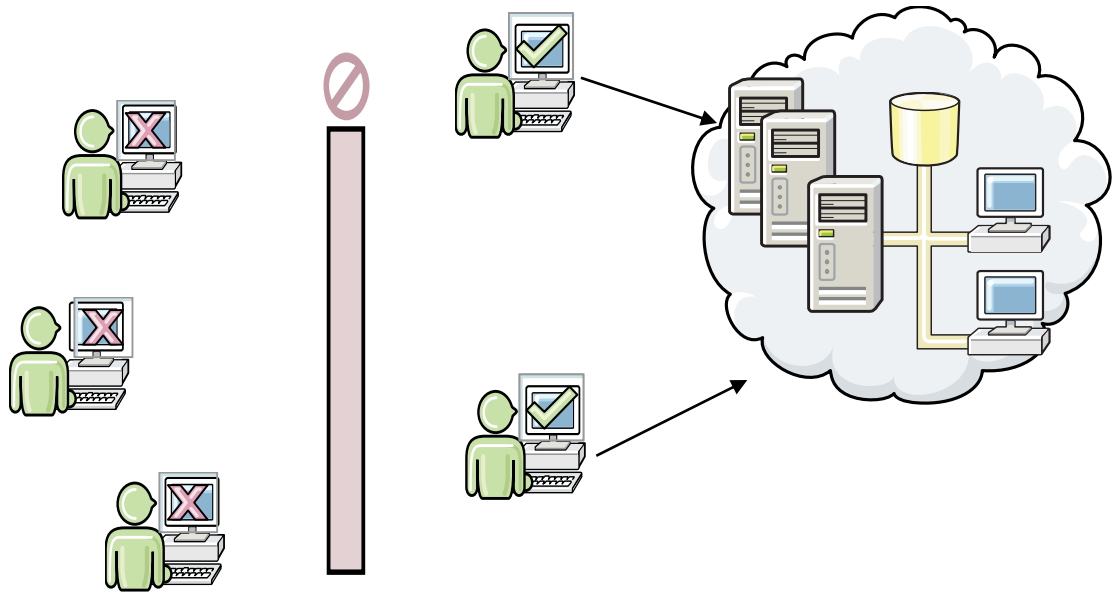

Figure 4-4. Private clouds WS009 / VS0091.0

Notes:

With a private cloud, computing resources are pooled and managed internally. This provides for greater efficiencies. Resources can be applied dynamically according to demand. A private cloud allows the enterprise to continue to follow workflow and security procedures. This ensures that the correct level of “code” is executing. These types of clouds are not burdened by network bandwidth and availability issues or potential security exposures that may be associated with public clouds. Private clouds can offer the provider and user greater control, security, and resilience.

The IBM Smart Business Development and Test Cloud is an example of a private cloud that can be installed on customer sites to provide on-demand provisioning of physical and virtualized test resources — including IBM and non-IBM components such as operating systems, middleware, storage, network, images, and data.

For details of this offering, visit: **www.ibm.com/cloud**

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Hybrid clouds

- Allows applications and data to flow across clouds
- Requires interoperability, visibility, and management
- Supports a very flexible performance model

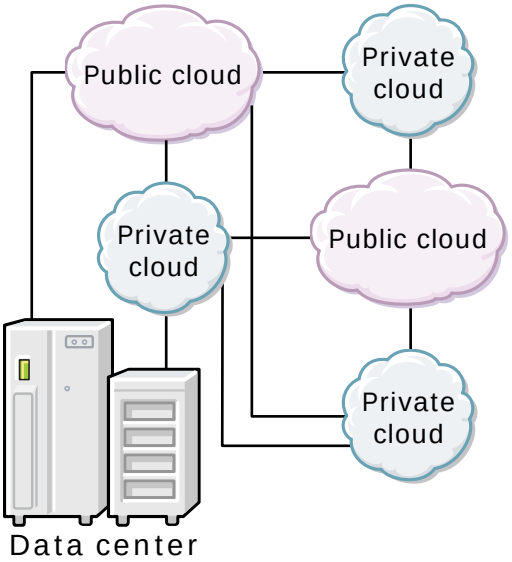

Figure 4-5. Hybrid clouds WS009 / VS0091.0

Notes:

Hybrid clouds are combinations of public and private clouds that work together.

In this model, IT typically outsources noncritical information and processing to the public cloud, while keeping business critical services and data in their control.

The hybrid cloud environment works to seamlessly integrate external applications on other private and public clouds, with your in-house processes.

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Community clouds

- Used and controlled by a group of organizations with a shared interest
- Private cloud purchased by a single user to support a community of users
- Fees may be charged to subsidiaries
- Functions vary
- Common functions
  - Computer ower
  - Storage
  - Elasticity
  - Community-wide sharing of data and applications

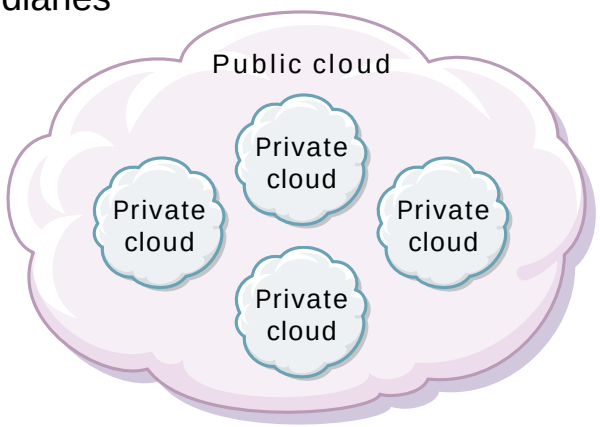

Figure 4-6. Community clouds WS009 / VS0091.0

Notes:

A community cloud can be a private cloud purchased by a single user to support a community of users, or a hybrid cloud with the costs spread over a few users of the cloud.

A community cloud is often set up as a sandbox environment where community users can test their applications, or access cloud resources.

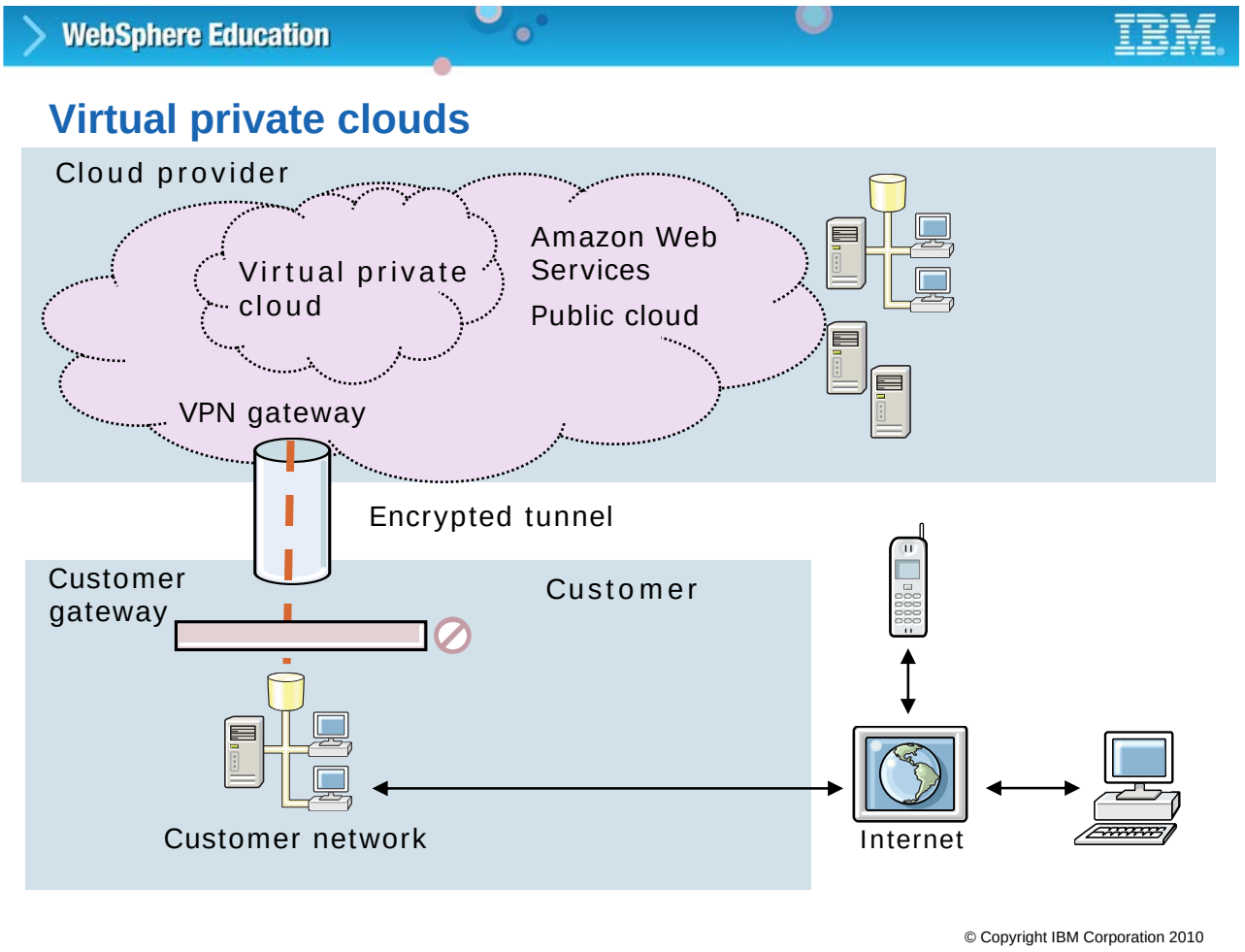

Figure 4-7. Virtual private clouds WS009 / VS0091.0

Notes:

A virtual private cloud (VPC) is dedicated to a single user within a public cloud.

The virtual private cloud extends the customer network into the cloud provider's "space", making the additional resources available on demand.

In this example, the customer can access a number of isolated subnets, or private IP address ranges, in the Amazon Web Services cloud. Traffic flowing between the VPC and the Internet is routed over the VPN connection so that it can be examined using the customer's existing security and networking assets before heading to the public Internet.

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Vertical and special purpose clouds

- Vertical clouds
  - Clouds for particular industries
  - May contain information, applications, services for that industry
- Horizontal clouds
  - Clouds for a purpose
  - Examples: development, test, collaboration, budgeting
- Regional clouds
  - Localized
  - Compliant to government regulations

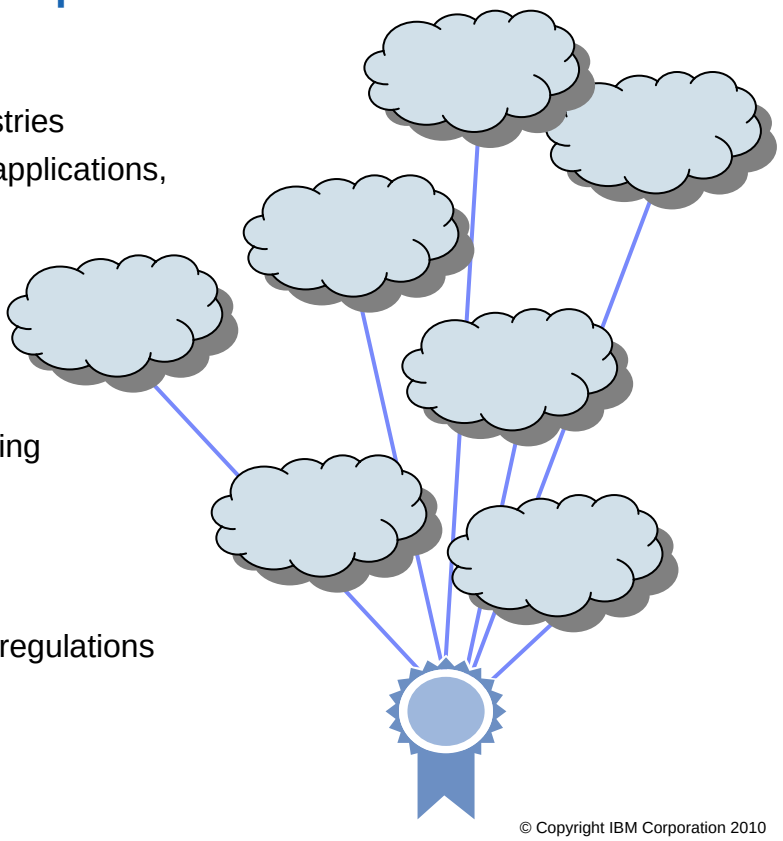

Figure 4-8. Vertical and special purpose clouds WS009 / VS0091.0

Notes:

This diagram shows some of the other cloud deployment types that may appear in cloud terminology.

These cloud types may be considered subtypes of community clouds.

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Migration paths for cloud adoption

- Use public clouds
  - Smaller organizations can use resources provided by larger cloud service providers
- Develop private clouds
  - Build or procure private clouds
  - Metering and chargeback
- Build or procure community clouds
  - For organizations that share common goals
  - Shared infrastructure or sandbox environment
- Use hybrid clouds
  - Balance workloads between clouds

Figure 4-9. Migration paths for cloud adoption WS009 / VS0091.0

Notes:

There is no single correct answer on how to get started using clouds.

One suggestion is to sign up to use a public cloud such as the IBM Smart Business Development and Test Cloud or Amazon Elastic Compute Cloud (EC2). Once signed up, you have access to a predefined set of cloud resources. You can launch a cloud instance, connect to an instance, and terminate an instance.

Smaller enterprises may use SaaS and public clouds to limit the growth of their data centers.

A second approach is to build or procure your own private cloud. IBM provides a service to build a custom version of the Smart Business Development and Test cloud, and will install it at the customer's site.

When developing private clouds, you should also consider the metering of resources so that you can determine the costs of doing business in the cloud.

Larger organizations may use a hybrid cloud infrastructure to balance workloads across internal and public clouds.

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Selection criteria for cloud deployment types (1 of 4)

- Private clouds
  - Provides a dedicated and secure infrastructure
  - Limited by the organization's physical hardware and other resources
  - Can be run off premises by a third-party infrastructure provider
  - Does not require federated identity, location awareness, common APIs

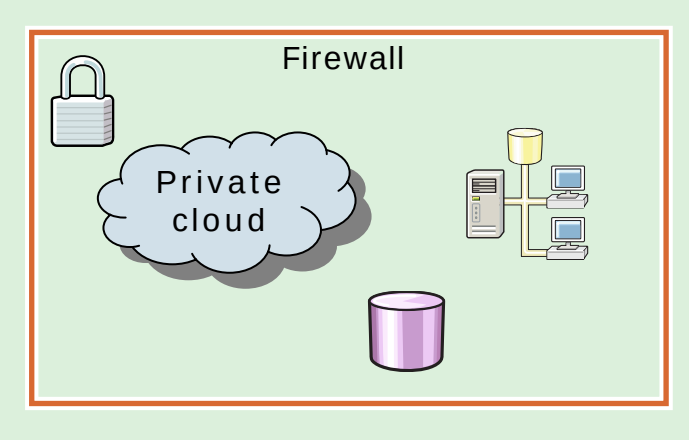

Figure 4-10. Selection criteria for cloud deployment types (1 of 4) WS009 / VS0091.0

Notes:

Security issues may drive how organizations deploy cloud infrastructures. Private clouds have less of a security threat than community clouds, which in turn have less security threat than public clouds.

With private clouds, the owner has complete control of the security mechanism and architecture. With other types of clouds, the organization may have to interface with other security implementations.

With a private cloud, computing power is spread across the enterprise. Departments are not limited to simply their own departmental resources, and they can utilize other departments' resources during periods of peak loads.

Applications running on a private cloud are generally not required to deal with federated identity, location awareness, standards-based APIs, or common APIs for middleware.

Note that running a private cloud still requires all of the governance and management that apply to IT. Requirements include an open client, security, metering and monitoring, and service level agreements.

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Selection criteria for cloud deployment types (2 of 4)

- Public clouds
  - Low cost data storage and disaster recovery solution
  - Expertise is provided
  - Easy access to public domain applications and storage such as Google Apps, Google Docs, and Gmail
  - Issues switching cloud providers

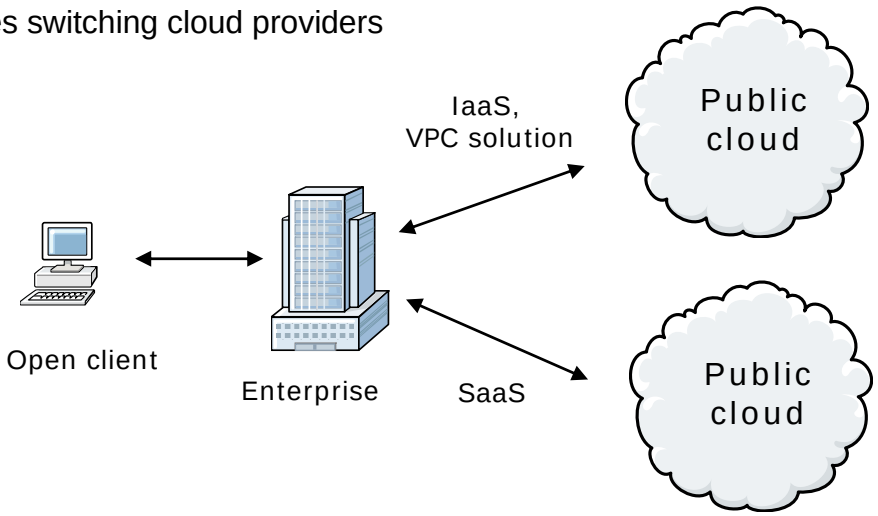

Figure 4-11. Selection criteria for cloud deployment types (2 of 4) WS009 / VS0091.0

Notes:

Strong security controls are required for most cloud deployments. The organization hosting the public cloud is likely to perform all of the required due diligence to ensure the security of the user's data.

Using a public cloud as a data storage or disaster recovery solution may be a low-cost alternative to building your own. The cloud solution is a pay-per-usage basis, and the capital cost required to set up an in-house solution may be much higher. In this way, you are turning fixed costs into variable costs.

Google allows Google Apps users to upload and store files in Google Docs. This is a cheap way for developers and users to use a cloud-based storage service to store and access their files. Users can access their data with a browser using any device. Access to the data is secured via password protection.

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Selection criteria for cloud deployment types (3 of 4)

- Community clouds
  - Shared infrastructure or hosted by a third-party
  - Shared costs
  - Shared mission, policy and compliance
  - Requires commitment from all parties

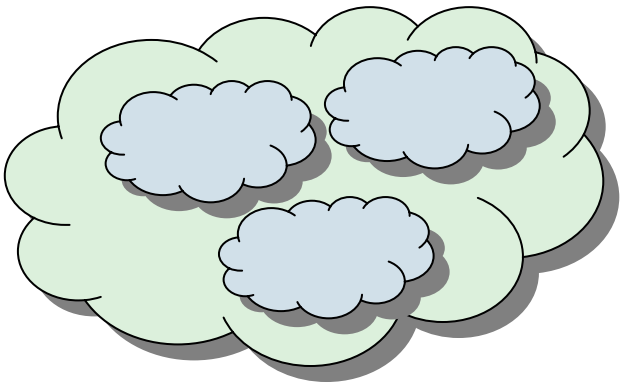

Figure 4-12. Selection criteria for cloud deployment types (3 of 4) WS009 / VS0091.0

Notes:

This types of cloud infrastructure can be shared by several organizations that support a specific community, such as health care or local governments. The benefit of this approach is the ability to easily share a vast array of resources among the participating community. Building this type of infrastructure requires a huge investment in terms of expertise, computing resources, and support.

Some of the challenges include deciding who funds the capital costs to build the infrastructure, who is responsible for managing and maintaining the cloud, and legal compliance issues.

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Selection criteria for cloud deployment types (4 of 4)

- Hybrid clouds
  - Using services of vendors on private clouds costs money
  - Consider moving some systems to an off-premises data center with applications offered back as a service
  - Heightened security concerns

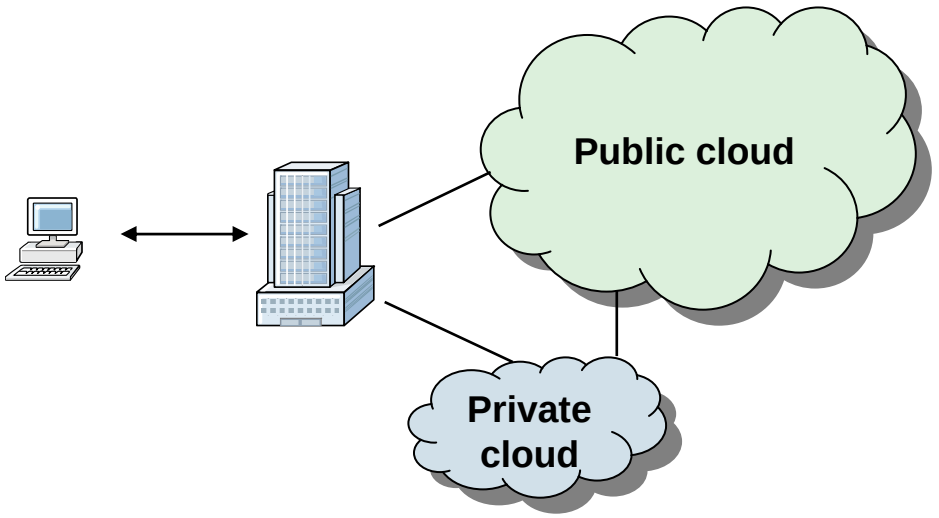

Figure 4-13. Selection criteria for cloud deployment types (4 of 4) WS009 / VS0091.0

Notes:

Instead of hosting all of your applications on your own private cloud, you can move some noncritical applications to an off-premises cloud hosted by a third-party provider that offers these back as a service. Or you can use alternative applications that are freely available in public clouds.

A single vendor hybrid cloud solution such as VMware vCloud lets you federate resources between internal and external clouds. This is advantageous since you do not need to interface with different vendor APIs.

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Case study example: IBM ITE cloud (1 of 3)

- Integrated Test Enablement (ITE) cloud
  - IBM Software Group internal roll out of cloud technology, automation, and tooling for developers across the various brands in the organization
- Mission:
  - Define common processes for accessing resources and capacity
  - Leverage cloud-based resources for high-volume testing
  - Deploy a common automation strategy to produce reusable test assets
  - Utilize IBM Rational and Tivoli brand products as the common tooling infrastructure
  - Host common test services to drive cost and infrastructure efficiencies
  - Deploy test configurations within hours or minutes instead of days

Figure 4-14. Case study example: IBM ITE cloud (1 of 3) WS009 / VS0091.0

Notes:

The Integrated Test Enablement (ITE) cloud is an internal IBM Software Group initiative to provide cloud-based access to automation and test facilities for their software developers.

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Case study example: IBM ITE cloud (2 of 3)

The situation prior to using the ITE cloud:

- Without ITE
  - Each team must reserve hardware for testing infrastructure
  - Each team incurs the direct cost to install and configure the infrastructure

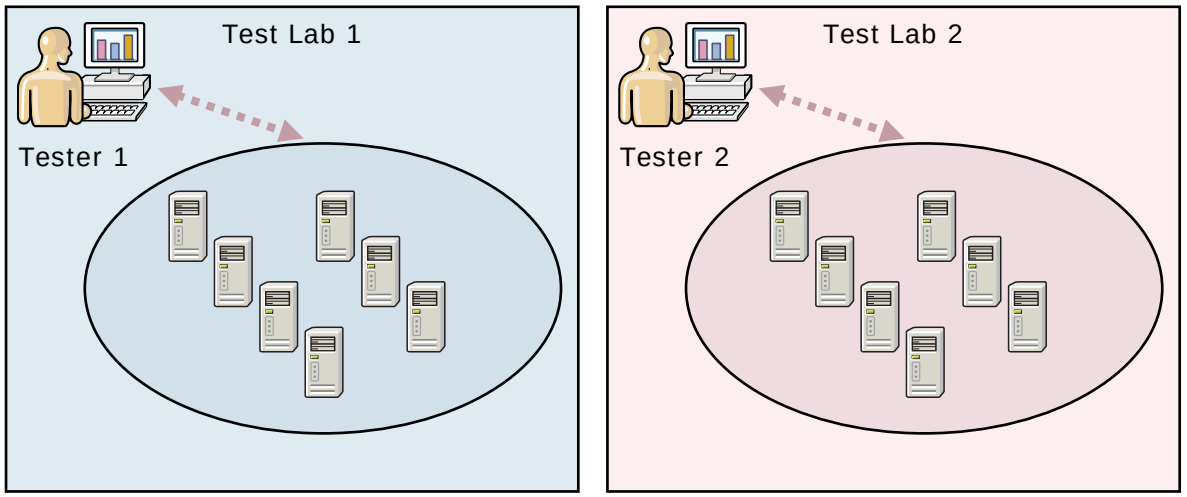

Figure 4-15. Case study example: IBM ITE cloud (2 of 3) WS009 / VS0091.0

Notes:

Prior to using the ITE cloud-based solution, the teams for each brand within the IBM Software Group needed to provision their own hardware and network infrastructure. After these resources had been acquired and installed, each team had to install, configure, and deploy the software necessary to run their regression tests.

The time and costs spent on procuring, configuring, and replicating the environment are replicated for each test lab environment. There is no sharing of resources, and so each team must create an environment that meets the peak loads for their test cases.

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Case study example: IBM ITE cloud (3 of 3)

- With the Integrated Test Enablement (ITE) cloud

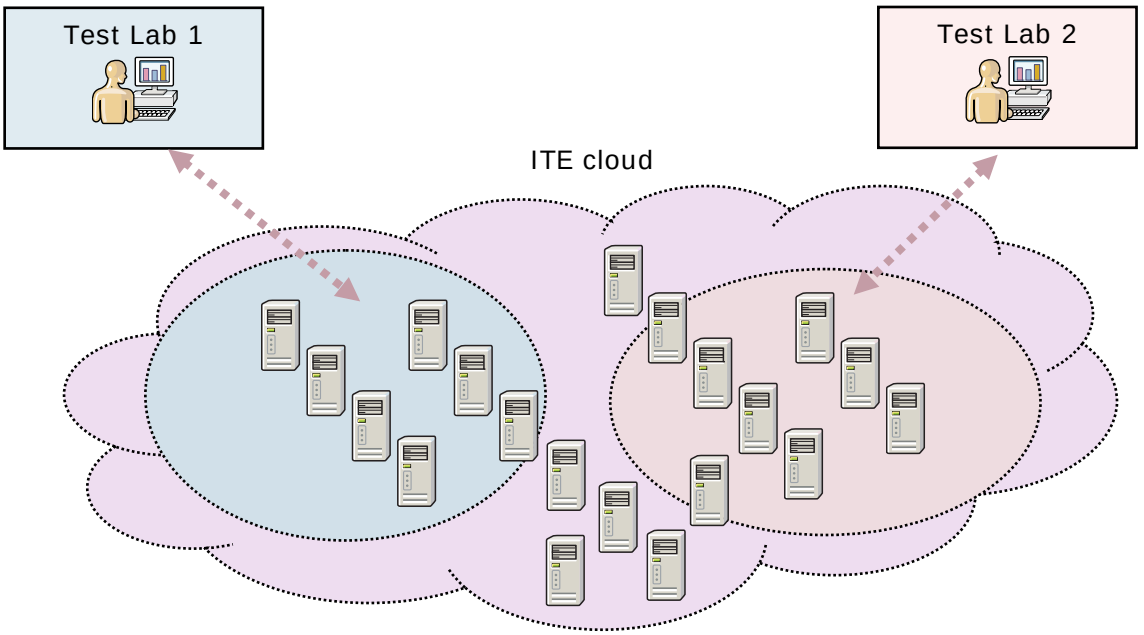

Figure 4-16. Case study example: IBM ITE cloud (3 of 3) WS009 / VS0091.0

Notes:

The diagram shows the ITE solution private cloud delivered as a platform as a service (PaaS) model.

Each team requests an instance of the test tooling infrastructure that is provisioned for them from the ITE cloud.

Each instance includes script and automation libraries to install the required testing software and test cases.

The ITE cloud lets each team access all resources that they need from a pool of virtualized resources. These resources can be provisioned and deprovisioned dynamically, allowing for the elastic use of resources across the testing teams.

Unit summary

Having completed this unit, you should be able to:

- List the four major cloud deployment types
- Describe the features of private, public, hybrid, and community clouds
- List some additional cloud deployment types
- Select the most appropriate deployment model based on a set of business and technical requirements

Figure 4-17. Unit summary WS009 / VS0091.0

Notes:

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Checkpoint

1. Select the correct answer:
   A private cloud deployment has the following characteristic or characteristics:
   A. Heightened security requirements
   B. Is surrounded by a firewall
   C. Is run on the enterprise premises
   D. All of the above

2. Select the correct answer:
   Which of these is *least* likely to be an issue in private cloud deployments?
   A. Monitoring and measurement
   B. Security
   C. Governance
   D. Federated identity

Figure 4-18. Checkpoint (objective only) WS009 / VS0091.0

Notes:

Write your answers here:

1.

2.

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Checkpoint answers

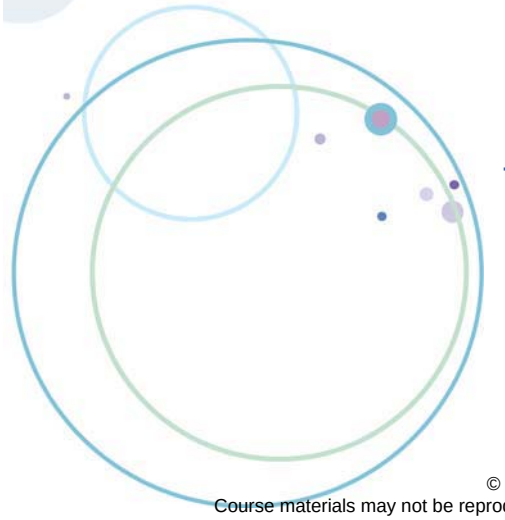
1. Select the correct answer:
   A private cloud deployment has the following characteristic or characteristics:
   A. Heightened security requirements
   B. Is surrounded by a firewall
   C. Is run on the enterprise premises
   D. All of the above
   Answer: B

2. Select the correct answer:
   Which of these is *least* likely to be an issue in private cloud deployments?
   A. Monitoring and measurement
   B. Security
   C. Governance
   D. Federated identity
   Answer: D

Figure 4-19. Checkpoint answers WS009 / VS0091.0

Notes:

Demonstration



Requesting contract forms for the IBM Smart Business Development and Test Cloud

Figure 4-20. Demonstration WS009 / VS0091.0

Notes:

Demonstration objectives

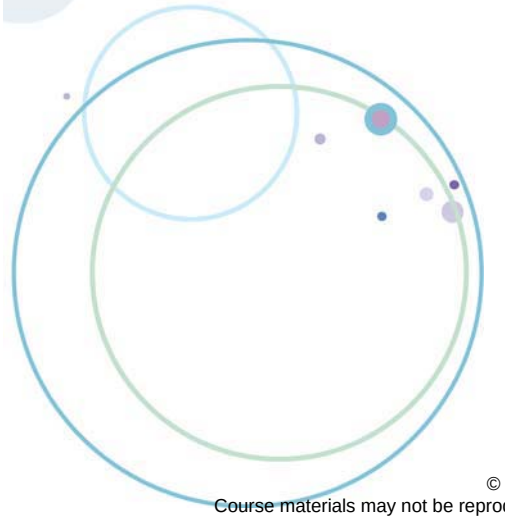
After completing these demonstrations, you should be able to:

- Request a contract for the IBM Smart Business Development and Test Cloud

Figure 4-21. Demonstration objectives WS009 / VS0091.0

Notes:

Demonstration



Reviewing a contract for the IBM Smart Business Development and Test Cloud

Figure 4-22. Demonstration WS009 / VS0091.0

Notes:

Demonstration objectives

After completing these demonstrations, you should be able to:

- Review a contract for the IBM Smart Business Development and Test Cloud

Figure 4-23. Demonstration objectives WS009 / VS0091.0

Notes:

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Demonstration instructions (optional)

1. Extract **`Cloud_demos.zip`** to your hard drive, ensuring that you select **Use folder names** when extracting the file
2. Navigate to **`\Cloud_demos`**; then double-click **`simulations.html`** to start the demonstrations
3. Select **Demonstration: Request contract forms for the IBM Smart Business Development and Test Cloud** to run the first demonstration
4. When completed, select **Demonstration: Review a contract for the IBM Smart Business Development and Test Cloud** to run the second demonstration

Figure 4-24. Demonstration instructions (optional) WS009 / VS0091.0

Notes:

Unit 5. Security in cloud computing

What this unit is about

This unit describes the security considerations in cloud computing.

What you should be able to do

After completing this unit, you should be able to:

- Review the integration of security into the cloud reference model
- Describe security considerations in cloud computing, including cloud security risks and cloud security breaches
- Identify security options available in cloud computing
- Formulate identity management techniques, including detection and forensics and encryption
- Identify the top security threats to cloud computing

How you will check your progress

- Checkpoint

Unit objectives

After completing this unit, you should be able to:

- Review the integration of security into the cloud reference model
- Describe security considerations in cloud computing, including cloud security risks and cloud security breaches
- Identify security options available in cloud computing
- Formulate identity management techniques, including detection and forensics and encryption
- Identify the top security threats to cloud computing

Figure 5-1. Unit objectives WS009 / VS0091.0

Notes:

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IBM

Topics

- Cloud security reference model
- Cloud security risks
- Principal security dangers to cloud computing
- Steps to reduce cloud security breaches
- Identity management
- Detection and forensics
- Encryption techniques

Figure 5-2. Topics

WS009 / VS0091.0

Notes:

5.1. Cloud security reference model

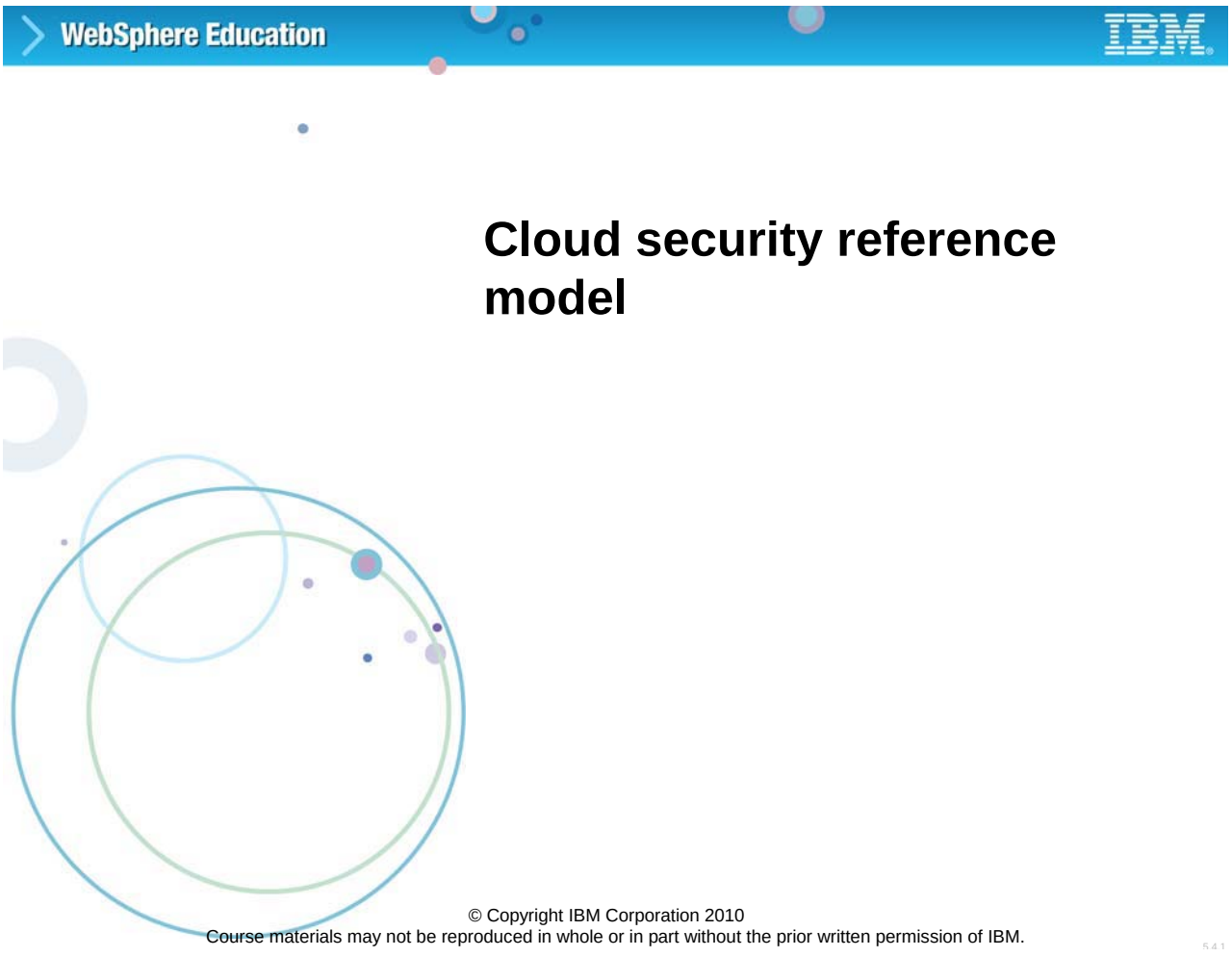

Figure 5-3. Cloud security reference model WS009 / VS0091.0

Notes:

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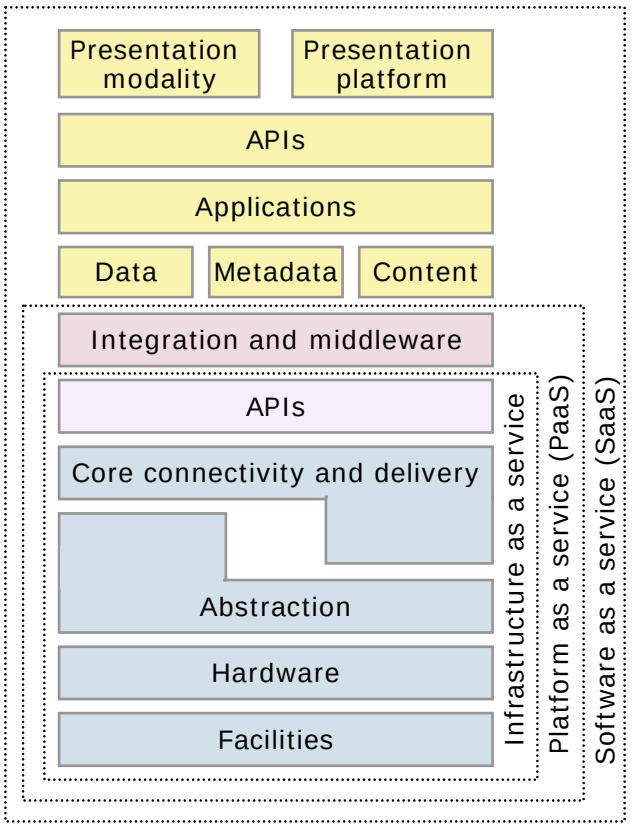
Cloud reference model



- The cloud computing model may be consider three subcomputing models: IaaS, PaaS, and SaaS
- The relationship and dependencies between these are important to fully grasp the security risks to cloud computing
  - IaaS is the base of all cloud services
  - PaaS is layered on top of IaaS
  - SaaS is built upon PaaS
- Layered architectures inherit capabilities
  - These capabilities include operations and functionality
  - Unfortunately, they also inherit risks, including security risks

Figure 5-4. Cloud reference model WS009 / VS0091.0

Notes:

Just as a quick recap, IaaS includes the infrastructure stack from facilities to hardware, and the interfaces required to manage them. PaaS, residing on top of IaaS, adds an additional layer of integration and application development. This may include middleware, such as MQ series, and databases. Developers are able to build applications using the PaaS stack.

SaaS resides upon PaaS and IaaS providing a self-contained operating unit that delivers the entire user experience, including all required software, such as presentation, content management, and user interface, graphical or other.

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How security gets integrated

- Cloud providers offer more services for customers at the top of the stack
- Therefore, SaaS, security from the customer's perspective, is contractual
- As customers move down the stack, such as an IaaS customer, they are responsible for building the security in their application and middleware layers (SaaS and PaaS functionality)

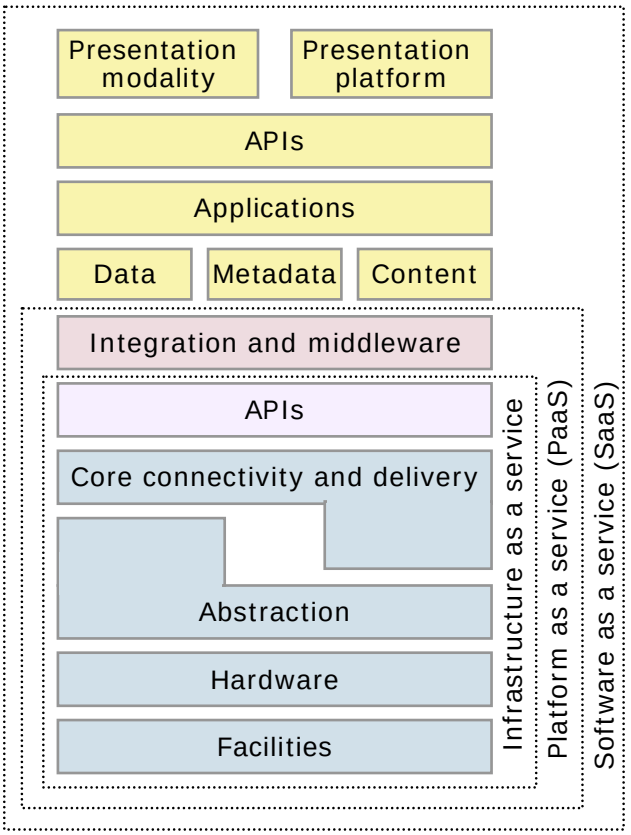

Figure 5-5. How security gets integrated WS009 / VS0091.0

Notes:

The cloud reference model is decomposed into three distinct groups, SaaS at the top, PaaS in the middle, and IaaS at the lowest level. The lower down the cloud reference model the consumer moves, that is going from SaaS down to IaaS, the more security the consumer is responsible for providing and managing.

There are trade-offs in each grouped layer of the model.

Generally speaking, SaaS provides the highest level of consumer functionality with the least amount of flexibility, requiring strong security already built-in.

PaaS provides a layer in which developers work, providing them the freedom to create functionality. This increased flexibility removes additional security layering that was provided in SaaS.

Finally, IaaS provides few application features but tremendous flexibility. This opens up the application layer and middleware layer requiring the cloud provider to focus the security capabilities on the operating system and underlying infrastructure.

5.2. Cloud security risks

Cloud security risks

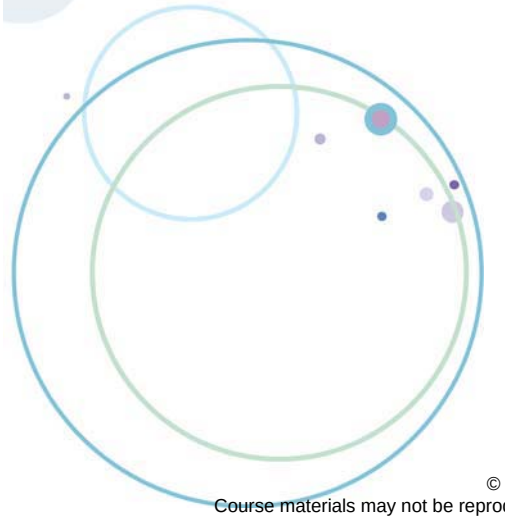

Figure 5-6. Cloud security risks WS009 / VS0091.0

Notes:

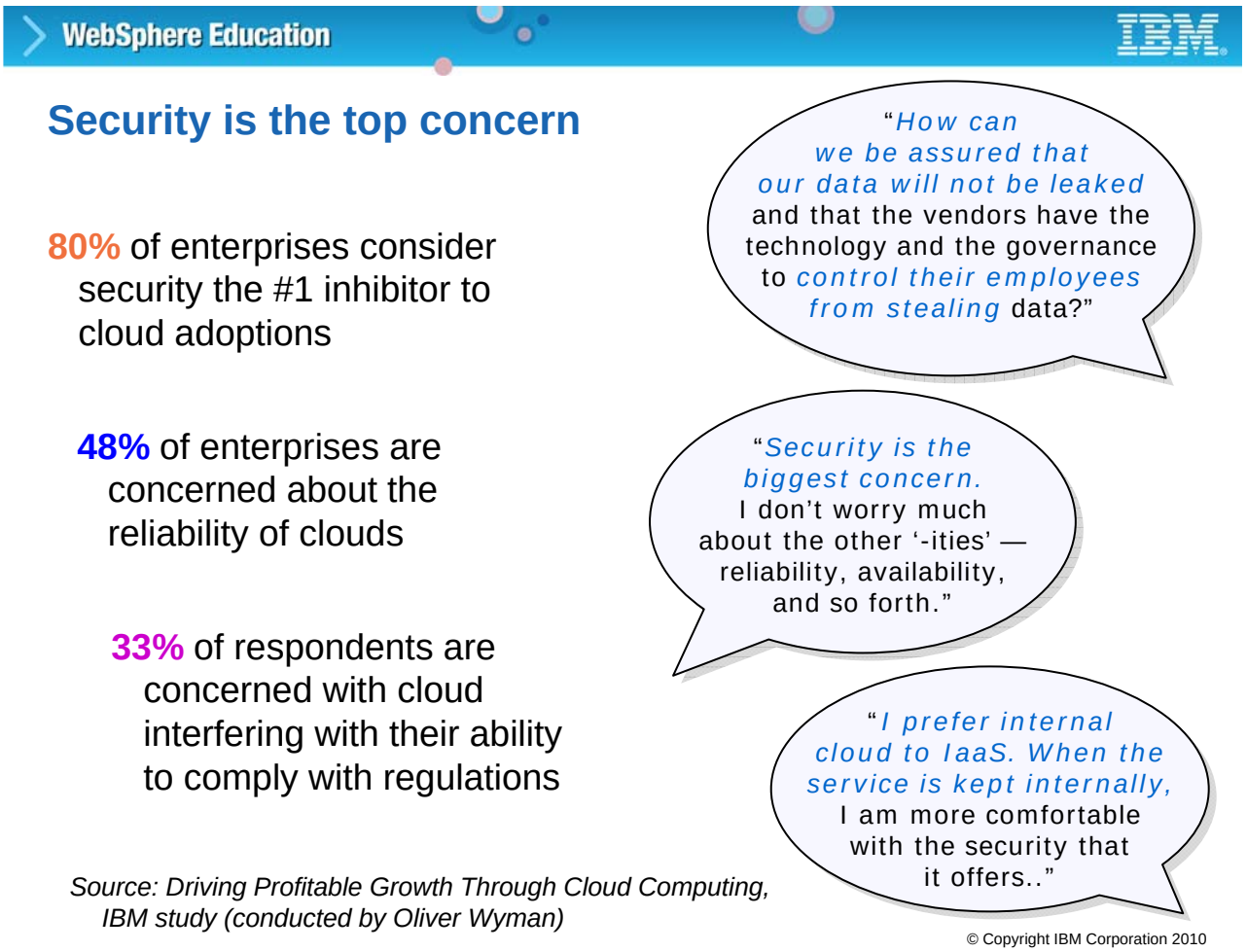

Figure 5-7. Security is the top concern WS009 / VS0091.0

Notes:

Security is the top concern for the adoption of cloud services.

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Understanding security risks

- IT security is a very complicated area of cloud computing for three reasons:
  - Security is trusted to the cloud provider; therefore, if the provider has not done a good job, there may be problems
  - Security is difficult to monitor, so problems may not be apparent until there is a problem
  - Measuring the quality of the cloud provider's security approach may be difficult because many cloud providers do not expose their infrastructure to customers
- Approximately 70% of security breaches are caused by insiders, (or people who get help from insiders)*
  - The security approach must deal with internal and external threats
- Often times with a cloud service agreement (contract), the agreement is crafted to protect the service provider, not the cloud customer
  - Cloud customers must have a deep level of understanding the contract

Source: Cloud Computing for Dummies, p. 176, Hurwitz, © 2010 by Wiley Publishing, Incorporated

Figure 5-8. Understanding security risks WS009 / VS0091.0

Notes:

There are good reasons that security, as on the last slide, is of top concern. IT security in cloud computing adds at least one critical layer of complexity. You, the consumer, are trusting security to an external source. This trusted relationship may add the challenge of monitoring and validating the security of the cloud provider, especially if the provider does not wish to expose their internal infrastructure to customers.

When an organization is relying on itself to meet service level agreements (SLA), there is a certain amount of control available to the customer. If there are problems within the organization's IT infrastructure, a manager may be able to get an executive to apply internal pressure, getting the attention required to meet the SLA. However, when the IT infrastructure, or layered services, are outside on an organization, the ability to apply pressure to get the required attention needed to fix the problem may rely on the details of the cloud contract and an external resource. With a poorly constructed contract, a consumer loses leverage.

5.3. Principal security dangers to cloud computing

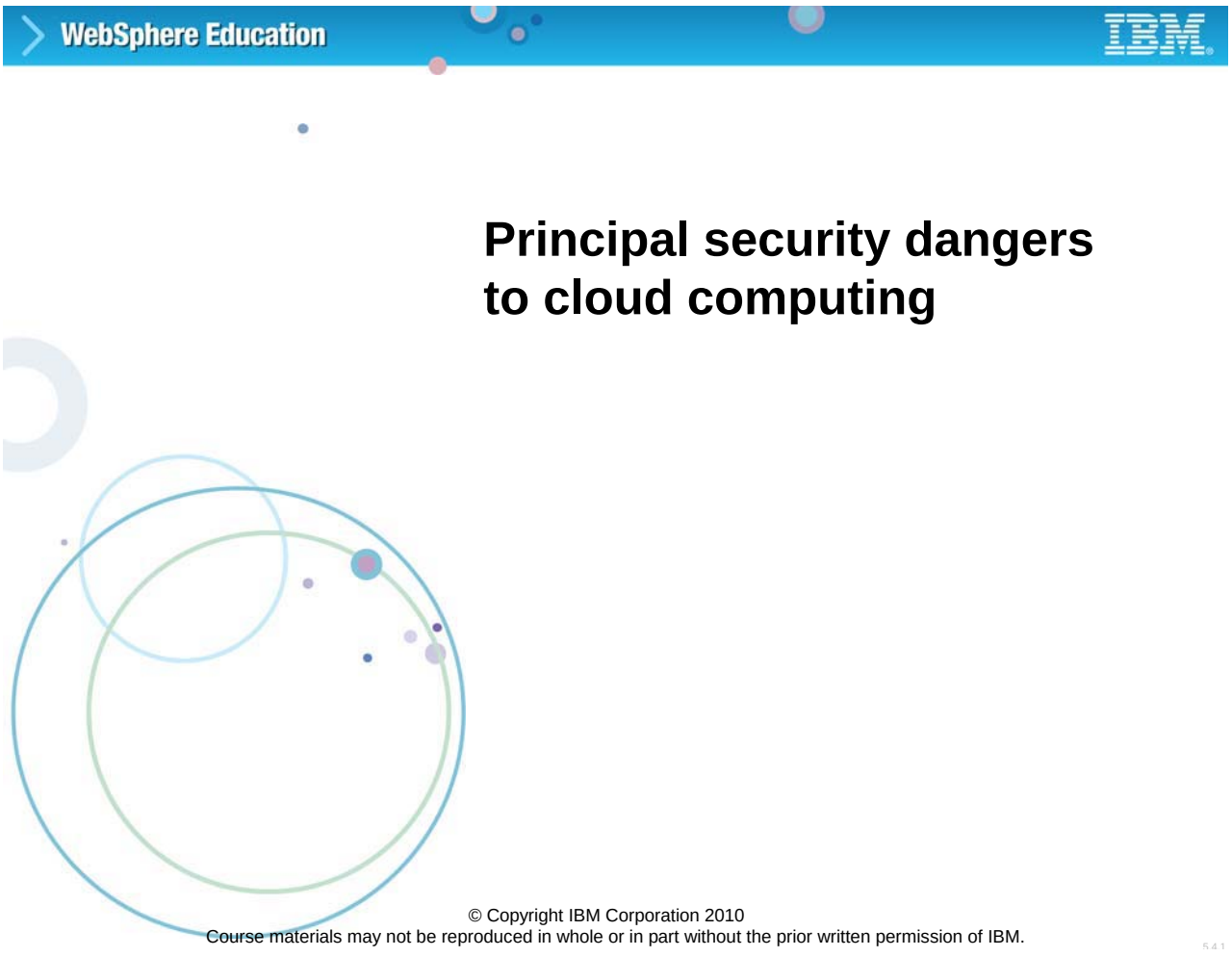

Figure 5-9. Principal security dangers to cloud computing WS009 / VS0091.0

Notes:

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Principal security dangers to cloud computing

- Virtualization and multitenancy
- Nonstandard and vulnerable APIs
- Internal security breaches
- Data corruption or loss
- User account and service hijacking

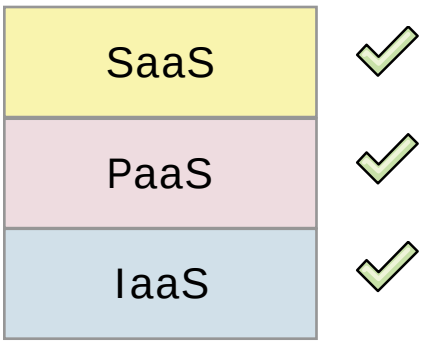

Figure 5-10. Principal security dangers to cloud computing WS009 / VS0091.0

Notes:

The principal security dangers to cloud computing include dangers that currently exist in pre-cloud computing. Cloud computing heightens the risks in certain dangers, such as data corruption, while introducing some new risks, such as virtualization and multitenancy.

Virtualization and multitenancy

- Cloud offers take advantage of economics of scale, offering shared services within their infrastructure
- Virtualization and multitenancy architectures make this possible
- However, these technologies were not designed with strong isolation in place
  - Hypervisors have extended these risks, potentially exposing the operating system
  - Creating an environment where attackers can gain access at the operating system level (hypervisors) and higher level services (functionality and data)
- To reduce these risks, consider:
  - Implement operating system security best practices, such as patch management
  - Implement application systems security best practices, such as AAA (authentication, authorization, and auditing)

Figure 5-11. Virtualization and multitenancy WS009 / VS0091.0

Notes:

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Nonstandard and vulnerable APIs

- Application programming interfaces (API) are the software interfaces that cloud providers offer, allowing customers access into their services
- Cloud API are not standardized, forcing users of multiple cloud providers to maintain multiprogramming interfaces, increasing complexity and security risk
- Since an API offers access to the internals of a system, a weak API exposes consumers to a variety of security issues encompassing all of the operational exposure the of the compromised API's functionality
- To reduce these risks, consider:
  - Implement API security best practices, such as requiring AAA (authentication, authorization, and auditing)
  - Review the cloud provider's security model being used for the API, including any API trusted chain

Figure 5-12. Nonstandard and vulnerable APIs WS009 / VS0091.0

Notes:

Internal security breaches

- The IT industry has well documented that over 70% of security violations are internal
  - This threat is amplified in cloud computing as both IT providers and consumers are under a single management domain
- To reduce these risks, consider the following key components of the contractual agreement between the customer and cloud provider:
  - Transparency in information and internal management practices
  - Understand the human resources requirements
  - Have a clear level of escalation and notification of a breach
  - Ensure that contractually you are in the loop if an internal breach occurs with the cloud provider (with your data or another customer's)

Figure 5-13. Internal security breaches WS009 / VS0091.0

Notes:

If another customer is breached by the cloud provider, you do not have the know the details of the information lost. However, you have a right to know the type of breach and what has been done to stop this type of breach from being repeated. Another customer's breach may offer insight into a potential hole in the cloud services being offered to you.

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Data corruption or loss

- Data corruption or loss is amplified since the cloud provider is the source for a companies data, not the company itself
- These operational characteristics of the cloud environment, at the PaaS and SaaS layers, amplify the threat of data loss or leakage increase
- To reduce these risks, consider:
  - Implement application systems security best practices, such as AAA (authentication, authorization, and auditing)
  - Implement strong encryption, SSL, digital signatures, and certificate practices
  - Ensure that strong disaster recovery processes exist and are tested on a periodic basis
  - Require that the persistent medium used to store your data is erased prior to releasing it back into the pool

Figure 5-14. Data corruption or loss WS009 / VS0091.0

Notes:

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User account and service hijacking

- User account and service hijacking occurs when a attacker obtains your cloud services information and uses it to take over your cloud access
- If attackers gain access to a cloud user's credentials, they can eavesdrop on activities and transactions, manipulate or steal data, return falsified data, and redirect clients to illegitimate sites
- To reduce these risks consider:
  - Implement security best practices, including human processes, such as strong passwords, two-factor authentication, and prohibiting the sharing of users' credentials
  - Implement application systems security best practices, such as AAA (authentication, authorization, and auditing)
  - Implement strong encryption, SSL, digital signatures, and certificate practices
  - Ensure that auditing and logging is being used to monitor activities

Figure 5-15. User account and service hijacking WS009 / VS0091.0

Notes:

Two-factor authentication means using any independent two of these authentication methods (for example, password + value from physical token) to increase the assurance that the bearer has been authorized to access secure systems.

5.4. Steps to reduce cloud security breaches

Figure 5-16. Steps to reduce cloud security breaches WS009 / VS0091.0

Notes:

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Reducing cloud security breaches

- The following steps offer a guideline to reducing cloud security breaches:
  1. Implement security best practices including human processes
  2. Implement operating system security best practices, such as patch management
  3. Implement application and API systems security best practices
  4. Implement strong encryption, SSL, digital signatures and certificate practices
  5. Ensure that auditing and logging are being used to monitor activities
  6. Ensure that strong disaster recovery process exist
  7. Transparency in information and internal management practice
  8. Understand the human resources requirements
  9. Have a clear level of escalation and notification of a breach, ensuring that you are in the loop if an internal breach occurs with the cloud provider (with your data or another customer's)
- Some import products can significantly contribute to security
  - Identity management
  - Detection and forensics
  - Data encryption

Figure 5-17. Reducing cloud security breaches WS009 / VS0091.0

Notes:

The slide offers some tangle steps that can be taken to reduce cloud security breaches. As with most security, a solid solution includes technical aspects, such as authorization and authentication; and also process.

If the cloud provider is responsible for security, and that has been backed up with a strong contract, then the customer's main technical focus is security from the user into the cloud.

5.5. Identity management: Detection and forensics

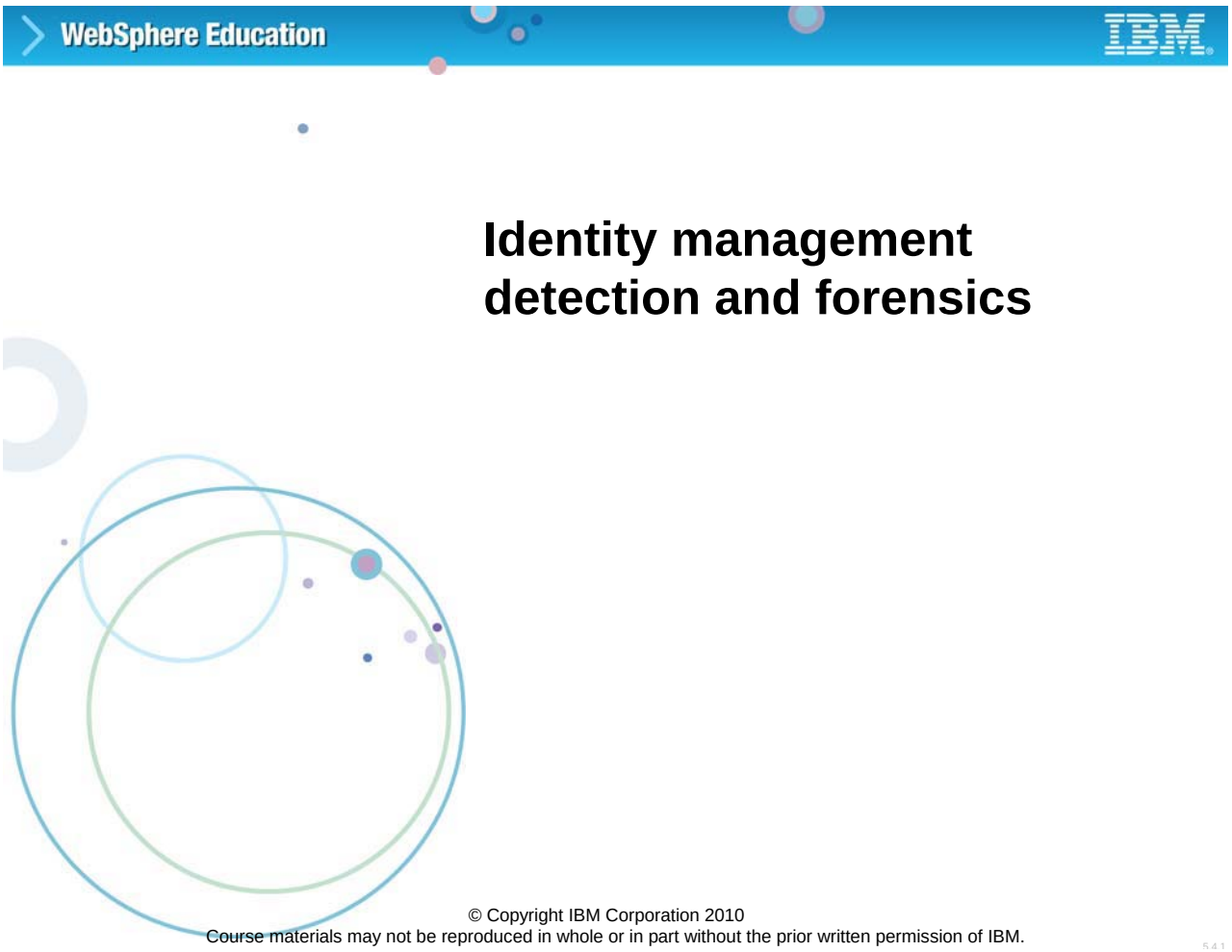

Figure 5-18. Identity management: Detection and forensics WS009 / VS0091.0

Notes:

Identity management

- **Identity management** is a broad administrative area that deals with identifying individuals in a system and controlling access to the resources in that system by placing restrictions on the established identities of the individuals
- Identity management is particularly important in a cloud environment since the cloud is sharing and virtualizing physical resource across many internal (and often external) users
  - Controlled access to different services is critical
- Identify management helps prevent security breaches and assists companies in meeting IT security compliance regulations

Figure 5-19. Identity management WS009 / VS0091.0

Notes:

Benefits of identity management

- Improved user productivity — productivity improvement comes from simplifying the interface
- Improved customer and partner services — customers and partners benefit from a more streamlined, secure process when accessing application data
- Reduced help desk costs — helps desks normally receive few “password reset” calls when an identity manage process is implemented
- Reduced IT costs — identity management enables automatic provisioning (providing and revoking user rights)

Figure 5-20. Benefits of identity management WS009 / VS0091.0

Notes:

Aspects of identity management

- Centrally locate the data — establishing a common database or directory is generally the first step to gaining control of identity data
- Integrating — identity management systems must effectively integrate with other systems
- Strengthen authentication — requiring stronger authentication measures, such as fingerprints, handprints, iris verification, identity tokens, and stronger password parameters
- Provisioning — when systems are linked to an identity system, provisioning can be automated, such as revoking or granting employee access rights
- Single sign-on — all systems communication with the identity management, system allowing the user to sign on once in an organization
- Security administration — administration is reduced due to automation
- Analyzing data — centralized data can produce reports more easily

Figure 5-21. Aspects of identity management WS009 / VS0091.0

Notes:

This section covers the various aspects of identity management as related to information technology.

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Detection and forensics

- Activity logs — log files provide information but are costly in space
- Host-based intrusion protection systems (HIPS) and network-based intrusion protection systems (NIPS)
  - System and log-file monitors — software looks for traces of hackers in log files
  - Network intrusion-detection systems (NIDS) — software programs that monitor data packets as they travel through the network
  - Digital deception software — software that deliberately misleads anyone who is attempting to attack the IT network
  - White-listing software — software that inventories valid executable programs running on a computer and prevents other executables from running
  - Unified threat management — analyzing combined information for threats
- Fooling attackers by spoofing
  - Spoofing — pretending to be something else, such as IP address, email accounts
  - Honey pot — system that pretends to be something else (something of value) that tricks attackers into revealing details about where they are attacking from
- Data audit — logging who looks at the data (Sarbanes-Oxley, SOX)

Figure 5-22. Detection and forensics WS009 / VS0091.0

Notes:

All access to cloud resources should be recorded, both for legitimate and illegitimate cloud users, leaving evidence of the resource utilization. The goal of detection and forensics is to capture a record of all situations. This allows organizations to maintain a record of what happened, providing the organization information to close the gap, while provide a record of what actually happened.

5.6. Encryption techniques

Encryption techniques

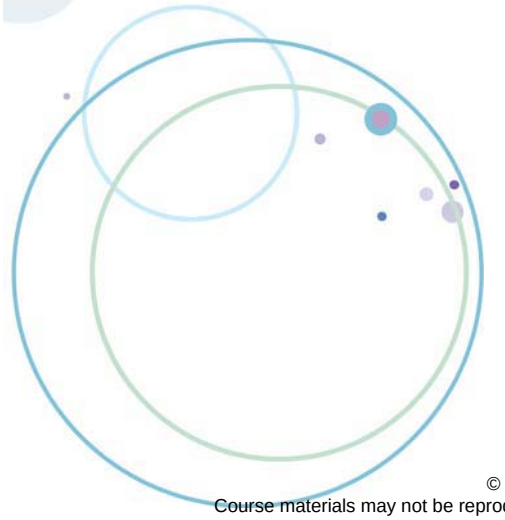

Figure 5-23. Encryption techniques WS009 / VS0091.0

Notes:

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Encrypting data

- Encryption is a critical component of cloud computing which is used to ensure that data moving from point A to point B with being altered or intercepted
- The journey from point A to point B may include:
  - Within the cloud environment (internal to the cloud)
  - The Internet between a corporation (cloud user) and the cloud provider
  - Between multiple clouds (external to the cloud)
- Encrypting methods
  - Symmetric keys
  - Asymmetric keys
  - Digital signatures
- Secure Sockets Layer (SSL) addressing cloud client connection issues
  - SSL overview
  - SSL handshake

Figure 5-24. Encrypting data WS009 / VS0091.0

Notes:

Symmetric key encryption

- Symmetric or secret key technology is a model in which two parties have a shared secret
- The same key is used for both encryption and decryption

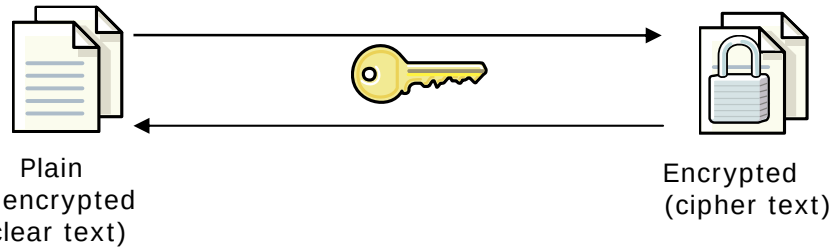

Figure 5-25. Symmetric key encryption WS009 / VS0091.0

Notes:

It is important that, once a key is established between the two parties, it is kept private. Symmetric encryption works relatively fast.

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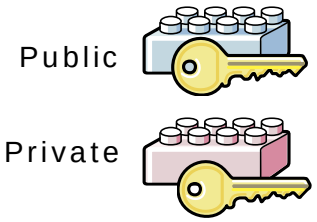
Asymmetric key encryption

Public key cryptography

- Two keys that are cryptographically related:
  - Public key (can share with everyone)
  - Private key (must never be shared; possession is proof)
- Keys are asymmetric:
  - Given message is encrypted with one key and decrypted with another
  - Symmetric, secret key technology uses same key for encrypt and decrypt



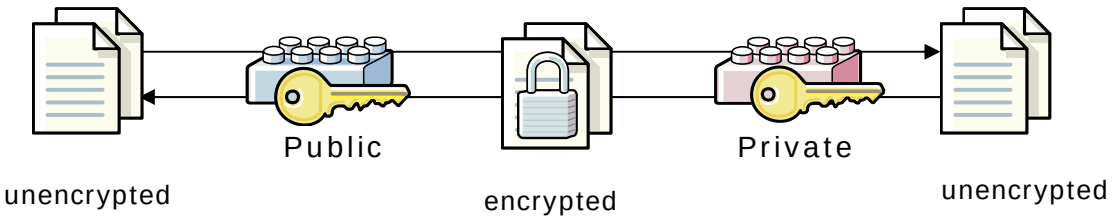


Figure 5-26. Asymmetric key encryption WS009 / VS0091.0

Notes:

Asymmetric algorithms use a pair of keys. One is used for encryption and the other one for decryption. The decryption key is kept private, so it is called a “private key” or “secret key”; while the encryption key is distributed, hence it is called a “public key”. Anyone who has the public key is able to send encrypted messages to the owner of the secret key. The secret key cannot be reconstructed from the public key.

Asymmetric algorithms seem to be ideally suited for real-world use; the secret key does not have to be shared, so the risk of it being discovered is much smaller. Each user only needs to keep one secret key private and maintain a collection of public keys that can be shared as necessary.

However, asymmetric algorithms are much slower than symmetric ones. Therefore, in many applications, a combination of both is being used. The asymmetric keys are used for authentication and after this has been successfully established, one or more symmetric keys are generated and exchanged using asymmetric encryption.

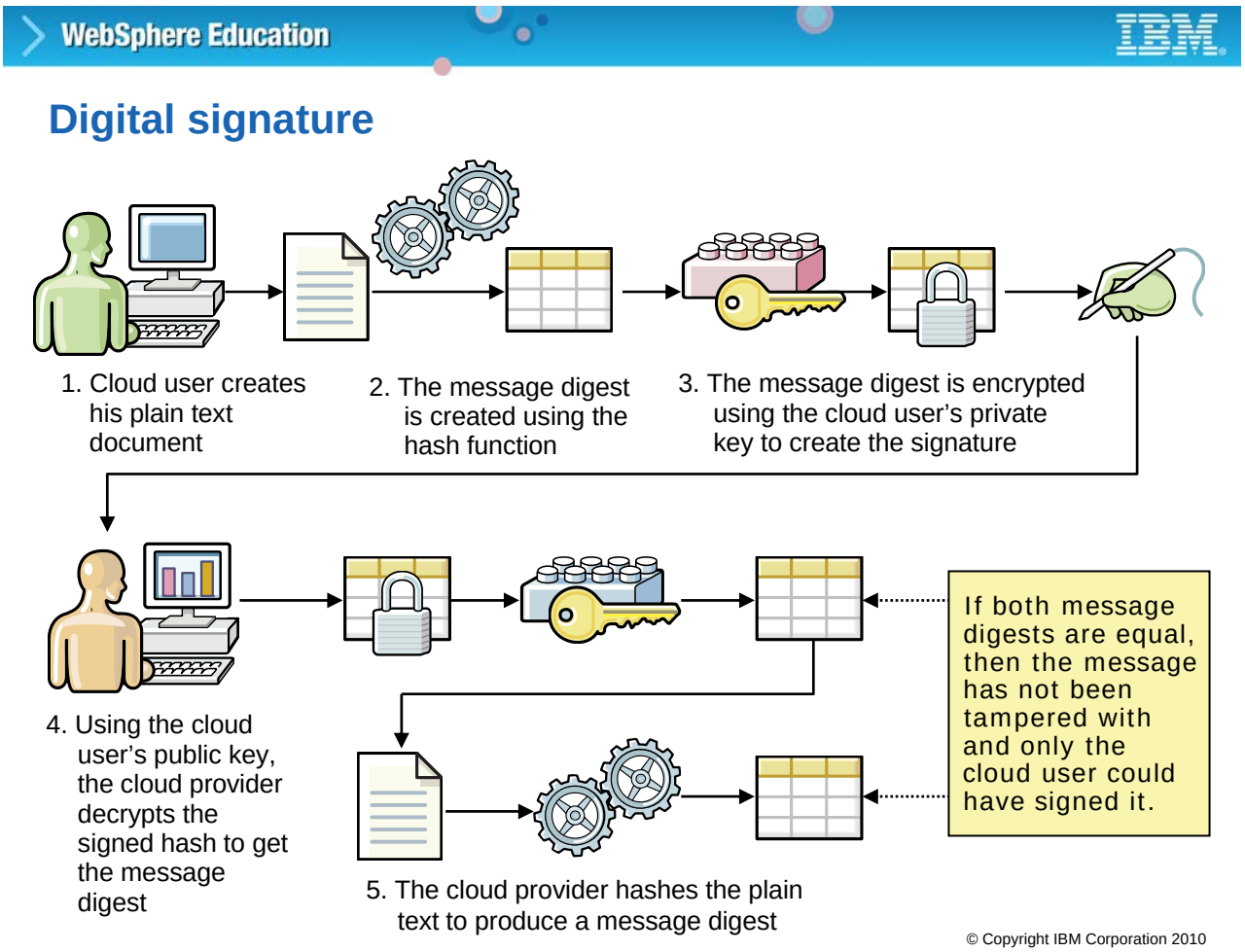


Figure 5-27. Digital signature WS009 / VS0091.0

Notes:

The cloud user creates a message, and it is encrypted into cipher text. The cipher text is then hashed to create the message digest. The message digest is then encrypted using the cloud user's private key; this creates the digital signature. The message is then sent to the cloud provider. The cloud provider receives the message, and two processes are run against the message:

1. The signed hash is decrypted using the cloud user's public key; this creates a message digest (hash number).
2. The message text is also hashed using the cryptographic hash algorithm; this produces another message digest (hash number).

If these two hash numbers are equal, then the message has not been tampered with.

What is SSL?

- SSL stands for Secure Sockets Layer
- Provides connection security through:
  - Communication privacy — the data on the connection can be encrypted
  - Communication integrity — the protocol includes a built-in integrity check
  - Authentication — the client knows who the server is
- Creates a VPN

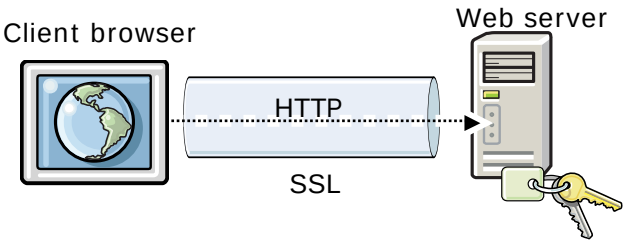


Figure 5-28. What is SSL? WS009 / VS0091.0

Notes:

SSL (Secure Sockets Layer) is the standard security technology for establishing an encrypted link between a web server and a browser. This link ensures that all data passed between the web server and browsers remains private and integral. SSL is an industry standard and is used by millions of websites in the protection of their online transactions with their customers.

Solving the security problems

- Solve the following security problems:
  - Tampering
  - Impersonation
  - Eavesdropping
- Using the following processes:
  - Symmetric and asymmetric keys
  - Encryption techniques
  - Digital signatures
  - Digital certificates
- These processes are combined together in a protocol called the Secure Sockets Layer

Figure 5-29. Solving the security problems WS009 / VS0091.0

Notes:

SSL provides

- Message privacy
  - Using asymmetric and symmetric key encryption
  - Uses a handshake when initiating contact (the handshake establishes a session key and encryption algorithm, between both parties, prior to any messages being sent)
- Message integrity
  - By using the combination of shared secret key and cryptographic hash functions
  - This ensures that the content of any messages does not change
- Mutual authentication
  - Server always authenticates to client
  - Client optionally authenticates to server
  - This happens during the handshake

Figure 5-30. SSL provides WS009 / VS0091.0

Notes:

Unit summary

Having completed this unit, you should be able to:

- Review the integration of security into the cloud reference model
- Describe security considerations in cloud computing, including cloud security risks and cloud security breaches
- Identify security options available in cloud computing
- Formulate identity management techniques, including detection and forensics and encryption
- Identify the top security threats to cloud computing

Figure 5-31. Unit summary WS009 / VS0091.0

Notes:

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Checkpoint

1. True or False: The lower down the Cloud Reference Model stack the consumer moves, the more security the consumer is responsible for providing and managing.
2. Which of the following terms is ***not*** an aspect of identify management?
   - A. Centrally locate the data
   - B. Integrating
   - C. Strengthen authentication
   - D. Provisioning
   - E. Single sign-on
   - F. Security administration
   - G. Analyzing data
   - H. Two-phased commit
3. Match the following:

Description	Definition
1) A doorway into cloud services	A. Internal security breaches
2) Internal security violations	B. User account and service hijacking
3) Leveraging shared technologies	C. Data corruption or loss
4) Lost or corruption of data	D. Nonstandard and vulnerable APIs
5) Attacker gains access to a cloud users credentials	E. Virtualization and multitenancy

Figure 5-32. Checkpoint WS009 / VS0091.0

Notes:

Write your answers here:

1.

2.

3. 1)
   2)
   3)
   4)
   5)

Checkpoint answers

1. **True** or False: The lower down the Cloud Reference Model stack the consumer moves, the more security the consumer is responsible for providing and managing.
2. Which of the following terms is ***not*** an aspect of identify management?
   - A. Centrally locate the data
   - B. Integrating
   - C. Strengthen authentication
   - D. Provisioning
   - E. Single sign-on
   - F. Security administration
   - G. Analyzing data
   - **H. Two-phased commit** is a database term
3. Match the following:

Description	Definition
1) A doorway into cloud services	D. Nonstandard and vulnerable APIs
2) Internal security violations	A. Internal security breaches
3) Leveraging shared technologies	E. Virtualization and multitenancy
4) Lost or corruption of data	C. Data corruption or loss
5) Attacker gains access to a cloud users credentials	B. User account and service hijacking

Figure 5-33. Checkpoint answers WS009 / VS0091.0

Notes:

Checkpoint (optional)

1. What is the name of systems that pretend to be something else (something of value) that tricks attackers into revealing details on where they are attacking from?

Figure 5-34. Checkpoint (optional) WS009 / VS0091.0

Notes:

Write your answer here:

1.

Checkpoint (optional) answer

1. What is the name of systems that pretend to be something else (something of value) that tricks attackers into revealing details on where they are attacking from?

   Answer: Honey Pot is the name of systems that pretend to be something else (something of value) that tricks attackers into revealing details on where they are attacking from.

Figure 5-35. Checkpoint (optional) answer WS009 / VS0091.0

Notes:

Unit 6. IBM cloud computing architecture and offerings

What this unit is about

This unit describes the cloud computing offerings and services that IBM provides.

What you should be able to do

After completing this unit, you should be able to:

- Position various vendors in the service delivery model of cloud computing
- Provide an example of an IBM cloud architectural configuration
- Describe the IBM cloud computing offerings and services
  - Collaboration — LotusLive, BlueWorks
  - Smart Business Desktop
  - Smart Business Development and Test
  - Smart Analytics Cloud
- Describe IBM tooling options for management and governance — Tivoli
- Describe the IBM Smart Business Development and Test cloud — Jazz for Rational
- Describe cloud computing using IBM WebSphere

How you will check your progress

- Checkpoint
- Demonstration

Unit objectives

After completing this unit, you should be able to:

- Position various vendors in the service delivery model of cloud computing
- Provide an example of an IBM cloud architectural configuration
- Describe the IBM cloud computing offerings and services
  - Collaboration — LotusLive, BlueWorks
  - Smart Business Desktop
  - Smart Business Development and Test
  - Smart Analytics Cloud
- Describe IBM tooling options for management and governance — Tivoli
- Describe the IBM Smart Business Development and Test cloud — Jazz for Rational
- Describe cloud computing using IBM WebSphere

Figure 6-1. Unit objectives WS009 / VS0091.0

Notes:

Topics

- Cloud services and vendor-positioning
- Cloud computing for a test environment
- IBM cloud architecture and TSAM
- Development and test on the IBM cloud

Figure 6-2. Topics WS009 / VS0091.0

Notes:

6.1. Cloud services and vendor positioning

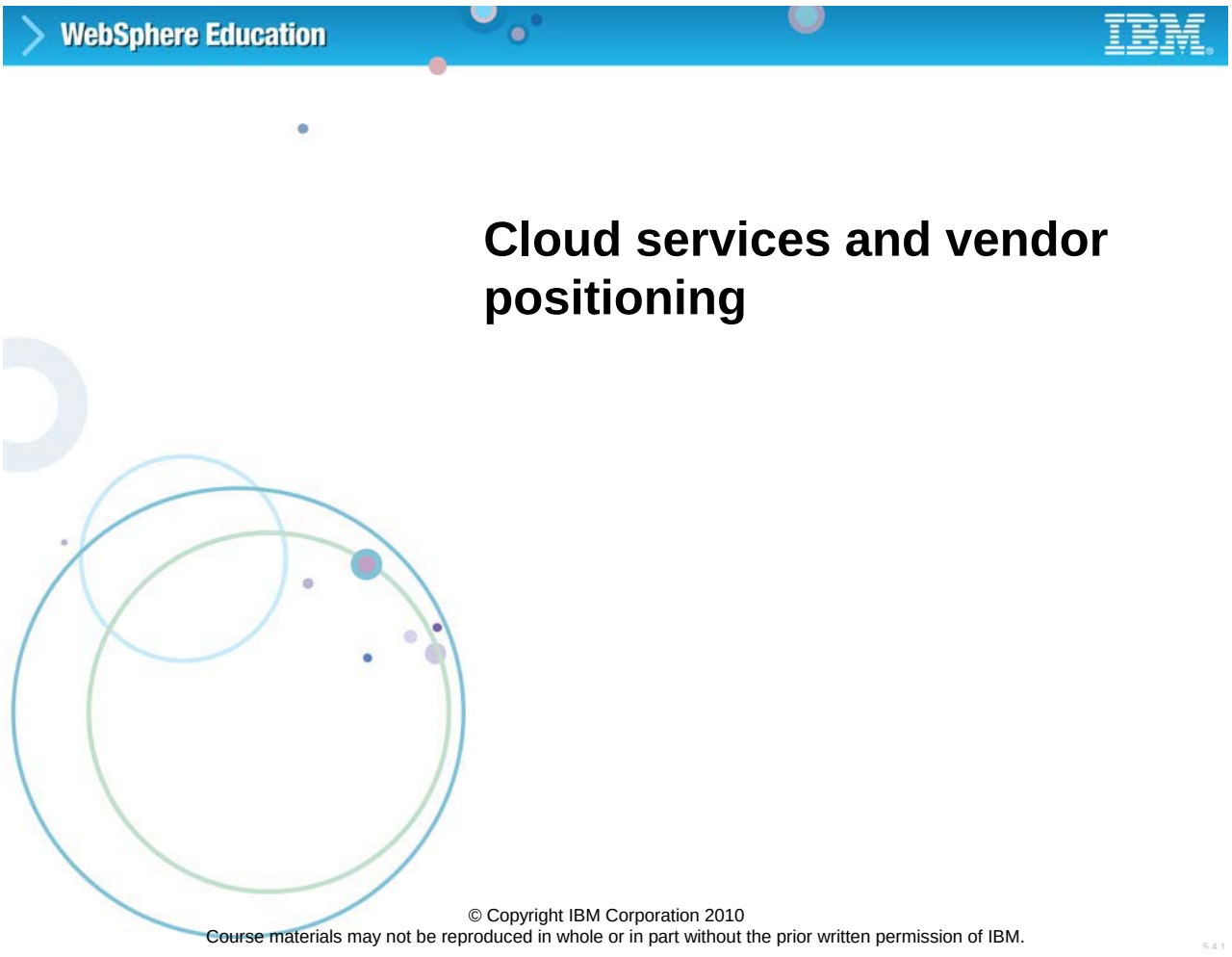

Figure 6-3. Cloud services and vendor positioning WS009 / VS0091.0

Notes:

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IT services that can be standardized for cloud

- Web-based applications
- Collaboration tools
  - Email and instant messaging
- Development and test environments
  - Desktop and user
- High-performance computing
  - File and image storage
  - CPU-intensive research and development applications that may require high availability and failover
  - Payment processing and expense management

Figure 6-4. IT Services that can be standardized for cloud WS009 / VS0091.0

Notes:

Cloud service layers and vendor positioning

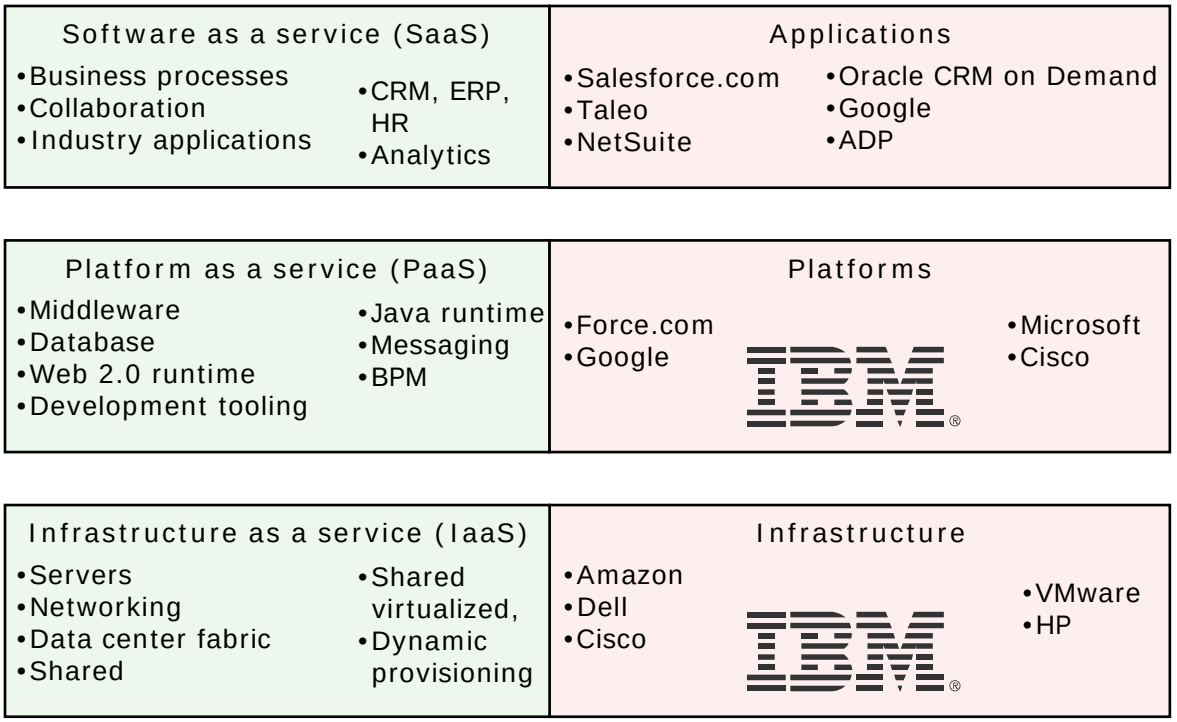

Figure 6-5. Cloud service layers and vendor positioning WS009 / VS0091.0

Notes:

The functions and services offered by cloud computing start with the needs of the user. In the case of the IBM Smart Business Development and Test Cloud and most other commercial cloud offerings, the user makes a request for services and resources through a self-service portal. Cloud applications then search for resources to match the request using a portfolio of cloud services. Access is provided back to the consumer through the portal.

Applications: Business process services are focused on providing existing business processes through a cloud. If there is an existing process with steps that are known, it can be provided as a service within the catalog. This allows the service provider to automate any steps within the process while leaving the changes transparent to the customer.

Platforms: Software platform services allow consumers to select a specific software instance that they want created, without the need to be aware of where and how it will be hosted. Key components of software platform services include tools and services for developers, dynamic software usage and accounting, and optimized middleware: application servers, database servers, and portal servers.

Infrastructure: Infrastructure services allow for the provisioning of standardized compute resources. They allow a consumer to request and receive a new computer instance without needing to focus on IT concerns such as network placement and hardware availability.

WebSphere Education

IBM cloud services

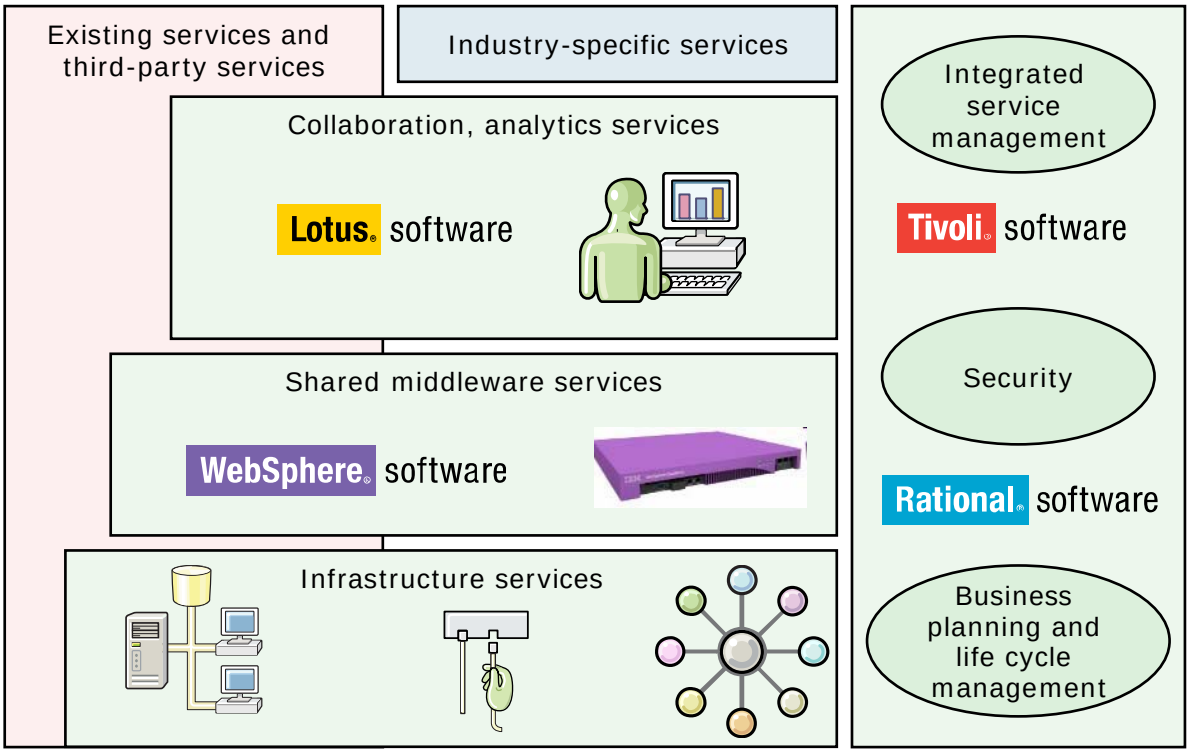

Figure 6-6. IBM cloud services WS009 / VS0091.0

Notes:

IBM provides technologies to plan, build, deliver, and manage cloud services. In addition, IBM provides enabling services: experience and expertise to help clients plan, build, and deliver cloud services.

Here is a list of IBM cloud-based offerings. Each one is described briefly on the following slides:

- Analytics services:
  - IBM Cognos 8 Business Intelligence
  - IBM Smart Analytics Cloud for System z
- Shared middleware services:
  - IBM WebSphere Application Server Hypervisor Edition
  - IBM WebSphere Cloudburst Appliance
- Infrastructure services:

  - IBM Information Archive
  - IBM Smart Business Storage Cloud
  - IBM Smart Business Desktop
  - IBM CloudBurst
  - IBM Smart Business for SMB
  - IBM Smart Business Development and Test Cloud
  - IBM Smart Business Development and Test on the IBM Cloud
- Service management:
  - IBM Service Delivery Manager
  - Rational Quality Manager
- Security:
  - IBM Rational AppScan family of products:
  - IBM Security Server Protection
  - IBM Security Network Intrusion Prevention System
  - IBM Managed Security Services
  - Business planning and life cycle management:
  - IBM Rational System Architect
  - IBM Rational Requirements Composer
  - IBM Rational Software Delivery Services, Rational Asset Manager

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Analytics services

- IBM Cognos 8 Business Intelligence
  - SOA-based; draws on data from all enterprise sources
  - Allows you to use reports, analysis, dashboards, and scorecards to monitor business performance, analyze trends, and measure results
- IBM Smart Analytics Cloud for System z
  - Provides business intelligence services powered by a cloud deployment

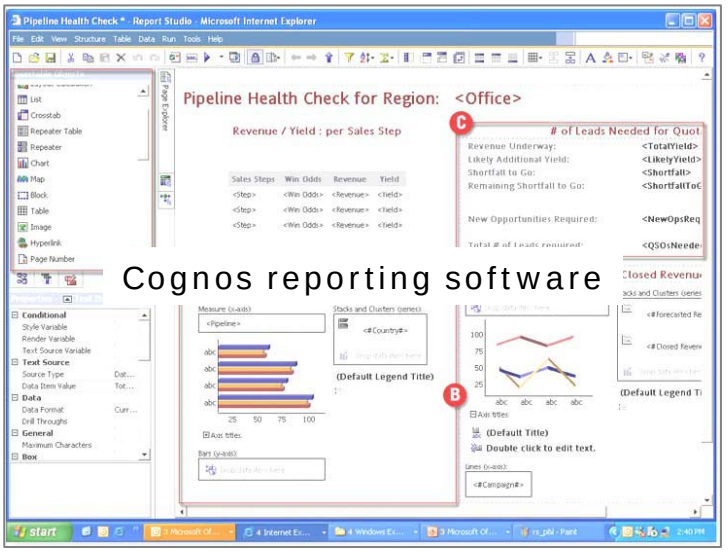


Figure 6-7. Analytics services WS009 / VS0091.0

Notes:

IBM Cognos 8 Business Intelligence delivers the complete range of BI capabilities: reporting, analysis, dashboarding and scorecards on a single, service-oriented architecture (SOA). Author, share and use reports that draw on data across all enterprise sources for better business decisions.

For more information, see: **http://www.ibm.com/software/data/cognos/products/cognos-8-business-intelligence/**

IBM Smart Analytics Cloud focuses on transforming traditional business intelligence and analytic environments into a self service knowledge dissemination solution for the enterprise. The Smart Analytics Cloud creates a standard private cloud business intelligence solution at the customer site built on mainframe capability. This solution is designed to provide customers with business intelligence services that are powered by a cloud deployment for greater efficiency with less cost and resources to reach a broader audience.

See: **http://www.ibm.com/systems/z/solutions/cloud/smart.html**

WebSphere Education

LotusLive

- Provides cloud-based collaboration solutions and social networking services for business
  - Email
  - Online meetings
  - Social networking
  - Instant messaging
  - File sharing, and so on

http://www.lotuslive.com/

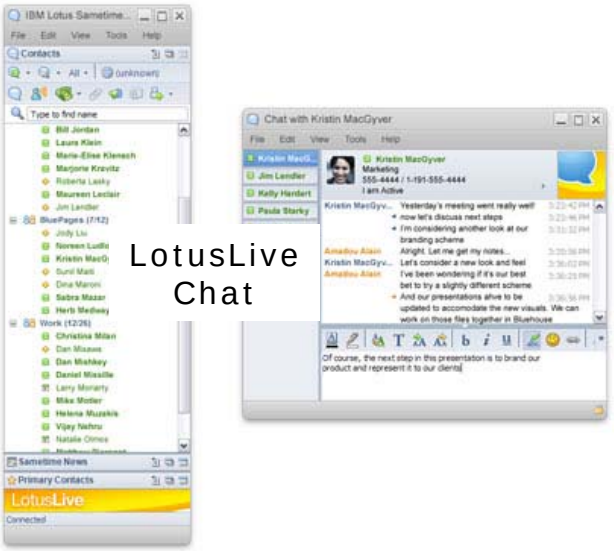


Figure 6-8. Lotus Live

WS009 / VS0091.0

Notes:

LotusLive is a collection of integrated, online collaboration solutions and social networking services for your business.

You can meet online, share files, chat, manage projects, and network with potential clients, anywhere, anytime. Whether you work remotely, manage remote teams, or just need one simple place to bring colleagues together, LotusLive delivers collaboration solutions, all in a securely designed environment.

LotusLive provides the following types of solutions:

- Reliable email options in a secure hosted environment
- Online meetings with anyone, anywhere, anytime
- Tools for business social networking
- Online services to bring your team together online
- Smart solutions for online collaboration, such as file sharing

See **http://www.lotuslive.com/** for more information.

WebSphere Education IBM

Other collaboration tools

- BPM BlueWorks:
  - Allows you to create a space to collaborate with your team and map your business vision
  - Create a free account and invite others to your design space, or register with an existing one
- BPM Blueprint
  - A cloud-based process discovery and documentation platform accessible from any browser
  - Allows users to outline, document, diagram, analyze, and share process details

Figure 6-9. Other collaboration tools WS009 / VS0091.0

Notes:

BPM BlueWorks:

- Allows you to create a space to collaborate with your team and map your business vision
- Create a free account and invite others to your design space, or register with an existing one
- Provides industry content submitted by other members of the BPM BlueWorks community
- Allows you to share your business design content with the BPM BlueWorks community
- Provides best practices, exchange tips
- Allows you to connect with other BPM practitioners through the BPM BlueWorks blog and community forum

BPM Blueprint:

- A cloud-based process discovery and documentation platform accessible from any browser
- Allows users to outline, document, diagram, analyze, and share process details

For more information, see:

- **https://apps.lotuslive.com/bpmblueworks/**
- **http://www.ibm.com/software/integration/bpm-blueprint/**

WebSphere Education

Shared middleware services

- IBM WebSphere Application Server Hypervisor Edition
  - Provides an innovative, performance based foundation to build, reuse, run, integrate and manage SOA applications and services within virtualized environments
- IBM WebSphere Cloudburst Appliance
  - A hardware appliance that provides access to software virtual images and patterns that can be used as is or easily customized, and then securely deployed, managed, and maintained in a private cloud
  - Works seamlessly with IBM WebSphere Application Server Hypervisor Edition

IBM WebSphere Cloudburst Appliance

WebSphere software

Figure 6-10. Shared middleware services WS009 / VS0091.0

Notes:

For more information see:

- **http://www.ibm.com/software/webservers/appserv/hypervisor/**
- **http://www.ibm.com/software/tivoli/products/cloudburst/**

These products will be described in the next unit.

WebSphere Education

IBM

Security

- IBM Rational AppScan family of products:
  - Automates web application security testing by scanning applications, identifying vulnerabilities, and generating reports with intelligent fix recommendations to ease remediation
  - Multiple editions available
- IBM Security Server Protection
  - Offers multilayered protection against known and unknown threats and supports a broad range of operating systems
  - Protects servers from attack and manages compliance with monitoring, recording, auditing
- IBM Security Network Intrusion Prevention System (formerly IBM Proventia Network Intrusion Prevention System):
  - Network security platform that delivers IBM Virtual Patch technology, client-side application protection, advanced IPS, data security, and protection for web applications
- IBM Managed Security Services, cloud security services
  - Provides expertise, tools, and infrastructure needed to secure information assets from Internet attacks 24-7-365
  - Express managed email and web security
  - Security event and log management service
  - Vulnerability management service

Tivoli software

Rational software

Figure 6-11. Security WS009 / VS0091.0

Notes:

IBM Rational AppScan family of products include:

- **AppScan Build Edition**: embeds web application security testing into the build management workflow.
- **AppScan Enterprise Edition**: provides web application vulnerability testing and reporting solution used to scale security testing.
- **AppScan Express Edition**: provides affordable web application security for smaller organizations.
- **AppScan OnDemand**: identifies and prioritizes web application security vulnerabilities via the SaaS model.
- **AppScan OnDemand Production Site Monitoring**: monitors production web content and sites for security vulnerabilities via the SaaS model.
- **AppScan Reporting Console**: provides centralized reporting on web application vulnerability data.

- **AppScan Source Edition**: prevents data breaches by locating security flaws in the source code.
- **AppScan Standard Edition**: automates web application security testing for IT security, auditors, and penetration testers.
- **AppScan Tester Edition**: integrates web application security testing into the QA environment.
- **IBM Security Server Protection** (formerly IBM Proventia Server Protection) offers multilayered protection against known and unknown threats and supports a broad range of operating systems. It helps provides host protection against data breaches and offers tracking and reporting to ease meeting regulatory compliance.
- **IBM Security Network Intrusion Prevention System** (formerly IBM Proventia Network Intrusion Prevention System) is a network security platform that delivers IBM Virtual Patch technology, client side application protection, advanced IPS, data security, and protection for web applications. It includes:
  - **IBM Web Application Security**: protects web applications with IBM Proventia Web Security for the same security of a stand-alone web application firewall
  - **IBM Security Content Analysis technology**: safeguards critical data

WebSphere Education

IBM Smart Business Development and Test Cloud

- Implementation of a private cloud for a test and development environment
- Includes:
  - Self-service catalog portal to request resources
  - Cloud management platform with service request management, automated provisioning, and change and configuration management
  - Enhanced Web 2.0-based GUI
  - Image management
  - Usage metering and accounting with ITUAM
  - Preconfigured software images for Rational Team Concert, Rational Asset Manager, Rational Quality Manager, BuildForge
- Supports VMware, KVM, and PowerVM environments

Figure 6-12. IBM Smart Business Development and Test Cloud WS009 / VS0091.0

Notes:

Provides design and implementation of a private cloud for a test and development environment, which includes:

- Self-service catalog portal to request resources
- Cloud management platform with service request management, automated provisioning, and change and configuration management
- Enhanced Web 2.0-based GUI
- Image management
- Usage metering and accounting with ITUAM
- Preconfigured software images for Rational Team Concert, Rational Asset Manager, Rational Quality Manager, BuildForge

Supports VMware, KVM, and PowerVM environments.

6.2. Cloud computing for a test environment

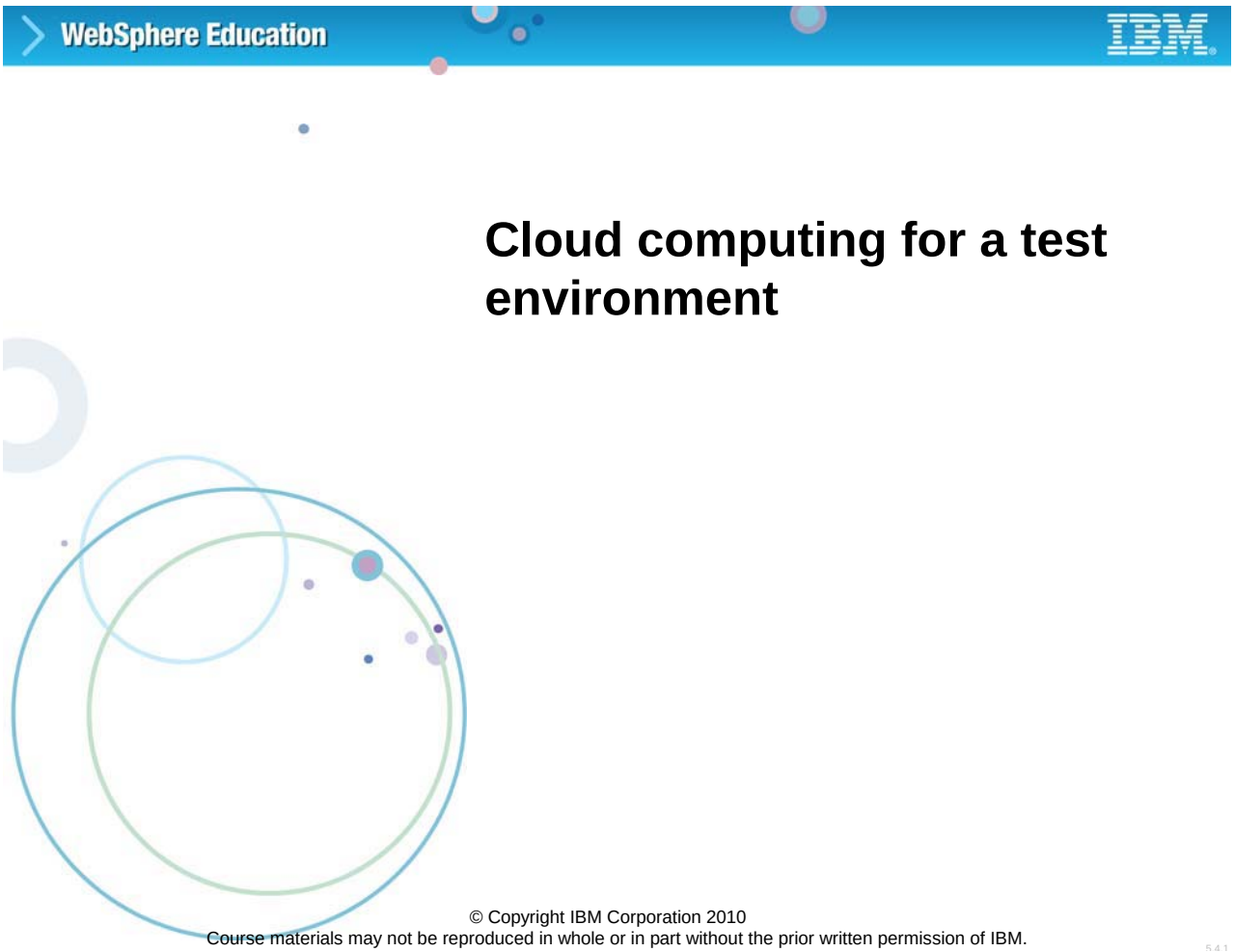


Figure 6-13. Cloud computing for a test environment WS009 / VS0091.0

Notes:

WebSphere Education

Using cloud computing for a test environment

- The characteristics of cloud computing are a natural fit for enhancing your test environment.

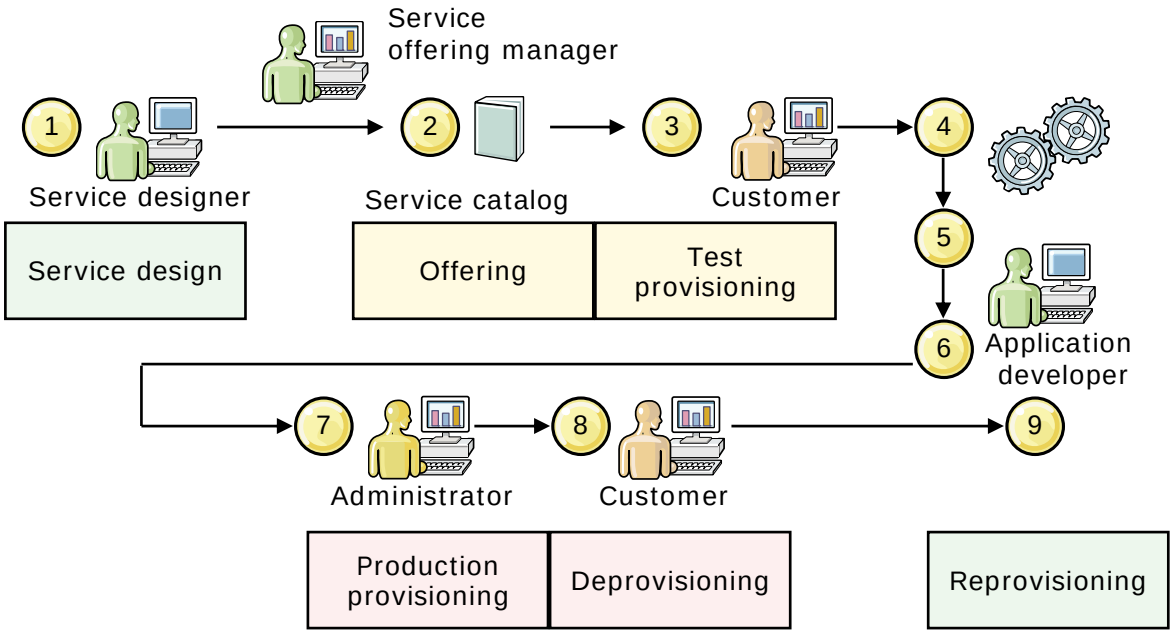


Figure 6-14. Using cloud computing for a test environment WS009 / VS0091.0

Notes:

This diagram illustrates an example cloud deployment and management process. When done manually, these steps can take a significant amount of time. A cloud environment dramatically reduces this complexity by implementing automation, business workflows, and resource abstraction that allows a user to browse a catalog of IT services and submit the order.

1. A service designer may define service offerings. In a cloud environment, predefined templates can be used.
2. Services are released to users in the form of a service catalog. In a cloud environment, this service catalog may be available through a user portal.
3. A resource request is initiated by a customer. The request may need to be approved by a service offering manager. In a cloud environment, this step can be automated or implemented by a workflow.

4. The test resources are reserved or allocated for the customer and provisioned. This process can be automated by using a service automation manager, such as TSAM (described later).
5. An application image is created. This process can also be managed by a service automation manager.
6. The developer works with the image. The developer may make changes to the image, run tests, and so on.
7. The image is promoted to production.
8. Resources are deprovisioned. The administrator returns resources to the pool when they are no longer needed. This process can also be automated by using a service automation manager.
9. The developer may initiate the cycle again. A cloud environment leverages reusable resources.

6.3. IBM cloud architecture and TSAM

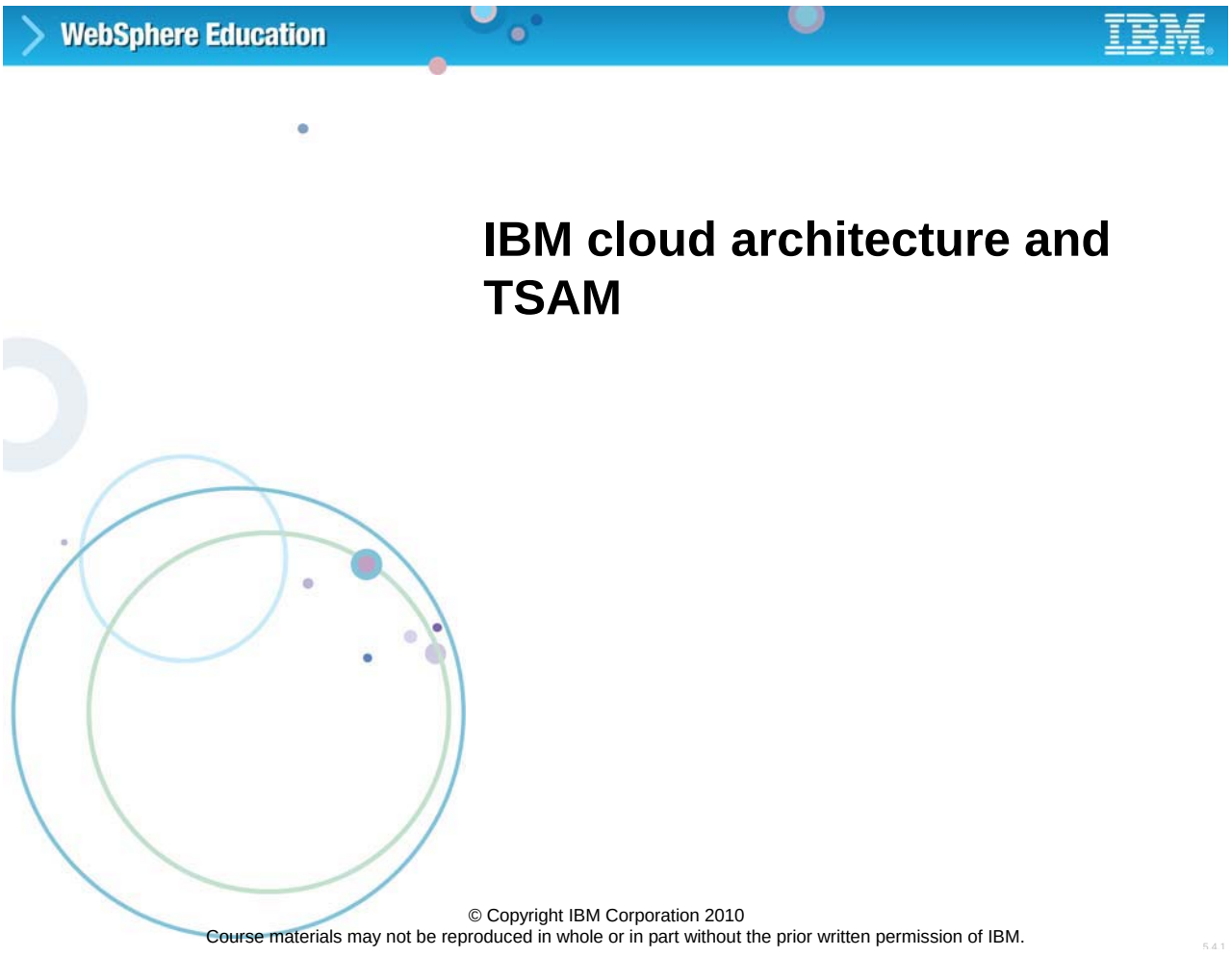


Figure 6-15. IBM cloud architecture and TSAM WS009 / VS0091.0

Notes:

Cloud systems view (1 of 2)

- A cloud is made up of the ***managing*** and the ***managed*** environments
- The managing environment supports the management of cloud services throughout their life cycle
- The managed environment is managed by the service management infrastructure; it includes the physical hardware layer and the virtual layer
- The combination of the managing layer and the managed layer ensures that resources in a data center are efficiently managed and can be provisioned, deployed, and configured rapidly

Figure 6-16. Cloud systems view (1 of 2) WS009 / VS0091.0

Notes:

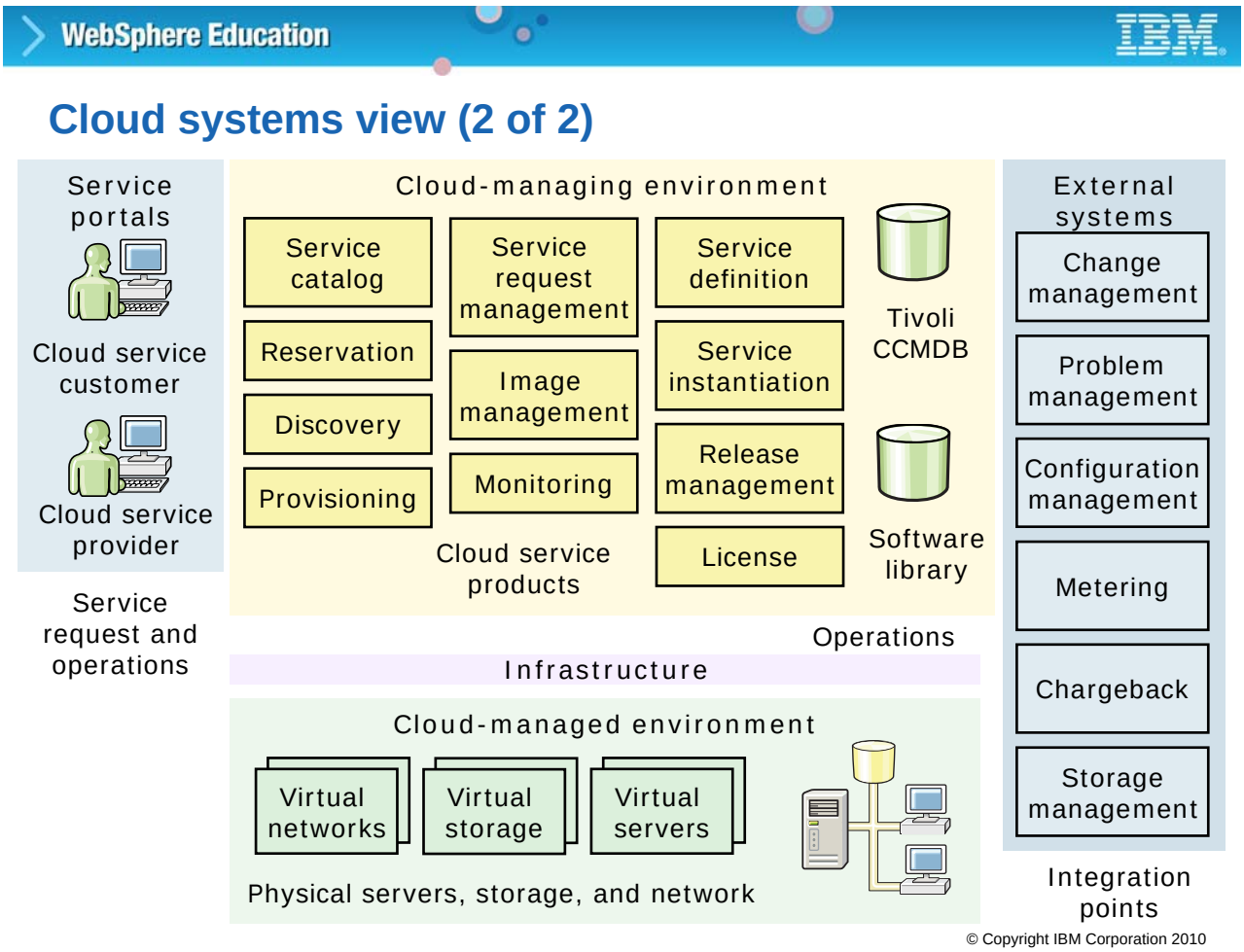


Figure 6-17. Cloud systems view (2 of 2) WS009 / VS0091.0

Notes:

Service portals: The service portals provide an easy-to-access, secure method for private test cloud service consumers and service providers to configure and request services from the cloud.

Cloud service products: The service products layer includes the private test cloud service offerings.

Cloud managing environment: The managing environment supports the management of cloud services throughout their life cycle. The private test cloud management layer acts like the brain or control center to efficiently manage the resources in the entire cloud environment. The combination of the managing layer and the managed layer ensures that resources in a data center are efficiently managed and can be provisioned, deployed, and configured rapidly. This environment allows the provisioning process to be shortened by up to four weeks.

Tivoli Change and Configuration Management Database (CCMDB): The Change and Configuration Management Database is the store of information related to the components

of the information management system. The CCMDB contains the data required to support service automation management, typically including the following elements:

- Service templates
- Topologies
- Management plans
- Reservations
- Assets and configuration items

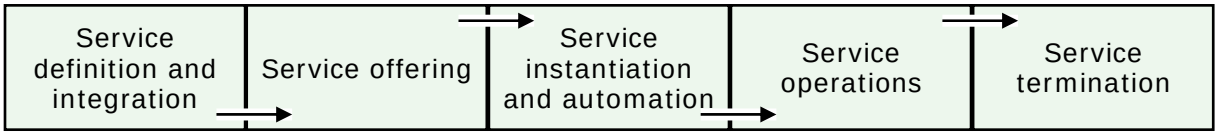
Software library: The software library is a repository that stores authorized versions of software packages and images.

Cloud managed environment: The managed environment is managed by the service management infrastructure. The managed environment includes the physical hardware layer and the virtual layer. This provides a flexible, adaptive platform to improve resource utilization. Virtualization allows a set of underutilized physical servers to be consolidated into a smaller number of more fully utilized physical servers. The virtual layer provides the abstraction of logical resources away from their underlying physical resources. Virtualization technology is not limited to servers; it can also be applied to storage, networking, and applications.

WebSphere Education IBM

IBM Tivoli Service Automation Manager (TSAM)

- Supports a comprehensive deployment and management process for cloud environments



- Users can request, deploy, monitor, and manage cloud service environments
- Templates define service offerings, such as virtualized operating systems and application middleware stacks, integrated with workflow processes and standardized configurations, and make them available to business operations staff members
  - Enables IT to respond quickly to demands for computing resources and application middleware deployments
  - Facilitates standardization and automation for deployment and management of cloud services
- Provides traceable processes and approval routings to serve as audit trails, and integrates with process governance
- Can be integrated with other service management capabilities such as:
  - Configuration and change management
  - In-depth monitoring
  - Release management
  - Financial management
  - Service desk functionality

Figure 6-18. IBM Tivoli Service Automation Manager (TSAM) WS009 / VS0091.0

Notes:

IBM Tivoli Service Automation Manager (TSAM) supports a comprehensive deployment and management process for cloud environments. The diagram provides a high-level view of this process.

Some attributes of IBM Tivoli Service Automation Manager are as follows:

- Users can request, deploy, monitor, and manage cloud service environments
- Templates define service offerings, such as virtualized operating systems and application middleware stacks, integrated with workflow processes and standardized configurations, and make them available to business operations staff members
- Enables IT to respond quickly to demands for computing resources and application middleware deployments
- Facilitates standardization and automation for deployment and management of cloud services
- Provides traceable processes and approval routings to serve as audit trails, and integrates with process governance

- Can be integrated with other service management capabilities, such as: configuration management, change management, in-depth monitoring, release management, financial management and service desk functionality

In addition, Tivoli Service Automation Manager integrates with the IBM WebSphere CloudBurst Appliance to speed the delivery of WebSphere-based cloud services by providing the ability to create projects and add servers based on WebSphere patterns. Tivoli Service Automation Manager is also included with IBM CloudBurst to help provide an easy-to-deploy private cloud package and provide consistent administration across your cloud environment.

Service request flow with TSAM

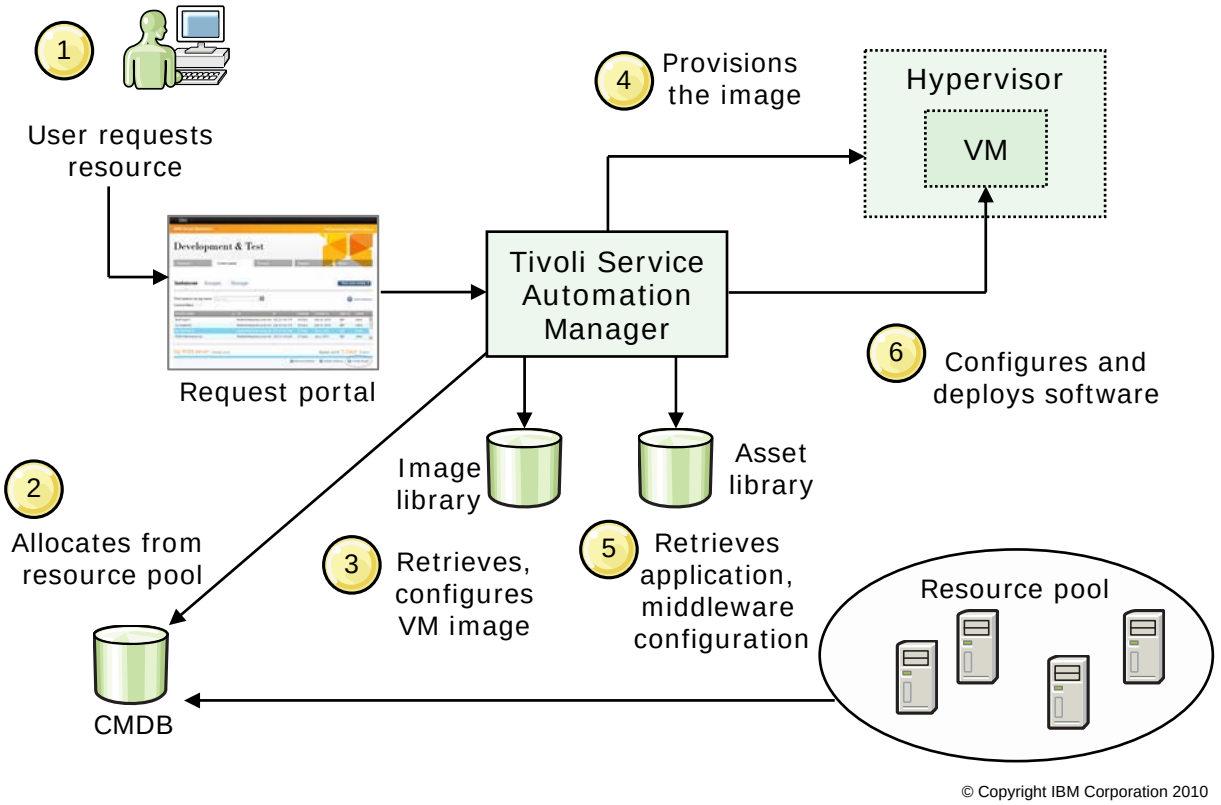


Figure 6-19. Service request flow with TSAM WS009 / VS0091.0

Notes:

The service automation manager, such as TSAM, is an integral component of the operation supporting system (OSS) layer. This diagram illustrates how a request is handled through the request life cycle by a service automation manager.

1. User requests or reserves a resource.
2. TSAM allocates it from the resource pool.
3. TSAM retrieves and configures a VM image from the image library.
4. TSAM provisions the image.
5. TSAM retrieves application and middleware configurations from the asset library.
6. TSAM configures and deploys the software onto the image.

WebSphere Education

TSAM overview screen of key metrics and tasks for the cloud administrator

Figure 6-20. TSAM overview screen of key metrics and tasks for the cloud administrator WS009 / VS0091.0

Notes:

Tivoli Service Automation Manager provides robust functionality for selecting and provisioning standard software packages on virtual servers. A simple, easy-to-use set of applications enable data center personnel to achieve rapid time-to-value for virtual-server provisioning from these platforms. The off-the-shelf configuration that is provided for these applications supports fully automated provisioning with a standardized set of deployment activities.

The self-service environment is supported by the self-service user interface. The Self-Service Virtual Server Management functionality addresses a long-standing need by data centers to efficiently manage the self-service deployment of virtual servers and associated software. Using a set of simple, point-and-click tools, a user can select a software stack and have the software automatically installed or uninstalled in a virtual host that is automatically provisioned.

The screen shown here shows some of the features available for Self-Service Virtual Server Management. From the Self-Service Virtual Server Management interface, you can perform the following types of tasks:

- Log in to the self-service user interface, which provides direct access to the offerings.
- Work with a set of built-in approval workflows and notifications that are invoked after self-service provisioning requests are created.
- Create a virtual server project with one or more virtual servers. Each server receives an automatically assigned host name.
- Create a new project and use the saved server images to provision a server in that project. This functionality is only available for VMware, System p LPAR, and KVM.
- Cancel a virtual server project. When you cancel a project, all of the servers that have been provisioned within that project are deprovisioned. The host names that were automatically assigned to these servers are freed up for use by other virtual servers that are created in the data center. Any image saved for a server that participated in the project is deleted.
- Add new servers to a project or modify the reservation date.
- Modify the state of a server, its resources, or reset the password for a server.
- Create and remove snapshot-like server images, and restore the servers using these images. This functionality is not implemented for the Xen and z/VM hypervisors.
- Manage the Tivoli Provisioning Manager Image Library — this is the source for software images to be used in provisioning the virtual servers. Once the image templates discovery has been performed in Tivoli Provisioning Manager by the system administrator, the images need to be registered in the Image Library, so that they can be used for provisioning. Use these tasks to learn how to register or unregister server images.
- Manage users and groups of users.
- View general details about a project and its servers.
- View the list of all servers and manage them.
- View the full list of requests and their statuses.
- View the details of a request and work with communication logs.
- View the details of the requests awaiting approval and approve or reject them.

These tools integrate with IBM Tivoli Service Request Manager to provide a self-service portal for reserving, provisioning, recycling, and modifying virtual servers, and working with server images, in the following platform environments in a virtualized non-production lab (VNPL):

- VMware on System x (also used in the IBM CloudBurst and WebSphere CloudBurst Appliance products)
- Xen on System x
- KVM on System x
- LPARs on System p

- z/VM guests on System z
- WebSphere CloudBurst Appliance

Capabilities support baseline reporting, management, and control.

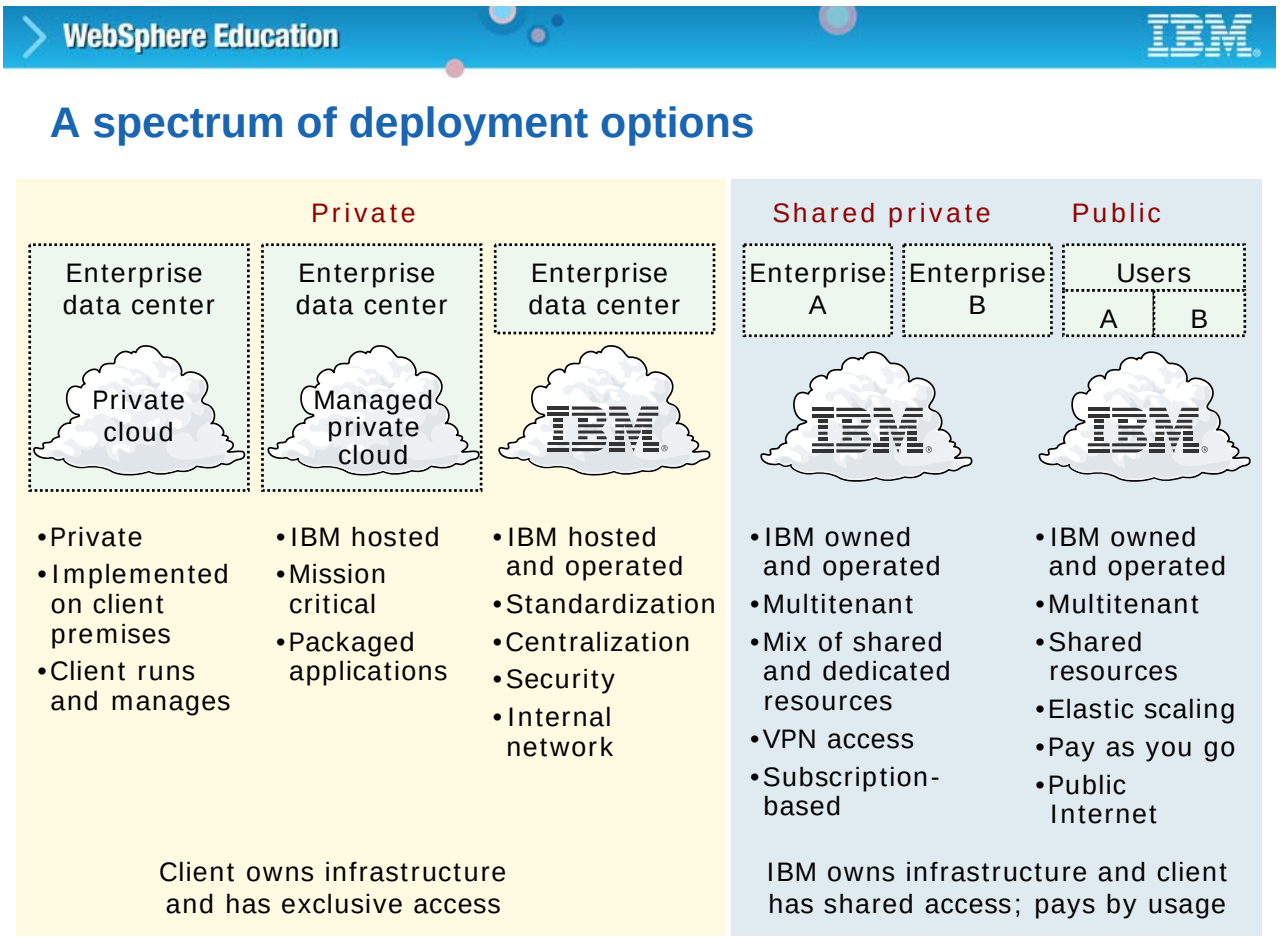


Figure 6-21. A spectrum of deployment options WS009 / VS0091.0

Notes:

These deployment options determine who owns and manages the cloud. The IBM Smart Business Development and Test on the IBM cloud model is an example of a public cloud, where customers can use IBM-owned and operated resources on a pay-as-you-go plan.

6.4. Development and test on the IBM cloud

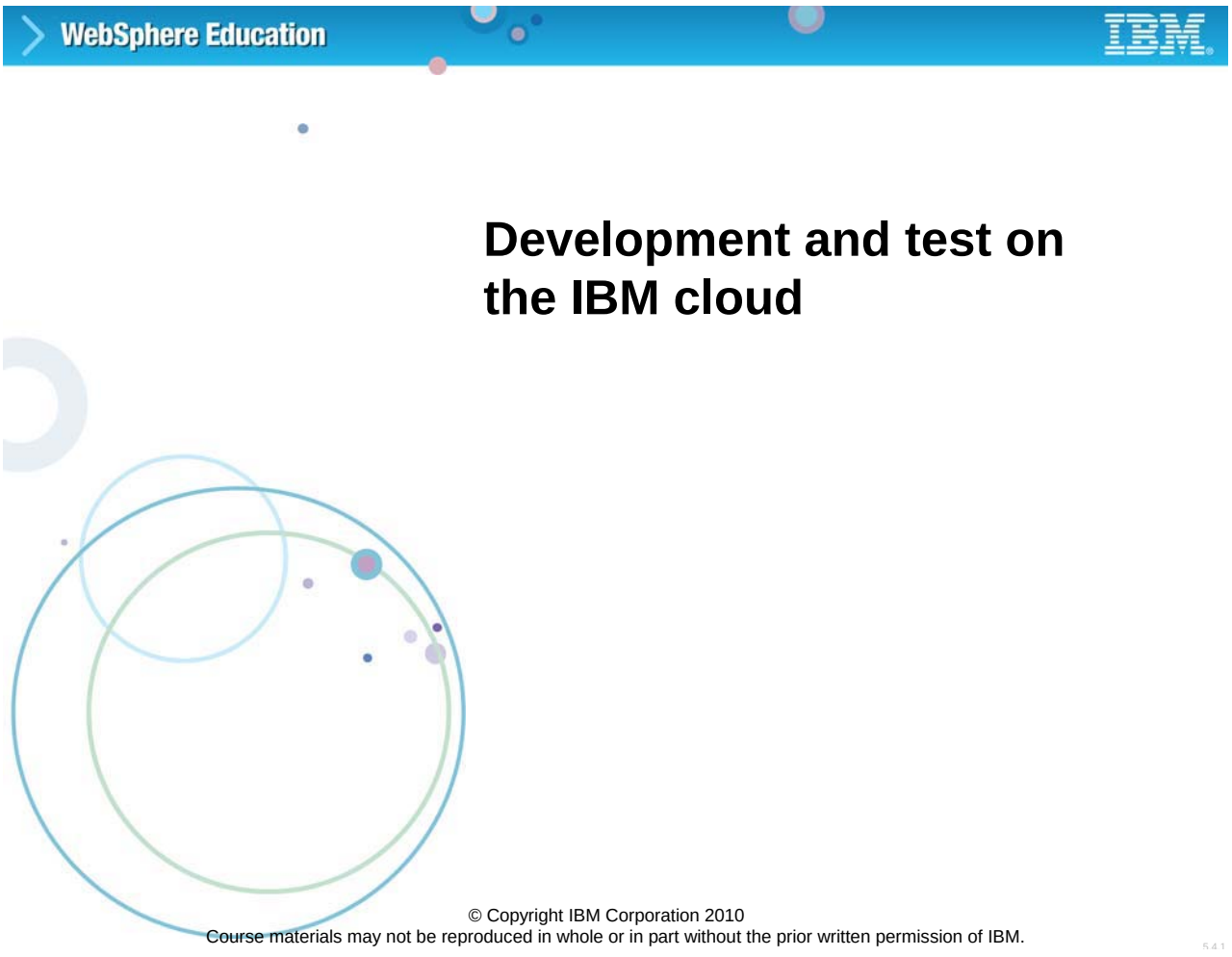


Figure 6-22. Development and Test on the IBM cloud WS009 / VS0091.0

Notes:

WebSphere Education

IBM Smart Business Development and Test on the IBM cloud

- A dynamic virtual development and test infrastructure service, designed for the enterprise, on the IBM cloud
- Provides users with
  - Choice of virtual configurations
  - Option to add persistent storage
  - Preconfigured software images
- Pay as you go (hourly rates per VM instance)
- Available support:
  - User forum
  - Premium support
- **http://www.ibm.com/services/us/igs/cloud-development/**
- An instance can be deployed and provisioned quickly in just three steps

Figure 6-23. IBM Smart Business Development and Test on the IBM cloud WS009 / VS0091.0

Notes:

The IBM cloud is a dynamic virtual development and test infrastructure environment, designed for the enterprise. It provides users with a choice of virtual configurations, the option to add persistent storage, and preconfigured software images. You pay as you go (hourly rates per VM instance). Free and paid support is available. Access via:

http://www.ibm.com/services/us/igs/cloud-development/

An instance can be deployed and provisioned quickly in just three steps, described on the next few slides.

WebSphere Education

IBM Smart Business Development and Test Cloud portal: Sign in

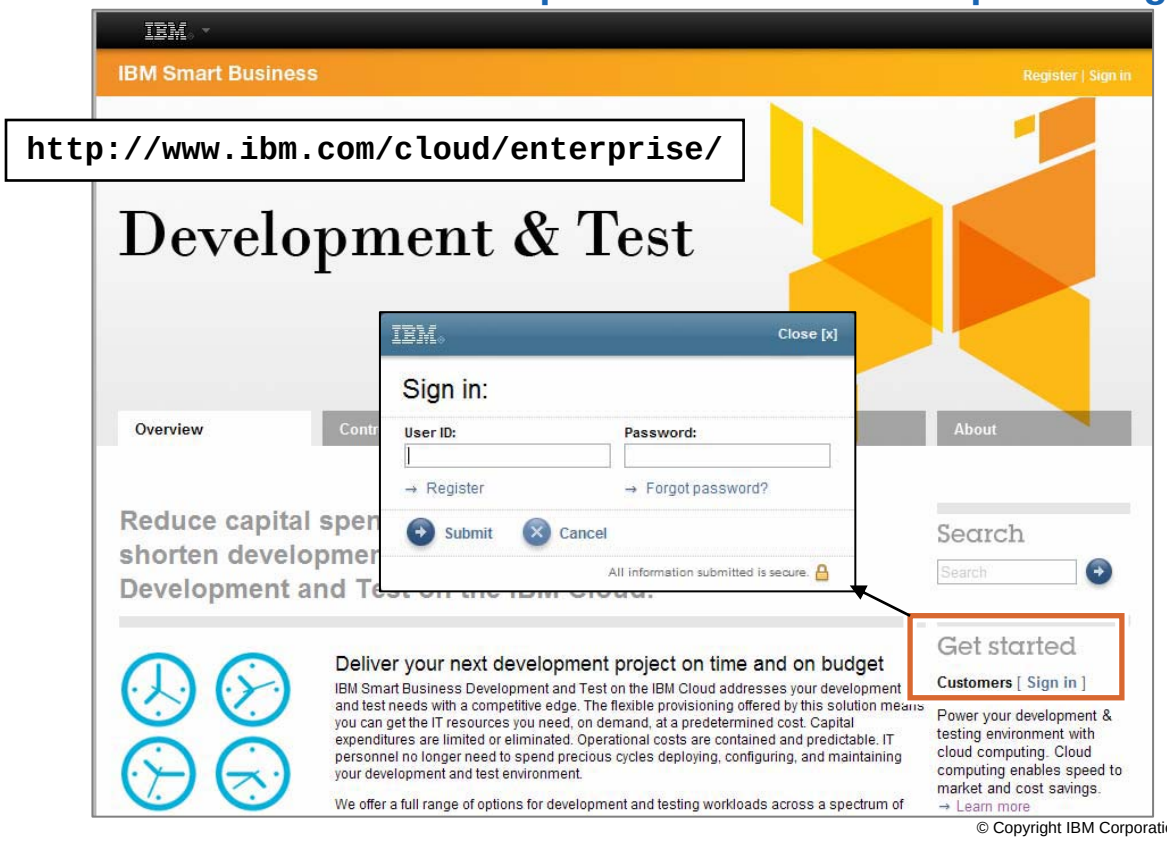


Figure 6-24. IBM Smart Business Development and Test Cloud portal: Sign in WS009 / VS0091.0

Notes:

After requesting a contract, you receive information on how to log into the Development & Test portal. The URL for the login page is: **`http://www.ibm.com/cloud/enterprise/`**

WebSphere Education

Account administration: Adding a user

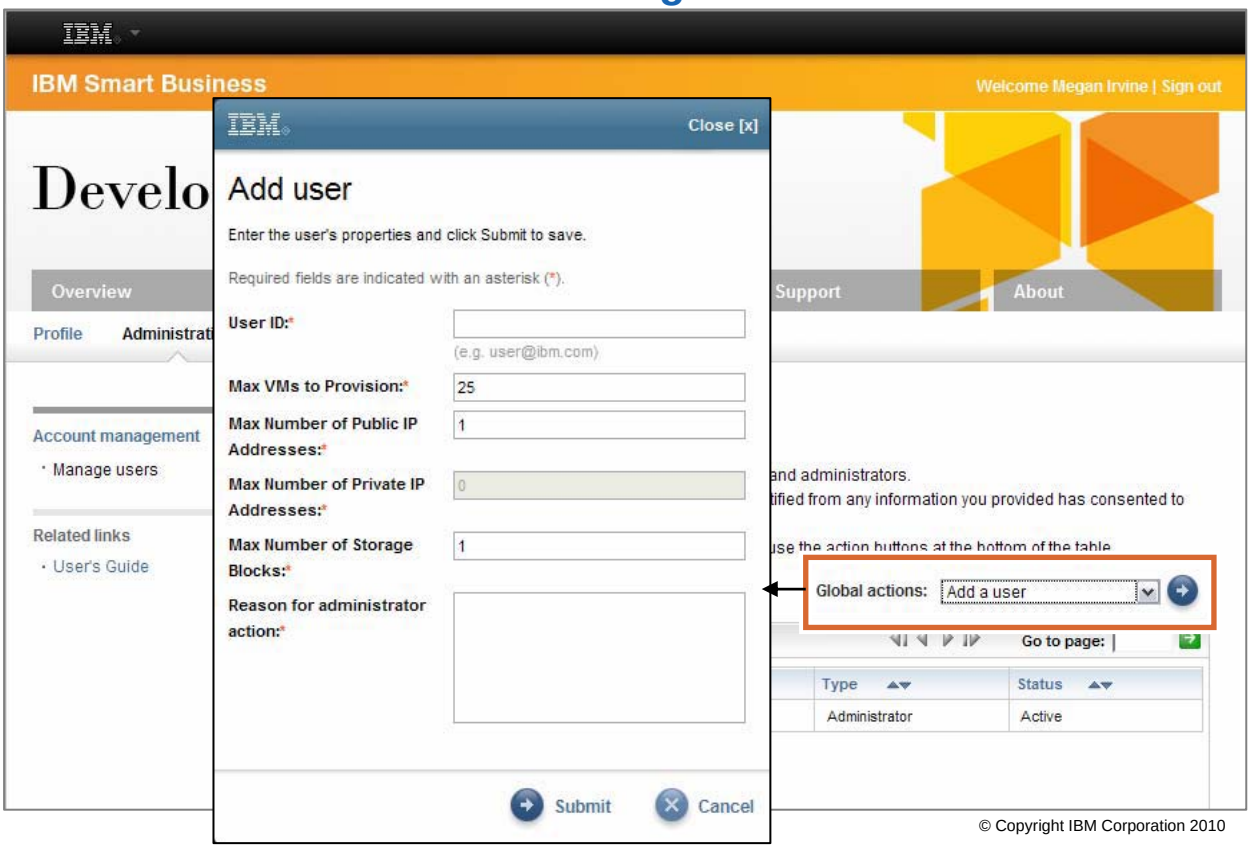


Figure 6-25. Account administration: adding a user WS009 / VS0091.0

Notes:

You can add users to the account on the **Account > Administration** page. Select **Add a user** from the **Global actions** menu and click the right-arrow button. Complete the form and click Submit.

WebSphere Education

Creating an instance (1 of 7)

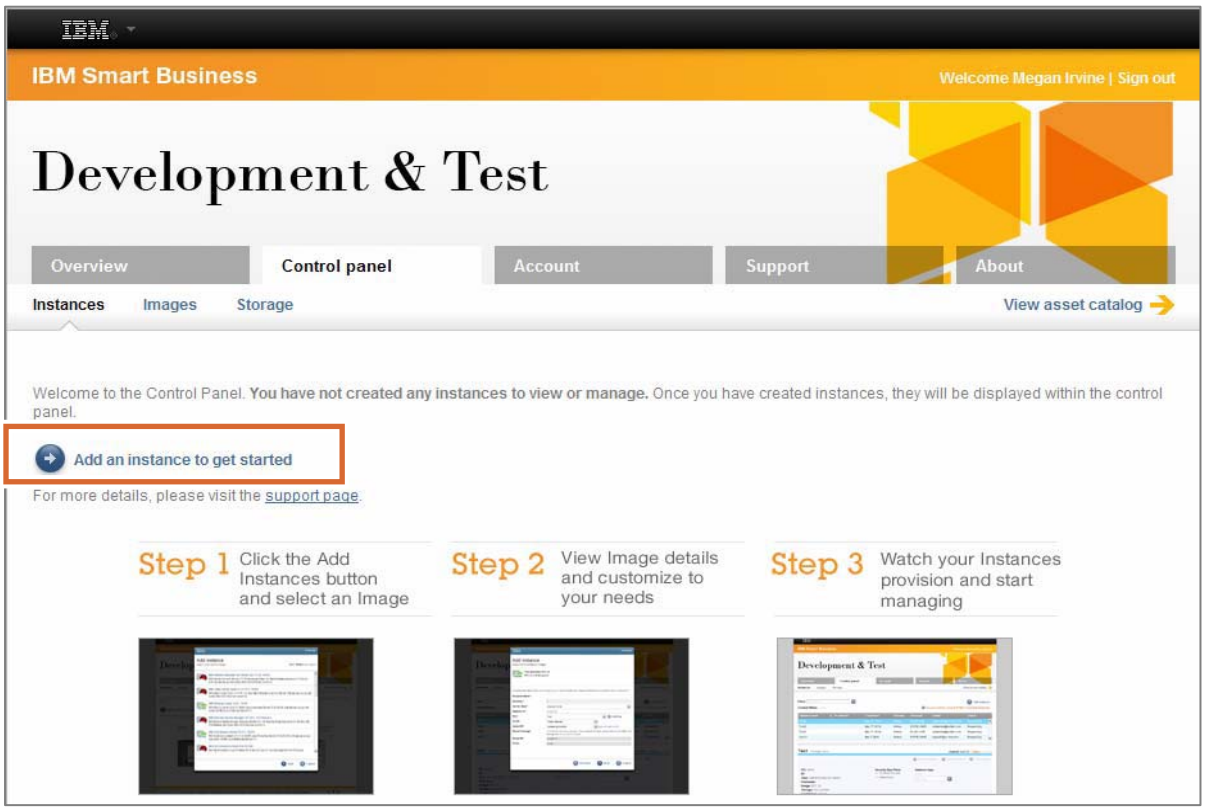


Figure 6-26. Creating an instance (1 of 7) WS009 / VS0091.0

Notes:

You can create an instance on the **Control Panel > Instances** page. Click **Add an instance** to get started.

After you have created some instances, they are listed here.

WebSphere Education

Creating an instance (2 of 7)

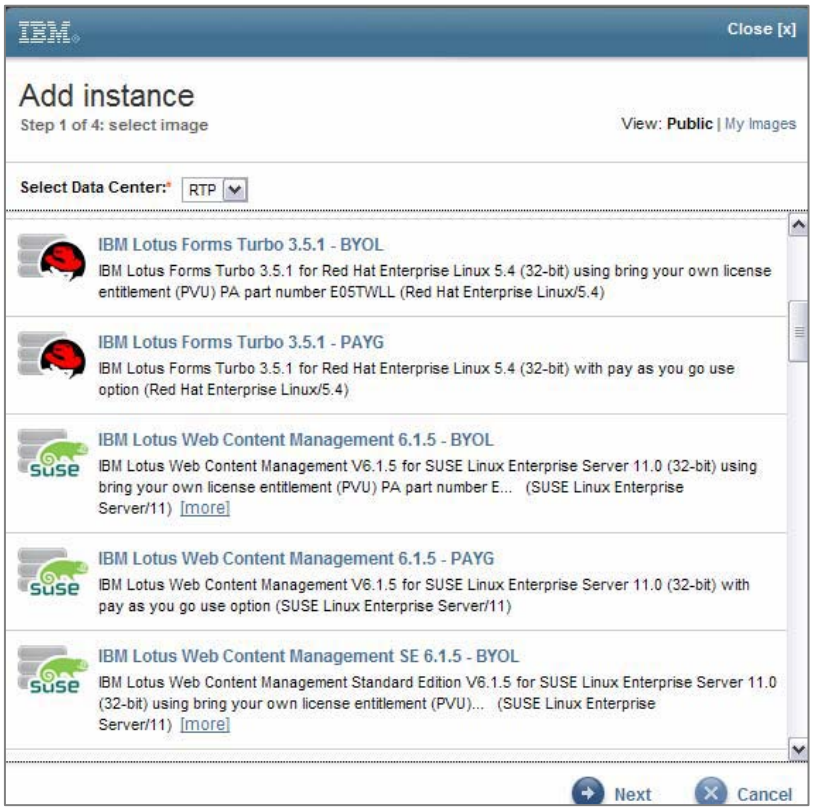


Figure 6-27. Creating an instance (2 of 7) WS009 / VS0091.0

Notes:

A catalog of images displays. You can select the **Data Center** from the drop-down menu, then choose an image, and click Next.

WebSphere Education

Creating an instance (3 of 7)

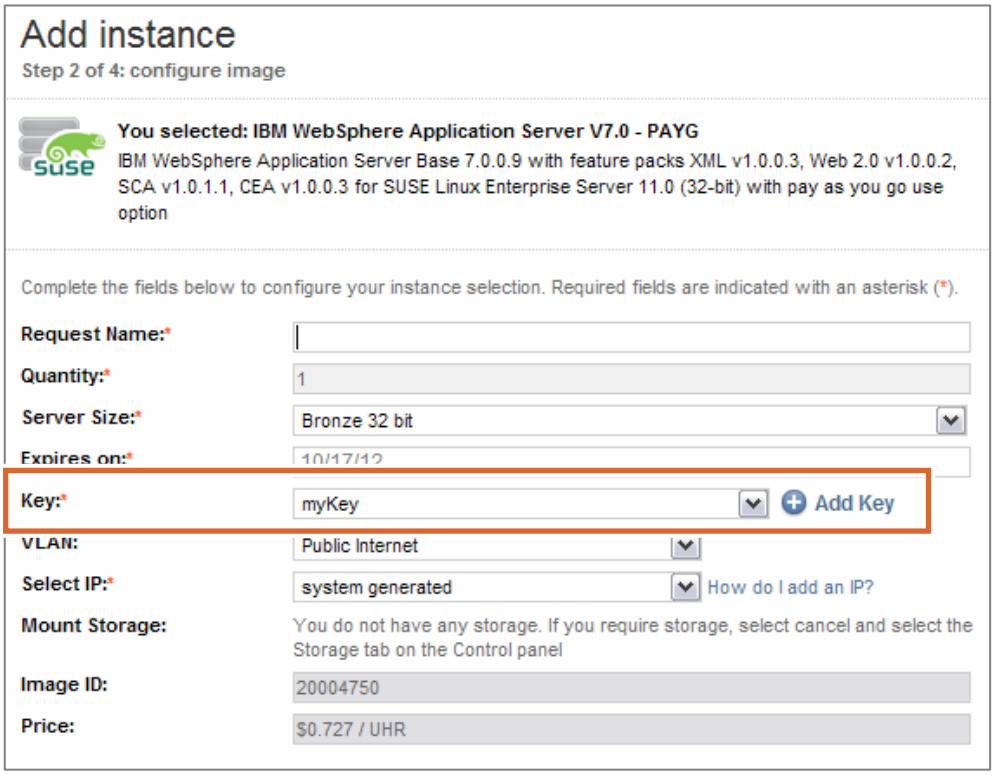


Figure 6-28. Creating an instance (3 of 7) WS009 / VS0091.0

Notes:

Depending on which image you chose in the previous step, the options on the next few screens may vary. In this example, the user chose an image with WebSphere Application Server Base 7.0.0.9. The form on the right asks you to specify a WebSphere administrator user ID and password, and you can choose from a list of feature packs to include.

Note that in this example, the user specified a security key (highlighted in the screen capture). If you have already generated a security key for your instance, you can select it from the drop-down menu. Otherwise, you can click the **Add key** link, and you go to the page to generate a new key pair. These steps are shown later in this unit.

WebSphere Education

Creating an instance (4 of 7)

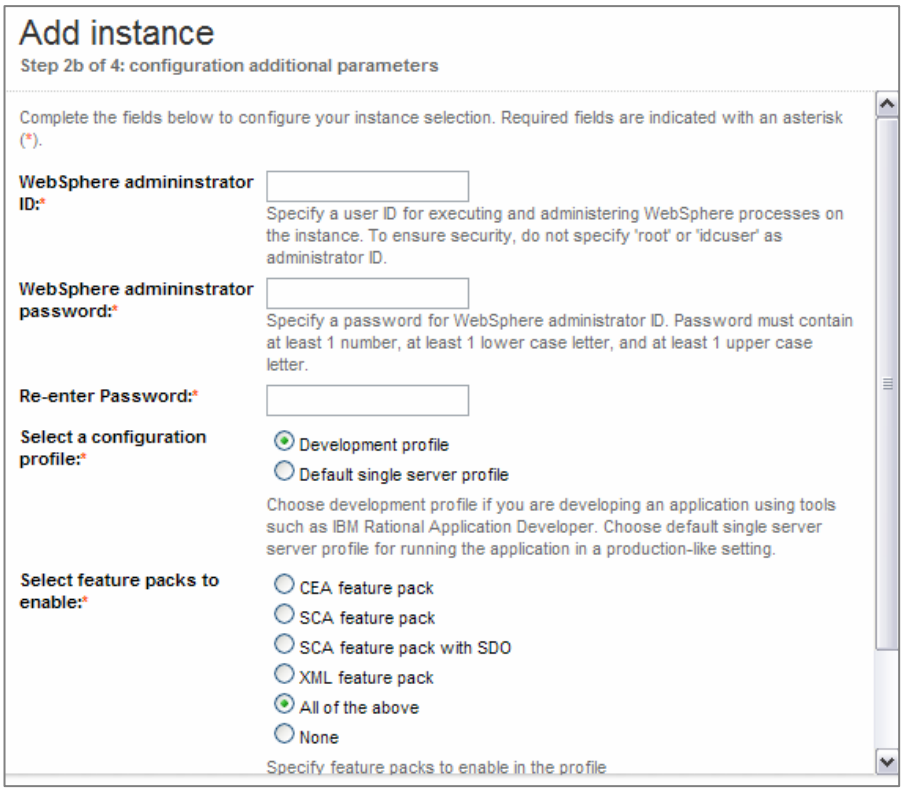


Figure 6-29. Creating an instance (4 of 7) WS009 / VS0091.0

Notes:

WebSphere Education

Creating an instance (5 of 7)

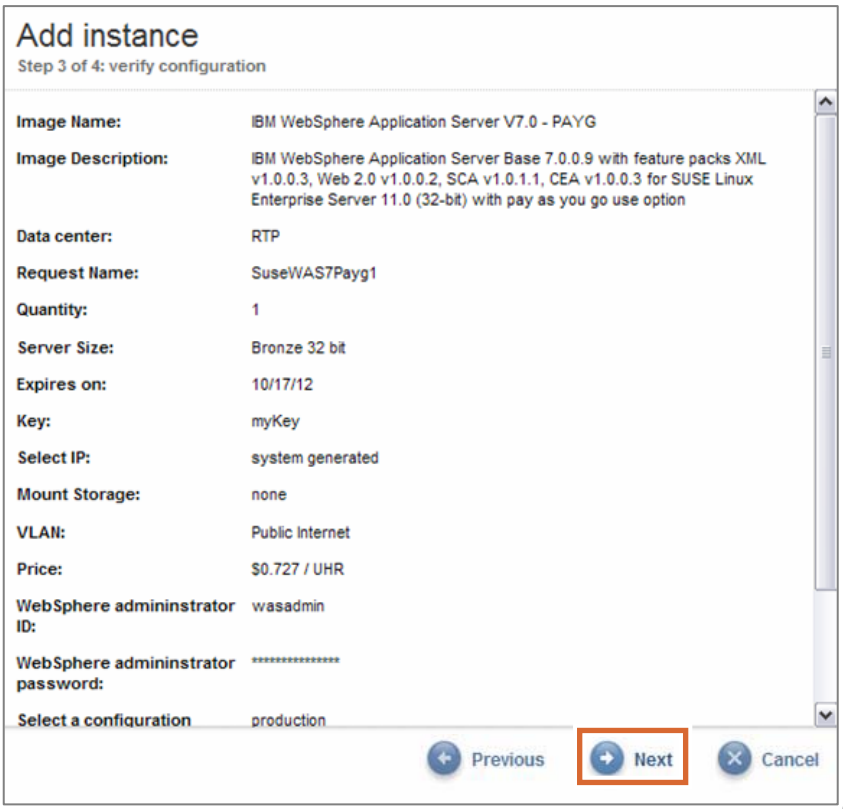


Figure 6-30. Creating an instance (5 of 7) WS009 / VS0091.0

Notes:

After choosing options for the image, you are prompted to verify the configuration details, and then you must agree to the service agreement. Upon activation of the instance, usage metering begins and your account is charged accordingly.

WebSphere Education

Creating an instance (6 of 7)

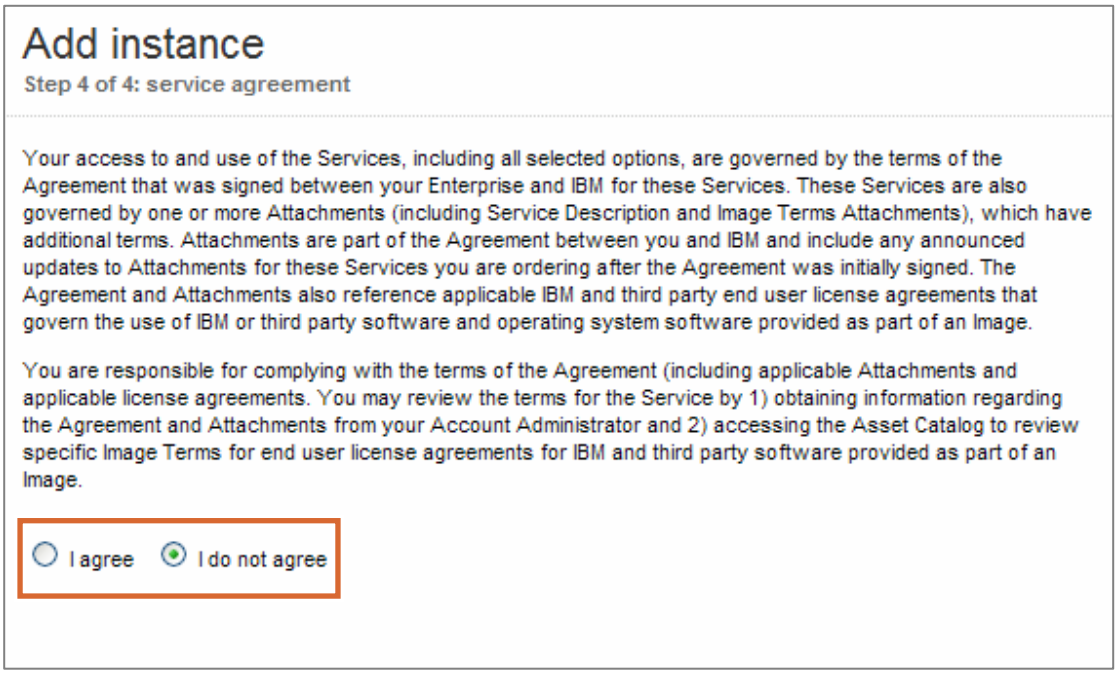


Figure 6-31. Creating an instance (6 of 7) WS009 / VS0091.0

Notes:

WebSphere Education

Creating an instance (7 of 7)

Figure 6-32. Creating an instance (7 of 7) WS009 / VS0091.0

Notes:

This screen indicates that the instance is being provisioned. This can take several minutes. The status changes when the provisioning is complete.

WebSphere Education

Generating security keys (1 of 2)

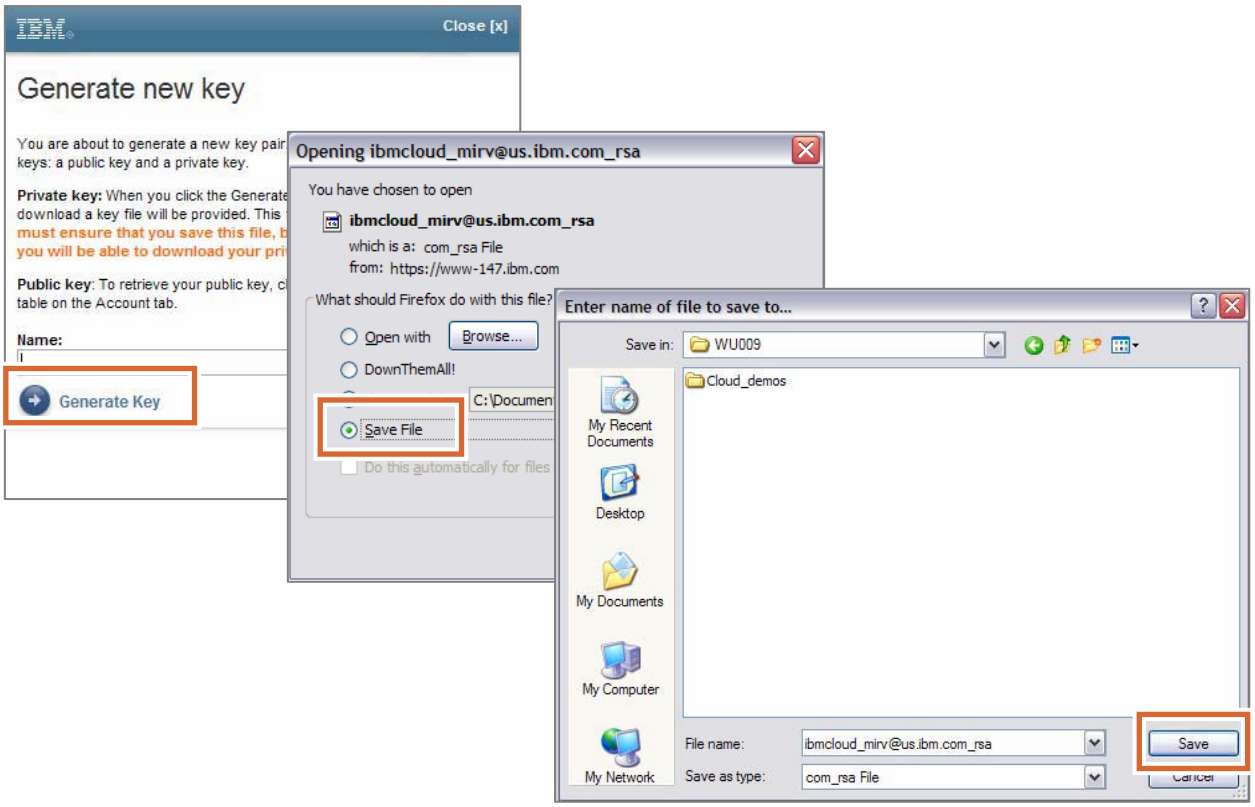


Figure 6-33. Generating security keys (1 of 2) WS009 / VS0091.0

Notes:

Click the **Add key** link, during instance creation, to generate a new key pair. You are prompted to save the file. Be sure to protect this file.

WebSphere Education

Generating security keys (2 of 2)

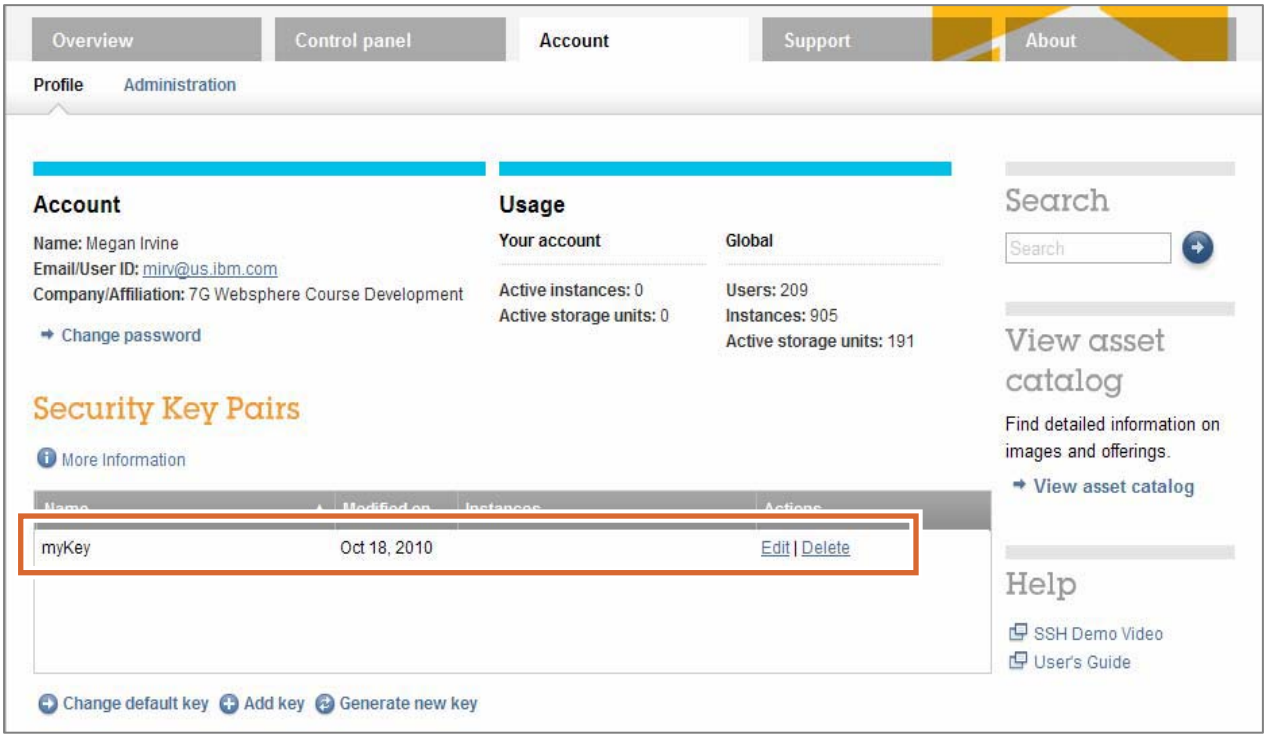


Figure 6-34. Generating security keys (2 of 2) WS009 / VS0091.0

Notes:

From the **Account > Profile** page, you can view and manage your keys.

WebSphere Education

Instance compute resources

32-bit VM component	Copper	Bronze	Silver	Gold
Virtual CPUs @ 1.25 GHz	1	1	2	4
Virtual memory (GB)	2	2	4	4
Virtual local storage (GB)	60	175	350	350

64-bit VM component	Copper	Bronze	Silver	Gold	Platinum
Virtual CPUs @ 1.25 GHz	2	2	4	8	16
Virtual memory (GB)	4	4	8	16	16
Virtual local storage (GB)	60	850	1024	1024	2048

Figure 6-35. Instance compute resources WS009 / VS0091.0

Notes:

Customers can select any of these instance compute resource configurations for either 32-bit or 64-bit virtual machines. Some instance resource configurations may not be available for certain images.

IBM tracks and meters the per hour usage for instances provisioned. The per hour metering for each instance begins when the instance is available for use and ends when the instance is deleted.

Each instance is provisioned and loaded with an image selected from the image asset catalog or web portal.

WebSphere Education IBM

Image use options (1 of 2)

- Pay as you go (PAYG)
  - Per hour usage metering for PAYG images
- Bring your own license entitlement (BYOL)
  - A BYOL image is only available if the customer has properly acquired (for example, Passport Advantage) authorizations to use an IBM software product
- Pre-release
  - Available for images designated as pre-release in the image asset catalog
- Developer use only (DUO)
  - DUO images are not part of the standard image enablement, and customers must complete and submit an enablement form for DUO to enable DUO images
- Third-party images
- Customer-provided software

Figure 6-36. Image use options (1 of 2) WS009 / VS0091.0

Notes:

Image use options (2 of 2)

- Persistent storage
  - You can order blocks of persistent storage to store content and use with an instance
  - IBM tracks and meters the number and size of storage packages provisioned and used, and the number of input and output access requests

Storage package	Storage amount (GB)
Small	256
Medium	512
Large	2048

- Internet data transfer
  - IBM provides for inbound and outbound data transfers between the IBM cloud and Internet
  - IBM tracks and meters the amount of data transfers, rounded up to the next whole GB
- Reserved IP addresses
  - You can order reserved public IP addresses on the publicly accessible shared virtual local area network (VLAN) in the IBM cloud
  - IBM tracks and meters per hour the number of reserved IP addresses used

Figure 6-37. Image use options (2 of 2) WS009 / VS0091.0

Notes:

WebSphere Education

Premium services options

- Reserved capacity package
  - Reserves instance compute resource capacity for a customer's exclusive use
- Virtual private network (VPN)
  - You can order a private VLAN connection to the IBM Cloud Center
- Premium support
  - Extends the base services support provided through the forum
  - Provides foundational support services and optional Linux support services

Instance compute resource	For each reserved capacity unit
Virtual CPUs @ 1.25GHz	64
Virtual memory (GB)	96
Virtual storage (GB)	9600

Figure 6-38. Premium services options WS009 / VS0091.0

Notes:

WebSphere Education

Other IBM cloud services

- Creating private images
  - You can create a snapshot image of an instance, and then save the snapshot as a custom image (private image)
- Security
  - IBM provides security for the IBM Cloud Center infrastructure only
  - Customer is responsible for securing instances once provisioned
- Online cloud services forum
  - Provides information posted by IBM and customers regarding services and support
  - IBM monitors the forum during business hours, US Eastern time
- Service level agreement
  - Customers may be eligible for a services credit in the event there is a degradation of services

Figure 6-39. Other IBM cloud services WS009 / VS0091.0

Notes:

Unit summary

Having completed this unit, you should be able to:

- Position various vendors in the service delivery model of cloud computing
- Provide an example of an IBM cloud architectural configuration
- Describe the IBM cloud computing offerings and services
  - Collaboration — LotusLive, BlueWorks
  - Smart Business Desktop
  - Smart Business Development and Test
  - Smart Analytics Cloud
- Describe IBM tooling options for management and governance — Tivoli
- Describe the IBM Smart Business Development and Test cloud — Jazz for Rational
- Describe cloud computing using IBM WebSphere

Figure 6-40. Unit summary WS009 / VS0091.0

Notes:

WebSphere Education

Checkpoint

1. True or false: Tivoli Service Automation Manager integrates with the IBM WebSphere CloudBurst Appliance.

2. The IBM Smart Business Development and Test on the IBM cloud is an example of what type of cloud?
   A. Private
   B. Shared
   C. Public

Figure 6-41. Checkpoint WS009 / VS0091.0

Notes:

Write your answers here:

1.

2.

WebSphere Education IBM

Checkpoint answers

1. **True** or false: Tivoli Service Automation Manager integrates with the IBM WebSphere CloudBurst Appliance.

2. The IBM Smart Business Development and Test on the IBM cloud is an example of what type of cloud?
   A. Private
   B. Shared
   C. Public

   Answer: C

Figure 6-42. Checkpoint answers WS009 / VS0091.0

Notes:

Checkpoint (optional)

1. Where do collaboration tools and analytics services fit into the cloud?
2. Where does WebSphere fit into the cloud?
3. What are some examples of Rational products that may be used in a cloud environment?

Figure 6-43. Checkpoint (optional) WS009 / VS0091.0

Notes:

Write your answers here:

1.

2.

3.

WebSphere Education IBM

Checkpoint (optional) answers

1. Software as a service (SaaS)
2. Platform as a service (PaaS), or shared middleware services
3. Jazz, IBM Rational Team Concert, Rational Quality Manager, Rational Requirements Composer, Rational Asset Manager, Rational Insight, and others.

Figure 6-44. Checkpoint (optional) answers WS009 / VS0091.0

Notes:

Demonstration

Instance creation on the IBM Smart Business Development and Test Cloud

Figure 6-45. Demonstration WS009 / VS0091.0

Notes:

Demonstration objectives

After completing this demonstration, you should be able to:

- Describe how to create an instance on the IBM Smart Business Development and Test Cloud

Figure 6-46. Demonstration objectives WS009 / VS0091.0

Notes:

Demonstration

Connecting to an instance on the IBM Smart Business Development and Test Cloud

Figure 6-47. Demonstration WS009 / VS0091.0

Notes:

WebSphere Education IBM

Demonstration objectives

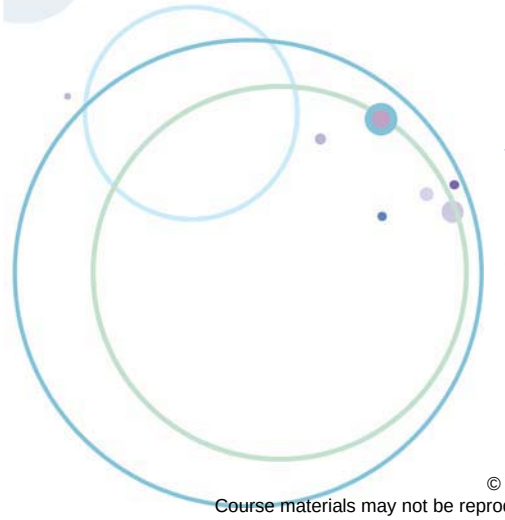
After completing this demonstration, you should be able to:

- Describe how to connect to an instance on the IBM Smart Business Development and Test Cloud

Figure 6-48. Demonstration objectives WS009 / VS0091.0

Notes:

Demonstration



Getting a fixed IP address, storage, and keys on the IBM Smart Business Development and Test Cloud

Figure 6-49. Demonstration WS009 / VS0091.0

Notes:

Demonstration objectives

After completing this demonstration, you should be able to:

- Describe how to request storage and manage keys

Figure 6-50. Demonstration objectives WS009 / VS0091.0

Notes:

Unit 7. IBM WebSphere CloudBurst and IBM WebSphere Hypervisor edition

What this unit is about

This provides an overview of the IBM WebSphere CloudBurst and IBM WebSphere Hypervisor edition. These two products can be used to create and provision cloud-based images.

What you should be able to do

After completing this unit, you should be able to:

- Describe IBM WebSphere CloudBurst
- Describe the features and capabilities of IBM WebSphere CloudBurst
- Describe the features of IBM WebSphere Hypervisor Edition

How you will check your progress

- Checkpoint
- Demonstration exercise

Unit objectives

After completing this unit, you should be able to:

- Describe IBM WebSphere CloudBurst
- Describe the features and capabilities of IBM WebSphere CloudBurst
- Describe the features of IBM WebSphere Hypervisor Edition

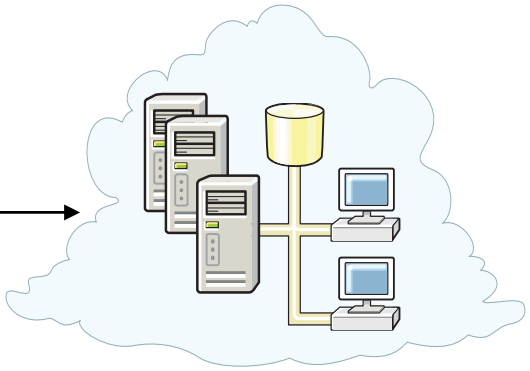
Figure 7-1. Unit objectives WS009 / VS0091.0

Notes:

WebSphere Education

What is IBM WebSphere CloudBurst?

1. An appliance from IBM that includes...
   - Hardware with built-in security and trust authority
   - WebSphere Application Server images
   - WebSphere Application Server patterns
2. ...that manages a private cloud...
   - Hypervisors
   - Storage
   - Network



3. ...comprises WebSphere virtual systems...
   - Customize images and patterns
   - Dispense and run in the cloud
   - Lifecycle management and optimization

Figure 7-2. What is IBM WebSphere CloudBurst? WS009 / VS0091.0

Notes:

IBM WebSphere CloudBurst appliance includes the hardware, the management application, and a set of preinstalled and preconfigured WebSphere Application Server virtual images and patterns. All access to the appliance is via supported interfaces, using the Web 2.0 user interface, the full command-line interface (CLI), or REST (representational state transfer) APIs.

The appliance supports a “bring your own cloud” model in which hypervisors, network capabilities, and storage are provided for use by the appliance. The cloud is where the deployed WebSphere applications run; they do not run on the appliance.

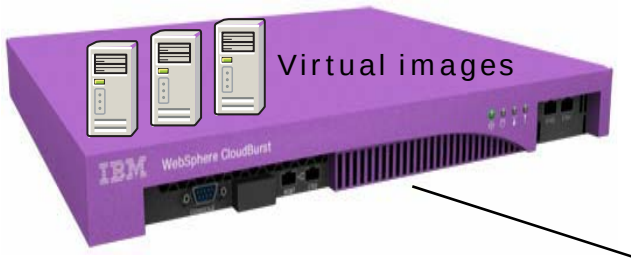
IBM WebSphere CloudBurst appliance provides the tooling to customize the IBM-provided images and patterns to create a self-service catalog of your WebSphere applications, and the capabilities to dispense WebSphere Application Server virtual systems into the private cloud. The appliance includes intelligent placement capabilities that enable the WebSphere Application Server patterns to be deployed to the cloud in such a way as to ensure efficient cloud resource usage and high availability characteristics. Once the patterns are deployed,

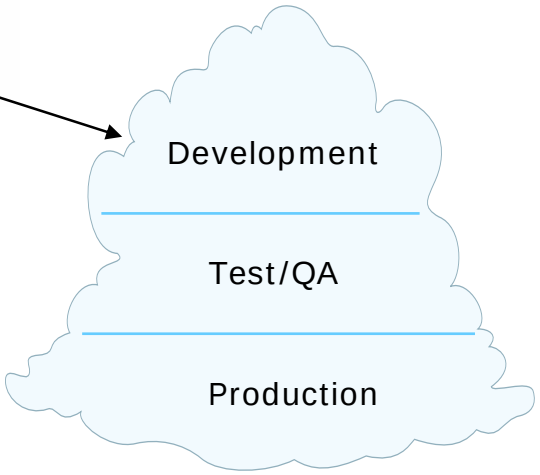
the appliance provides management and optimization capabilities, including mechanisms to apply fixes to the environment.

WebSphere Education

Provisioning of WebSphere Application Server instances

What problems does IBM WebSphere Cloudburst address?





- Provisioning of IBM WebSphere Application Server instances
- Shorten the development and testing life cycles

Figure 7-3. Provisioning of WebSphere Application Server instances WS009 / VS0091.0

Notes:

The appliance enhances rapid provisioning of IBM WebSphere Application Server instances from predefined patterns into a private cloud. The private cloud may contain environments for development, test, QA, and production. You can move development images directly to and from test as well as migrate test and QA instances to production. A distributed WebSphere production environment can be re-created on a single virtualized physical system for test purposes. A WebSphere Application Server test environment can be reset efficiently. You can save multiple versions and stages of test images. Development and test images can be rolled back using virtual machine snapshots.

WebSphere Education

Benefits of an appliance

- Consumability
  - Available immediately after installation
  - Build private clouds after installation
- Security
  - Everything stored is encrypted
  - Three secure interfaces
- Performance
  - Advanced compression techniques
  - Advanced storage techniques

Figure 7-4. Benefits of an appliance WS009 / VS0091.0

Notes:

The appliance affords a great deal of consumability. After connecting the appliance and accepting the initial licenses, the WebSphere CloudBurst Appliance console is immediately available. No extra installation steps are necessary, and you can immediately begin to build out your private WebSphere clouds.

The WebSphere CloudBurst Appliance, like an IBM WebSphere DataPower SOA Appliance, provides a tamper-resistant casing. In addition, WebSphere CloudBurst Appliance applies encryption to SSL certificates, passwords, virtual images, applications, and everything else that is stored on it. Users interact with WebSphere CloudBurst using one of three interfaces:

- Web 2.0 user interface
- Full command-line interface (CLI)
- REST APIs

There are no other access points (like a command-line shell), thus decreasing the surface area for malicious attacks.

The WebSphere CloudBurst Appliance serves as a dedicated store for both the shipped and customized WebSphere Application Server virtual images and patterns. The appliance includes advanced compression and storage techniques that enable a significant number of these sizeable virtual images to be stored by a user. The appliance also delivers the processing power needed to manage these virtual images and enable you to create private WebSphere clouds.

WebSphere Education

What is WebSphere Application Server Hypervisor Edition?

Multiple disk design

A. WebSphere profile types precreated on disk

B. WebSphere Application Server binary disk

C. IBM HTTP Server binaries disk

D. Base SUSE Linux Enterprise Server installation disk

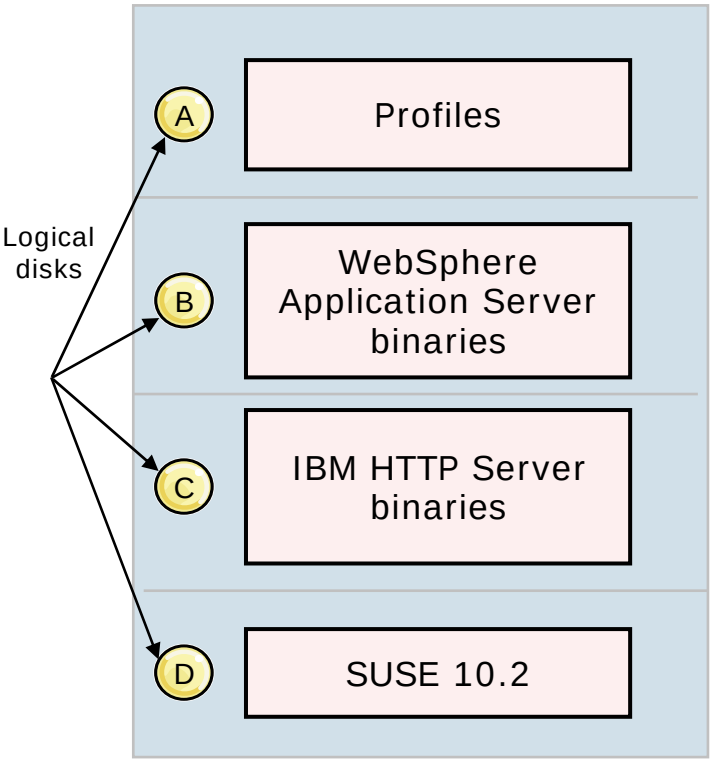


Figure 7-5. What is WebSphere Application Server Hypervisor Edition? WS009 / VS0091.0

Notes:

WebSphere Application Server Hypervisor Edition is part of the WebSphere Application Server family of products. It is included in the appliance. It contains a preinstalled, preconfigured, OS-included binary image of the application server from which virtual machines can be created and deployed on hypervisors.

For each release of WebSphere Application Server Hypervisor Edition V6.1 and V7.0 products, the base image contains SUSE Linux operating system as well as the IBM HTTP Server, WebSphere Application Server binaries, and all profiles supported for that specific release. WebSphere Application Server Hypervisor Edition uses OVF format, which is an optimized format to store virtual images.

WebSphere Education

WebSphere Application Server Hypervisor Edition features

- WebSphere shipped ready to run on hypervisor
- No installation required
  - Just choose a profile and run
- Single virtual image capable of supporting single servers or clusters
- Support for WebSphere Application Server V6.1 and V7
- Support for WebSphere Application Server feature packs
- Maintenance, support, and fixes for both WebSphere Application Server and operating system
- Based on Open Virtualization Format (OVF) standard

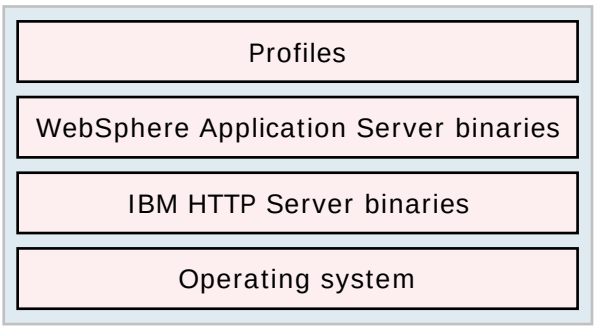


Figure 7-6. WebSphere Application Server Hypervisor Edition features WS009 / VS0091.0

Notes:

Previously, when IBM customers wanted to use WebSphere Application Server in a virtualization context, they were required to build their own images, which involved managing two parallel sets of code (operating system and middleware). Now IBM is building and supporting the entire virtual image.

WebSphere Education

WebSphere CloudBurst console

- Sign on to WebSphere CloudBurst using the administrative console
- Request Application Server Hypervisor editions to be dispensed

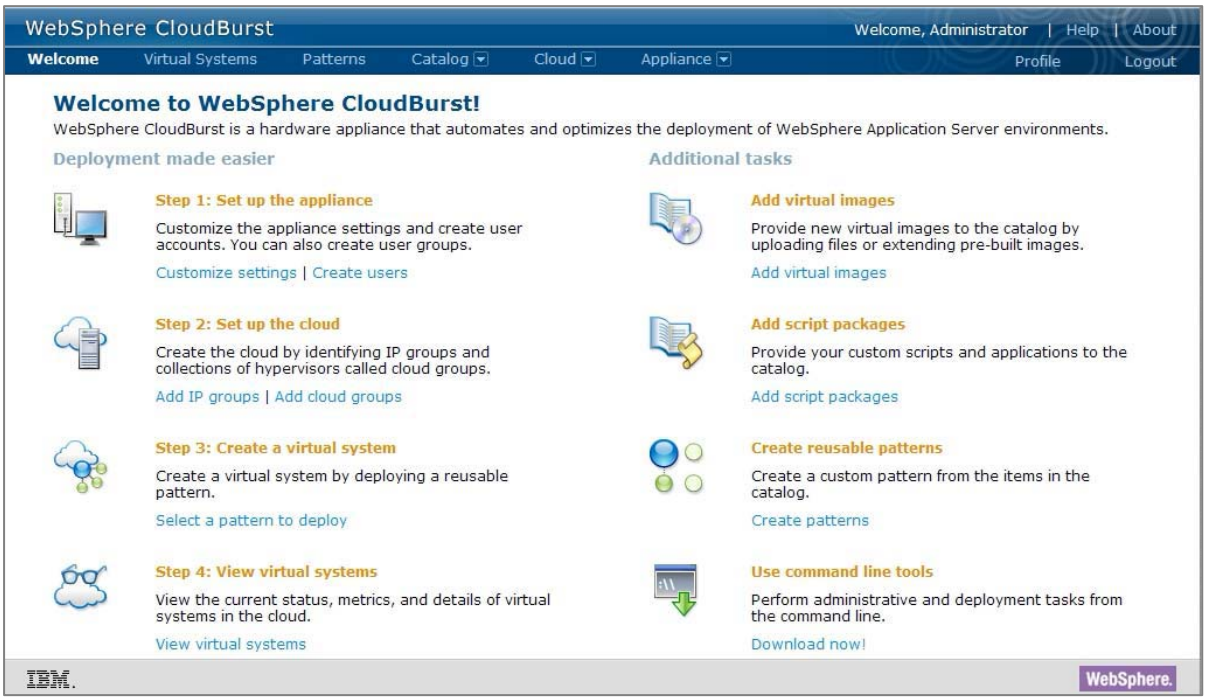


Figure 7-7. WebSphere CloudBurst console WS009 / VS0091.0

Notes:

The user logs onto the WebSphere CloudBurst box, and based on the permissions set for that login, is presented with a list of environments, or patterns, as they are called, that can be made available in the cloud. These patterns are multiserver arrangements of WebSphere Hypervisor Edition.

Users can create patterns from the WebSphere CloudBurst catalog of WebSphere Application Server Hypervisor Edition virtual images that ships with the CloudBurst product.

WebSphere Education

Dispensing WebSphere Hypervisor edition images

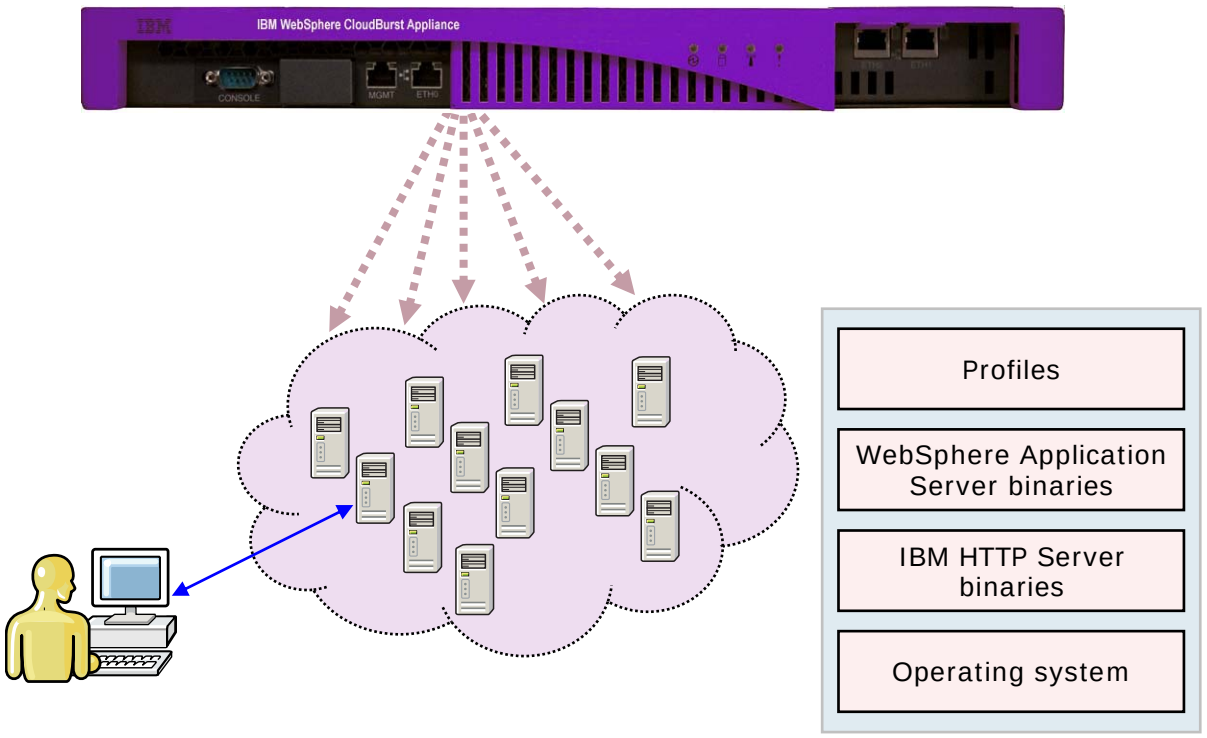


Figure 7-8. Dispensing WebSphere Hypervisor edition images WS009 / VS0091.0

Notes:

An environment or pattern is selected, and CloudBurst then chooses a set of hypervisors (based on utilization) in the cloud to dispense the environment into. WebSphere CloudBurst then presents the user with a list of the host names that were chosen, and the user can access the patterns that have been deployed as virtual systems running in the cloud.

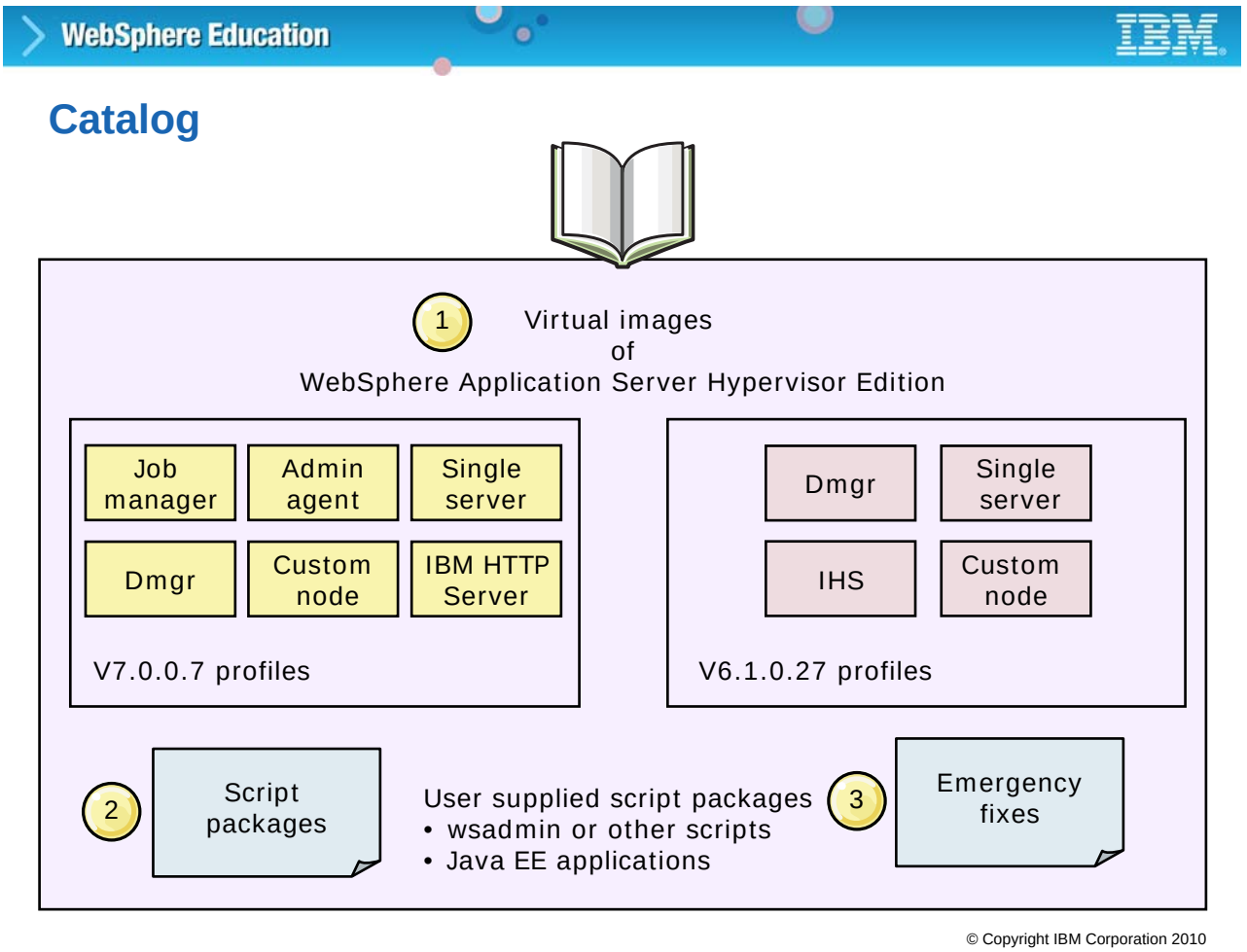


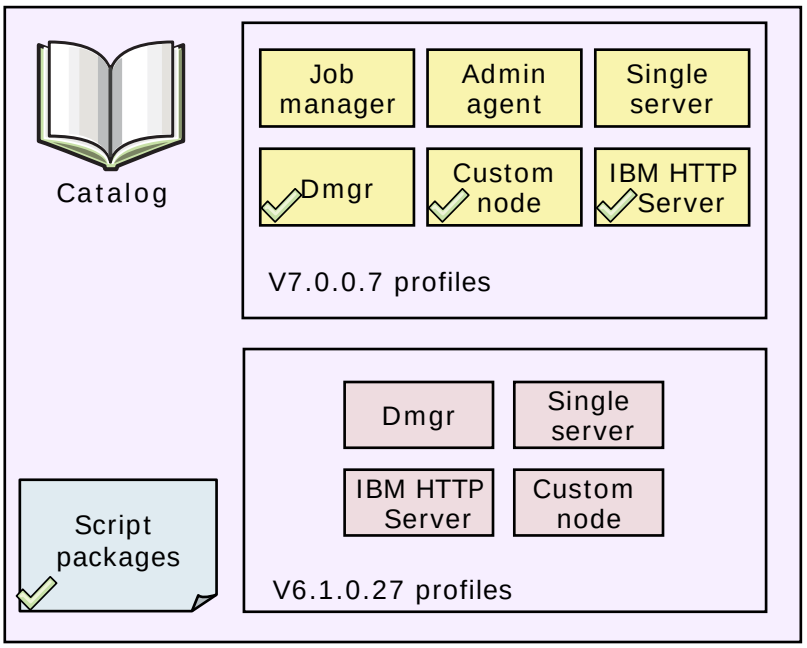
Figure 7-9. Catalog WS009 / VS0091.0

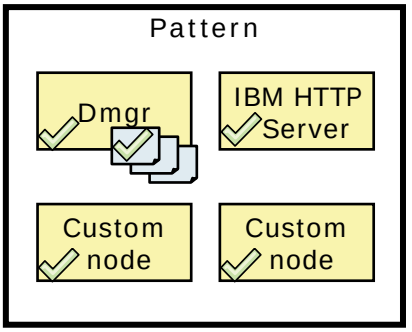
Notes:

1. Provided with the appliance is a catalog of virtual images of WebSphere Application Server Hypervisor Edition V7.0 and V6.1. The catalog of virtual images contains all profiles related to those versions of the application server, as shown in the graphic.
2. In addition, users can supply their own script packages. These script packages can contain script package files (wsadmin scripts or other OS executables), along with any Java EE applications or other artifacts. The user associates the scripts to a given deployment. At deployment time, the script is extracted and the executable specified in the package is executed on the virtual machine. Through this mechanism, the user can customize the WebSphere Application Server configuration on the virtual machine. Examples of custom scripts can include installing a Java EE application, or configuring a JDBC connection.
3. A list of emergency fixes is also included in the catalog.

WebSphere Education

Patterns





- Pattern is one or more virtual image parts and script packages selected from the catalog used to create a deployment topology
- Example illustrates a V7.0 clustered topology

Figure 7-10. Patterns WS009 / VS0091.0

Notes:

Using the catalog of WebSphere Application Server Hypervisor Edition virtual images and script packages, users can create patterns that can be deployed as virtual systems to the private cloud. Patterns are like templates that can be used to deploy virtual systems on the cloud. The pattern can be as simple as single server topology where a single server virtual image from the catalog for a given version is used to create a pattern.

As shown in this example, the pattern is for a WebSphere Application Server V7.0 network deployment cell. From the catalog, a deployment manager, two custom nodes, and IBM HTTP Server were added to a pattern. At a later time, the pattern could be deployed as a virtual system to the private cloud. Each virtual image in the pattern is deployed as its own virtual machine into the private cloud.

WebSphere Education IBM

Virtual systems: Deployed patterns

- Virtual systems are patterns that have been deployed to the cloud

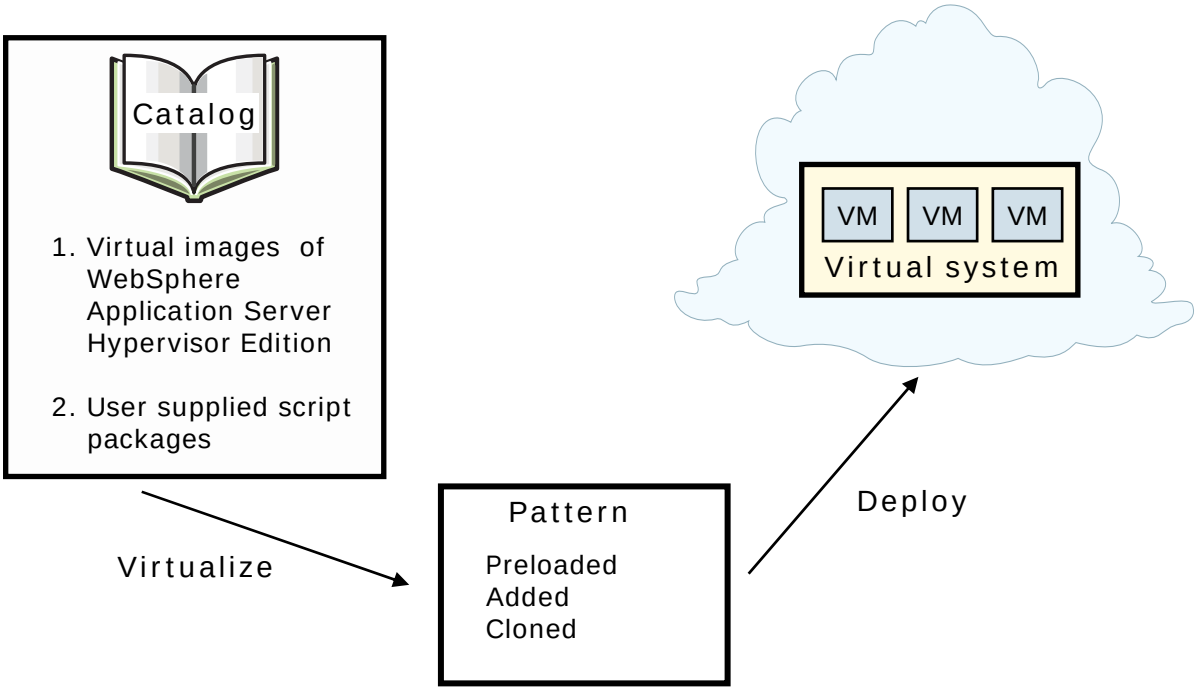


Figure 7-11. Virtual systems: Deployed patterns WS009 / VS0091.0

Notes:

There are a number of tasks that must be performed before a pattern is deployed as a virtual system to the private cloud. The user first must determine which virtual images in the catalog are suitable for the situation on hand. Next the user creates script packages. Script packages customize the deployment of the pattern to the cloud. The virtual image and script package combine to make a pattern. Users can work with preloaded patterns, add their own, or clone preloaded patterns. Once a pattern is finalized, it is deployed (or dispensed) to a hypervisor in the private cloud. A deployed pattern is called a virtual system. A virtual system is made up of one to many virtual machines that run on the hypervisor.

WebSphere Education

Virtual image life cycle

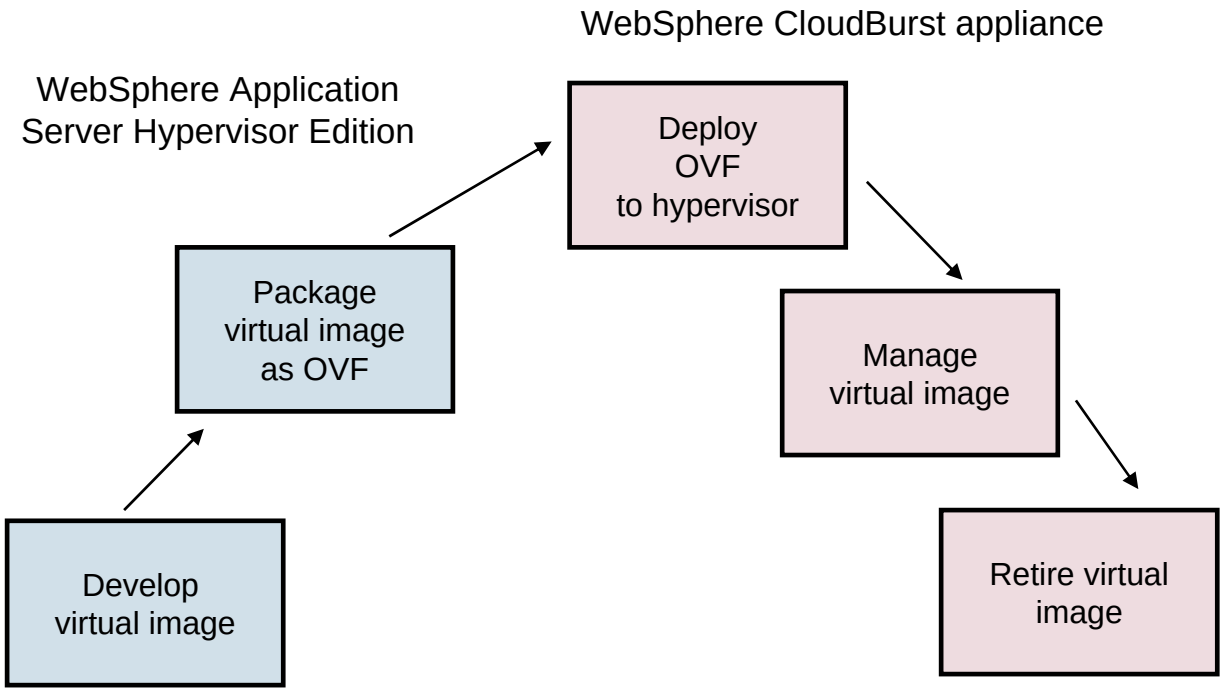


Figure 7-12. Virtual image life cycle WS009 / VS0091.0

Notes:

WebSphere Application Server Hypervisor and WebSphere CloudBurst appliance introduce a new life cycle to consider. Virtual images are developed and packaged using Hypervisor Edition. Those images are deployed, managed, and retired by the CloudBurst appliance.

Unit summary

Having completed this unit, you should be able to:

- Describe IBM WebSphere CloudBurst
- Describe the features and capabilities of IBM WebSphere CloudBurst
- Describe the features of IBM WebSphere Hypervisor Edition

Figure 7-13. Unit summary WS009 / VS0091.0

Notes:

Checkpoint

1. **True or false**: IBM WebSphere CloudBurst runs WebSphere Hypervisor edition virtual machines on the appliance.

2. **True or false**: A distributed WebSphere production environment can be recreated on a single virtualized physical system for test purposes.

Figure 7-14. Checkpoint (objective only) WS009 / VS0091.0

Notes:

Write your answers here:

1.

2.

Checkpoint answers

1. **True or false**: IBM WebSphere CloudBurst runs WebSphere Hypervisor edition virtual machines on the appliance.
   Correct answer: False.
   WebSphere CloudBurst dispenses the WebSphere Hypervisor edition into a pool of ESX hypervisors that run on a set of hardware devices that must be held in a table on the appliance.

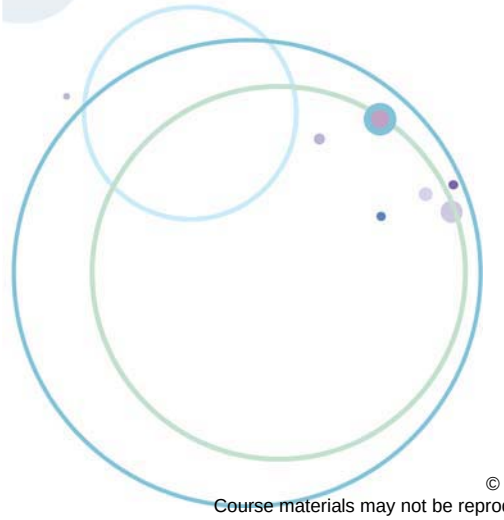
2. **True or false**: A distributed WebSphere production environment can be recreated on a single virtualized physical system for test purposes.
   Correct answer: True.

Figure 7-15. Checkpoint answers WS009 / VS0091.0

Notes:

WebSphere Education

Demonstration



Showing WebSphere CloudBurst

5.4.1.1

Figure 7-16. Demonstration WS009 / VS0091.0

Notes:

WebSphere Education IBM

Demonstration objectives

After completing this demonstration, you should be able to:

- Describe the capabilities and function of the IBM WebSphere CloudBurst appliance

Figure 7-17. Demonstration objectives WS009 / VS0091.0

Notes:

Demonstration instructions

1. If you have not already done so, extract **`Cloud_demos.zip`** to your hard drive, ensuring that you select **Use folder names** when extracting the file
2. Navigate to **`\Cloud_demos`**; then double-click **simulations.html** to start the demonstrations
3. Select **Demonstration: Showing WebSphere CloudBurst** to start the demonstration
4. Select **Final Exercise: Cloud crossword (requires Java browser plug-in)** to run the puzzle
5. Follow the instructions provided

Figure 7-18. Demonstration instructions WS009 / VS0091.0

Notes:

Unit 8. Course summary

What this unit is about

This unit provides a short summary of the course.

What you should be able to do

After completing this unit, you should be able to:

- Explain how the course met its learning objectives
- Submit your evaluation of the class
- Identify other WebSphere Education courses related to this topic
- Access the WebSphere Education website
- Locate appropriate resources for further study

Unit objectives

After completing this unit, you should be able to:

- Explain how the course met its learning objectives
- Submit your evaluation of the class
- Identify other WebSphere Education courses related to this topic
- Access the WebSphere Education website
- Locate appropriate resources for further study

Figure 8-1. Unit objectives WS009 / VS0091.0

Notes:

WebSphere Education

Course learning objectives (1 of 2)

Having completed this course, you should be able to:

- Define cloud computing
- Identify the key characteristics of cloud computing
- List the benefits of using clouds
- Describe some of the challenges to adopting a cloud architecture
- Describe key cloud computing concepts and terminology
- Describe the service delivery models in cloud computing
  - Identify the software as a service (SaaS) delivery model
  - Identify the platform as a service (PaaS) delivery model
  - Identify the infrastructure as a service (IaaS) delivery model
- List the various cloud deployment scenarios
  - Describe the features of private, public, hybrid, and community clouds
  - List some additional cloud deployment types
  - Select the most appropriate deployment model based on a set of business and technical requirements

Figure 8-2. Course learning objectives (1 of 2) WS009 / VS0091.0

Notes:

WebSphere Education IBM

Course learning objectives (2 of 2)

Since completing this course, you should be able to:

- Review the integration of security into the cloud reference model
- Describe security considerations in cloud computing
- Identify security options available in cloud computing
- Recognize the top security threats to cloud computing
- Describe the architecture of IBM cloud computing and IBM cloud computing offerings
  - Position the various vendors in the service delivery model of cloud computing
  - Illustrate an IBM example cloud architectural configuration
  - Describe some of the IBM cloud offerings
- Describe the capabilities WebSphere CloudBurst and WebSphere Hypervisor edition

Figure 8-3. Course learning objectives (2 of 2) WS009 / VS0091.0

Notes:

WebSphere Education

Class evaluation

- Your comments about this class are very useful to WebSphere Education
- Feedback on the site, curriculum, and instructor tell WebSphere Education what was good about the class and what can be improved
- Take the time to fill out the course evaluation on the IBM Training website, and receive your certificate for the course
  `osart.atlanta.ibm.com`
  - Course code: VS009 or WS009
  - Class number:

Figure 8-4. Class evaluation WS009 / VS0091.0

Notes:

Check the course code and class number with your instructor.

To learn more on this subject

- WebSphere Education website:
  - **www.ibm.com/websphere/education**
- Training paths:
  - **www.ibm.com/software/websphere/education/paths/**
  - Identify the next courses in this sequence
- Resource Guide
  - Contains information on many useful sources of information
  - Many of these sources are free
  - See handout in your class materials, or download a copy
    www.ibm.com/developerworks/wikis/display/WEinstructors/WebSphere+Resource+Guide
- Email address for more information:
  - **websphere_skills@us.ibm.com**
- Education CD and documents in your class materials

Figure 8-5. To learn more on this subject WS009 / VS0091.0

Notes:

References

- developerWorks Cloud community:
  - **https://www.ibm.com/developerworks/mydeveloperworks/groups/service/html/communityview?communityUuid=c2028fdc-41fe-4493-8257-33a59069fa04&successMessage=label.action.confirm.community.join**
- IBM Cloud Community:
  - **https://www.ibm.com/communities/service/html/communityview?communityUuid=fa3a3fd5-6d7b-48b9-b13b-ba25f3325dda**
- Cloud Security Alliance:
  - **www.cloudsecurityalliance.org**
- IBM Test Cloud:
  - **http://www.ibm.com/developerworks/cloud/devtest.html**
- Cloud Computing for Dummies, J. Hurwitz, ISBN 978-0-470-484-8
- IBM Test Preparation, Cloud Computing, A Primer, Part I & II:
  - **http://www.ibm.com/certify/tests/edu032.shtml**

Figure 8-6. References WS009 / VS0091.0

Notes:

Unit summary

Having completed this unit, you should be able to:

- Explain how the course met its learning objectives
- Submit your evaluation of the class
- Identify other WebSphere Education courses related to this topic
- Access the WebSphere Education website
- Locate appropriate resources for further study

Figure 8-7. Unit summary WS009 / VS0091.0

Notes:

List of abbreviations and acronyms

A

AAA	authentication, authorization, and auditing
ADP	Automatic Data Processing, Inc.
AES	Advanced Encryption Standard
AMI	Amazon Machine Image
API	application programming interface
ASP	application service provider

B

BSS	business support system
BYOL	bring your own license entitlement

C

CCMDB	Change and Configuration Management Database
CD	compact disc
CLI	command-line interface
CPU	central processing unit
CRM	customer relationship management

D

DES	Data Encryption Standard
DSA	Digital Signature Algorithm
DUO	developer use only

E

EC2	Elastic Compute Cloud
EE	Enterprise Edition
EJB	Enterprise JavaBean
ERP	enterprise resource planning

G

GB	gigabyte
GUI	graphical user interface

H

HIPS	host-based intrusion protection systems
HR	human resources
HTTP	Hypertext Transfer Protocol

I

IaaS	infrastructure as a service
IBM	International Business Machines Corporation
IDE	integrated development environment
IDEA	International Data Encryption Algorithm
I/O	input/output
IP	infrastructure provider
IP	Internet Protocol
IPS	intrusion prevention system
ISP	independent service provider
ISP	Internet service provider
IT	information technology
ITE	Integrated Test Enablement
ITE	integrated test environment
ITUAM	IBM Tivoli Usage and Accounting Manager

J

JDBC	Java Database Connectivity

K

KVM	kernel-based virtual machine

L

LAN	local area network
LPAR	logical partition

M

MQ	Message Queue

N

NIDS	network intrusion-detection system
NIPS	network-based intrusion protection system
NIST	National Institute of Standards and Technology

O

OS	operating system
OSS	operation supporting system
OVF	Open Virtualization Format

P

PaaS	platform as a service
PAYG	pay-as-you-go
PC	personal computer

Q

QA	quality assurance

R

REST	Representational State Transfer
RSA	Rivest, Shamir and Adleman

S

SaaS	software as a service
SLA	service level agreement
SMB	small and medium business
SOA	service-oriented architecture
SOAP	usage note: SOAP is not an acronym; it is a word in itself (formerly an acronym for Simple Object Access Protocol)
SOX	Sarbanes–Oxley
SP	service provider
SSL	Secure Sockets Layer

T

TSAM	Tivoli Service Automation Manager

U

UI	user interface
URL	Uniform Resource Locator

V

VDI	virtual desktop infrastructure
VLAN	virtual local area network
VM	virtual machine
VMM	virtual machine monitor
VNPL	virtualized non-production lab
VPC	virtual private cloud
VPN	virtual private network

X

XML	Extensible Markup Language
XSL	Extensible Stylesheet Language