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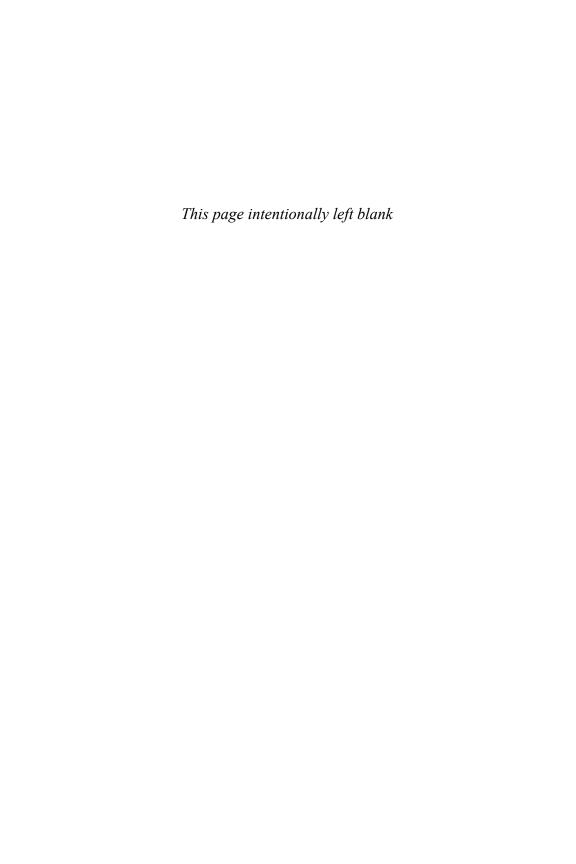**Devices:** Desktop and laptop computers, tablets running Android v8.0 and above or iPadOS v13 and above, smartphones running Android v8.0 and above or iOS v13 and above with a minimum screen size of 4.7". Internet access required.

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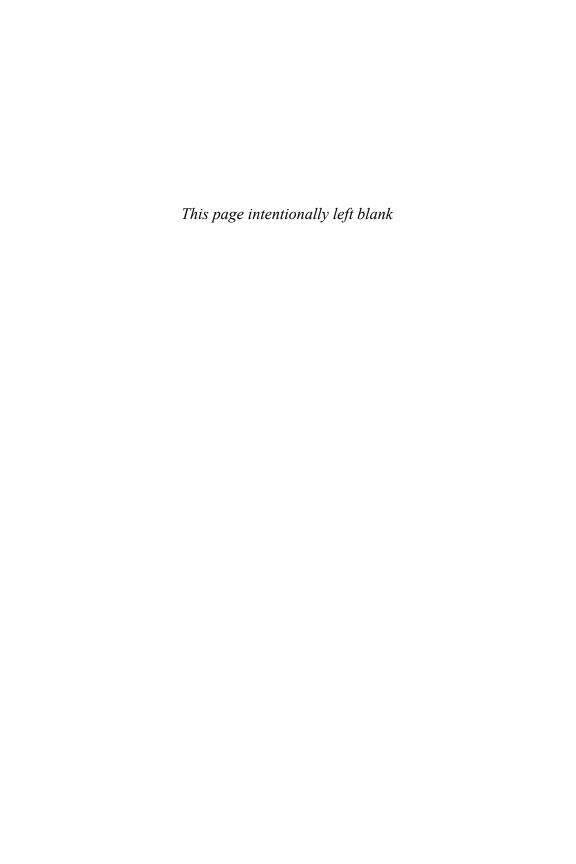

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Domain 4.0: Virtualization and Cloud Computing

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CHAPTER 21

Cloud Computing Concepts

This chapter covers the following A+ 220-1101 exam objective:

▶ **4.1** – Summarize cloud-computing concepts.

Cloud computing and virtualization in general have grown by leaps and bounds in recent years. These technologies have become so popular for businesses, organizations, and home users that they are now common-place. You're not likely to go a day without connecting to some kind of cloud-based service or virtualized system.

Two chapters are not nearly enough to even scratch the surface of the cloud and virtualization. However, for the A+ exams, you need to know only the basics. Let's begin with an introduction to cloud computing.

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>
> **Objective 4.1** concentrates on the following concepts: common cloud models, cloud characteristics, and desktop virtualization.

Introduction to Cloud Computing

Cloud computing can be defined as a way of offering on-demand services that extend the capabilities of a person's computer or an organization's network. These might be free services, such as browser-based email from providers such as Gmail and Yahoo!, and personal storage from providers such as Microsoft (OneDrive); they might also be offered on a pay-per-use basis, such as services that offer data access, data storage, infrastructure, and online gaming. A network connection of some sort is required to make the connection to the "cloud" and gain access to these services in real time.

Some benefits that cloud-based services provide for organizations include reduced costs, reduced administration and maintenance, greater reliability, increased scalability, and possibly increased performance. A basic example of a cloud-based service is browser-based email. A small business with few employees definitely needs email, but it might not be able to afford the costs of an email server and perhaps might not want to have its own hosted domain and face the costs and work that go along with that. By connecting to a free (or inexpensive) browser-based service, the small business can benefit from nearly unlimited email, contacts, and calendar solutions. However, keep in mind that with cloud computing, you lose administrative control, and there are some security concerns as well.

Common Cloud Models

Cloud computing services are generally broken down into a few categories of services, including

> ▶ **Software as a service (SaaS):** The most commonly used and recognized of the three categories is SaaS, in which users access applications provided by a third party over the Internet. The applications need not be installed on the local computer. In many cases, these applications are run within a web browser; in other cases, a user connects with a screen-sharing program or remote desktop program. A common example of this is webmail such as Gmail. Other examples include Dropbox and Microsoft Office 365. SaaS can potentially offer lower hardware, software, and maintenance costs because the provider houses the hardware and software.

▶ **Infrastructure as a service (IaaS):** IaaS is a service that offers computer networking, storage, load balancing, routing, and virtual machine (VM) hosting. The cloud provider hosts the network infrastructure hardware components that are normally present in a traditional on-premises data center. Through a subscription service, you access hardware only when you need it. The potential benefits include scalability, minimized hardware maintenance and support, and reduced downtime. Common examples of IaaS providers include Amazon Web Services (AWS) and Microsoft Azure. More and more organizations are seeing the benefits of offloading some of their networking infrastructure to the cloud.

▶ **Platform as a service (PaaS):** PaaS is a service that provides various software solutions to organizations, especially the ability to develop and test applications in a virtual environment without the cost or administration of a physical platform. It is also used on a subscription basis to reduce costs and increase collaboration. PaaS is used for easy-to-configure operating systems and on-demand computing. Often, PaaS users utilize IaaS as well for an underlying infrastructure to the platform. Cloud-based virtual desktop environments are often considered to be part of this type of service, but they can be part of IaaS as well. PaaS works well for *serverless* environments also—where the programmer/developer doesn't want or need a server to host applications or code. Examples of PaaS providers include the usual suspects: Azure, AWS (Lambda), and Google (App Engine). There are also private tools, such as OpenShift and Docker.

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>
> Know what SaaS, IaaS, and PaaS are.

Organizations use different types of clouds: public, private, hybrid, and community. Let's discuss each briefly:

▶ **Public cloud:** A service provider offers applications and storage space to the general public over the Internet. A couple examples of this are free, web-based email services and pay-as-you-go business-class services. The main benefits of a public cloud include low (or zero) cost and scalability. Providers of public cloud space include Google, Microsoft, Rackspace, and Amazon.

▶ **Private cloud:** A private cloud is designed with the needs of an individual organization in mind. The security administrator has more control over the data and infrastructure than is the case with a public cloud. A limited