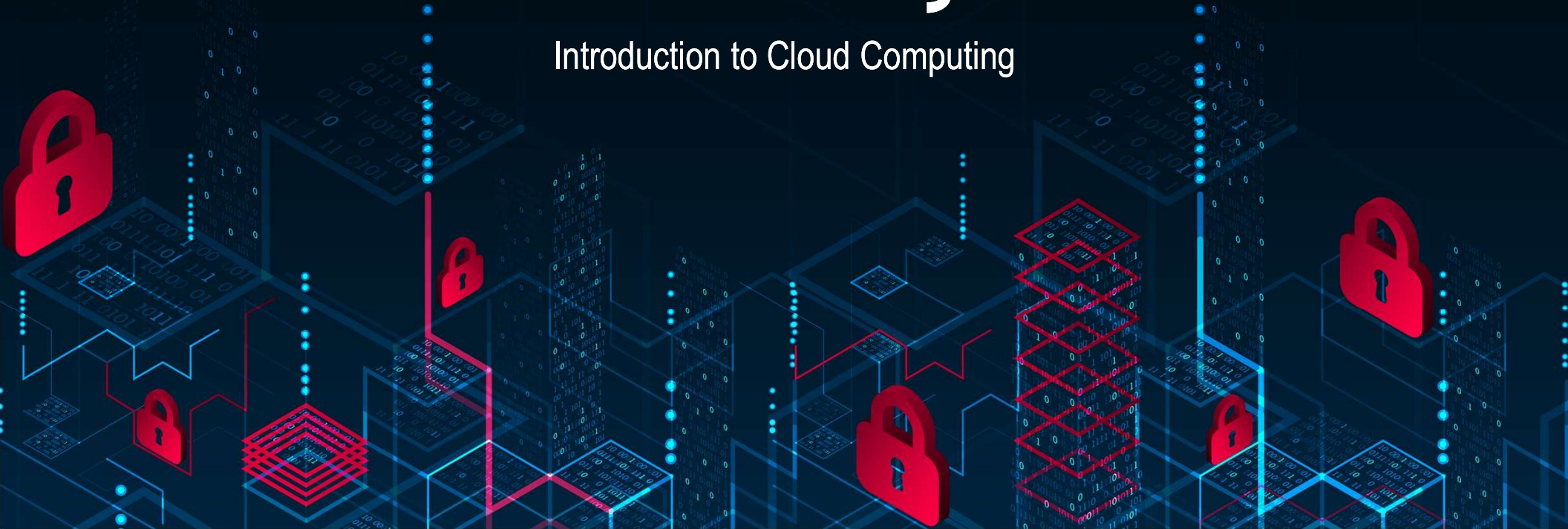


CPR E 431

## BASICS OF INFORMATION SYSTEM SECURITY

# Wireless, IoT, and Cloud Security

Introduction to Cloud Computing



# Video summary

- What is Cloud Computing?
- Cloud Computing Elements
  - Deployment Models
  - Service Models
  - Essential Characteristics



# Cloud Computing

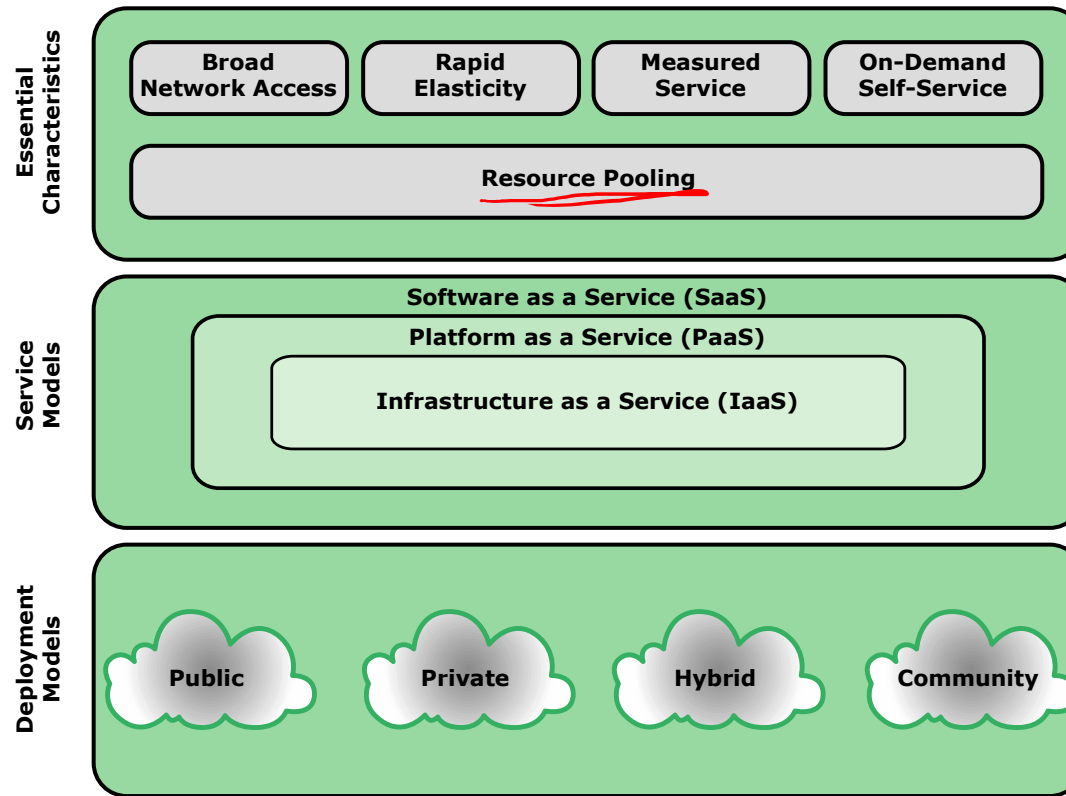
- NIST defines cloud computing, in NIST SP-800-145 (*The NIST Definition of Cloud Computing*, September 2011) as follows:

**“Cloud computing:** A model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model promotes availability and is composed of five essential characteristics, three service models, and four deployment models.”



# Cloud Computing

- Simply put, cloud computing is the delivery of computing services—including servers, storage, databases, networking, software, analytics, and intelligence—over the Internet (“the cloud”) to offer faster innovation, flexible resources, and economies of scale. You typically pay only for cloud services you use, helping you lower your operating costs, run your infrastructure more efficiently, and scale as your business needs change.



**Figure 13.1 Cloud Computing Elements**

# Cloud Service Models

NIST defines three service models, which can be viewed as nested service alternatives

Software as a service (SaaS)

Platform as a service (PaaS)

Infrastructure as a service (IaaS)



# Software as a Service (SaaS)

CSA

SaaS provides service to customers in the form of software, specifically application software, running on and accessible in the cloud



It enables the customer to use the cloud provider's applications running on the provider's cloud infrastructure

- The applications are accessible through a simple interface, such as a Web browser
- Instead of obtaining desktop and server licenses for software products it uses, an enterprise obtains the same functions from the cloud service



The use of SaaS avoids the complexity of software installation, maintenance, upgrades, and patches



Examples of this service are Google Gmail, Microsoft 365, Salesforce, Citrix GoToMeeting, and Cisco WebEx





# Platform as a Service (PaaS)

A PaaS cloud provides service to customers in the form of a platform on which the customer's applications can run

PaaS enables the customer to deploy onto the cloud infrastructure customer-created or acquired applications

A PaaS cloud provides useful software building blocks, plus a number of development tools, such as programming language tools, run-time environments, and other tools that assist in deploying new applications

In effect, PaaS is an operating system in the cloud

It is useful for an organization that wants to develop new or tailored applications while paying for the needed computing resources only as needed, and only for as long as needed

Examples of PaaS include AppEngine, Engine Yard, Heroku, Microsoft Azure, Force.com, and Apache Stratos



# Infrastructure as a Service (IaaS)

With IaaS, the customer has access to the resources of the underlying cloud infrastructure

The cloud service user does not manage or control the resources of the underlying cloud infrastructure, but has control over operating systems, deployed applications, and possibly limited control of select networking components

IaaS provides virtual machines and other virtualized hardware and operating systems

IaaS offers the customer processing, storage, networks, and other fundamental computing resources so the customer is able to deploy and run arbitrary software, which can include operating systems and applications

IaaS enables customers to combine basic computing services, such as number crunching and data storage, to build highly adaptable computer systems

Examples of IaaS are Amazon Elastic Compute Cloud, Microsoft Windows Azure, Google Compute Engine, and Rackspace



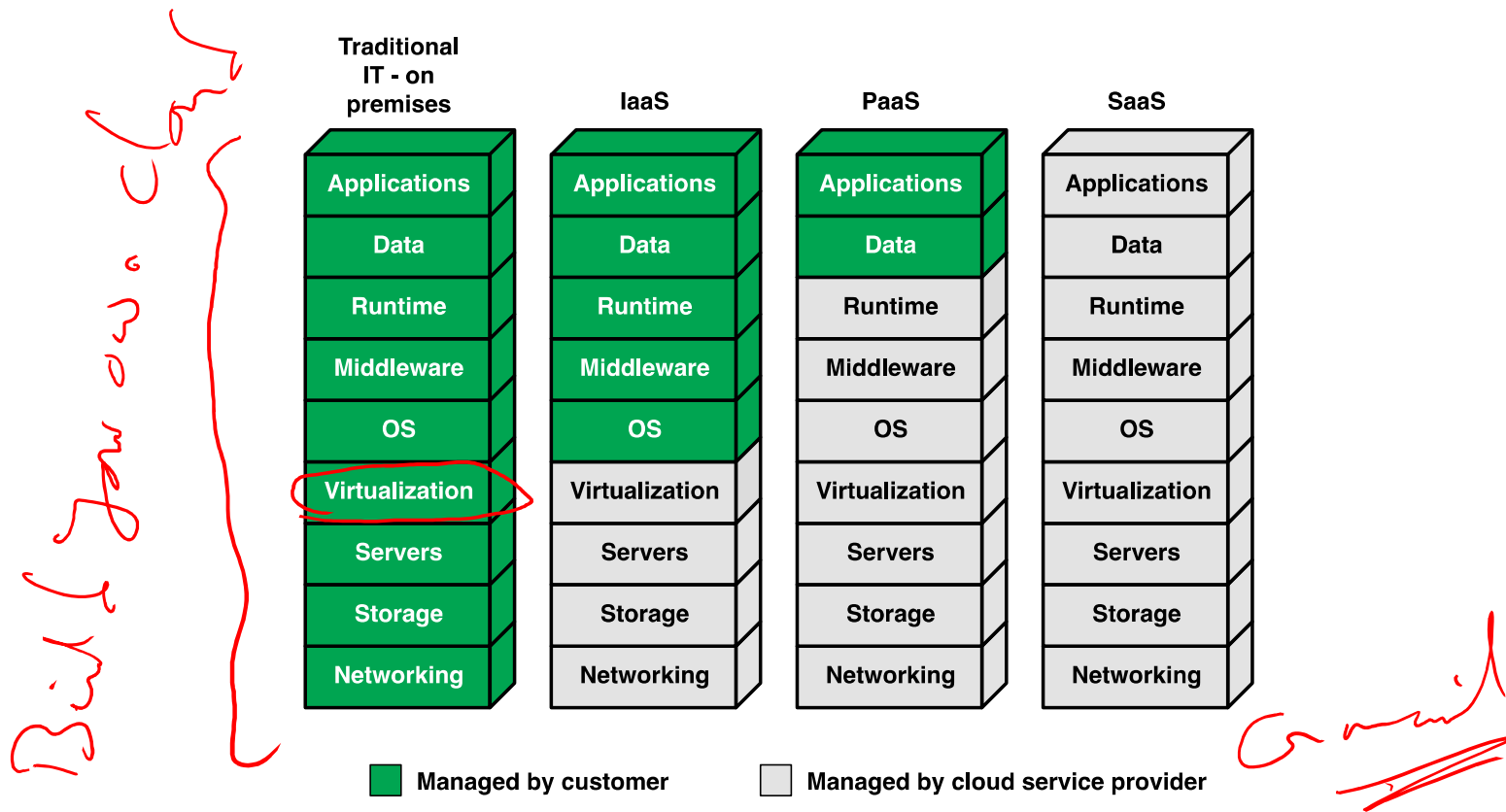


Figure 13.2 Separation of Responsibilities in Cloud Service Models

# Cloud Deployment Models

①

Public cloud

③

Community cloud

The four most prominent deployment models for cloud computing are:

②

Private cloud

④

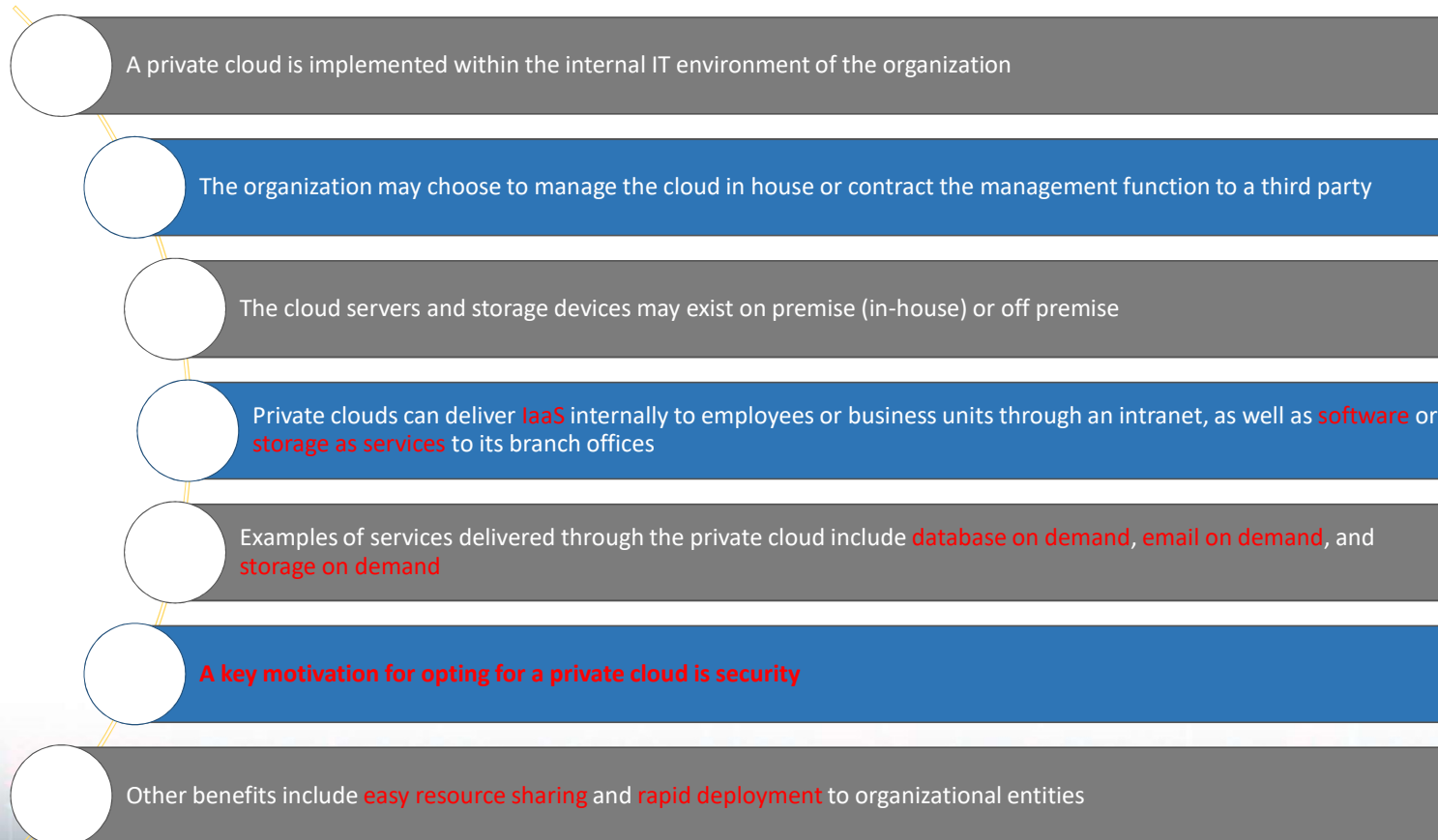
Hybrid cloud

# Public Cloud

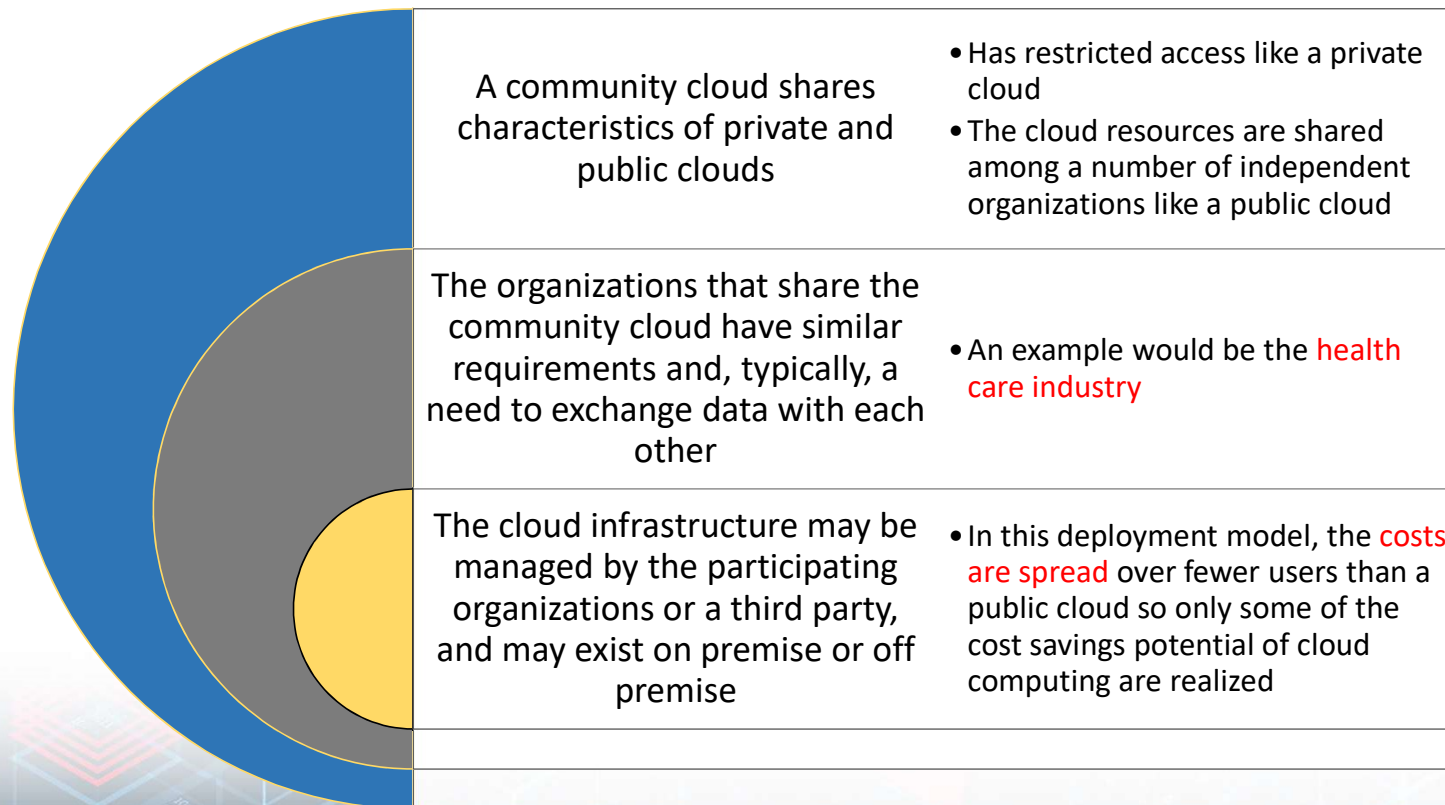
- A public cloud infrastructure is made available to the general public or a large industry group, and is owned by an organization selling cloud services
- A public cloud may be owned, managed, and operated by a **business**, **academic**, or **government organization**, or some combination of them
  - Applications and storage are made available over the Internet via secured IP, and can be free or offered at a pay-per-usage fee
- The major advantage of the public cloud is cost
- The principal concern is security



# Private Cloud

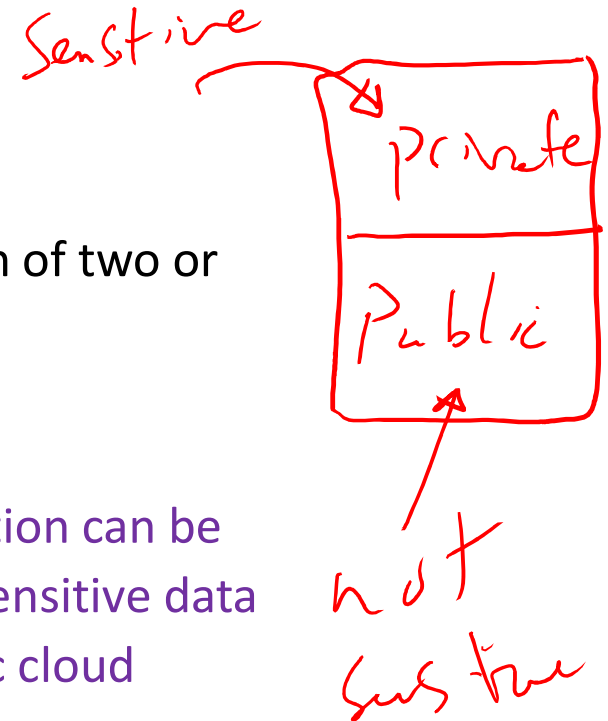


# Community Cloud



# Hybrid Cloud

- The hybrid cloud infrastructure is a composition of two or more clouds (private, community, or public)
- With a hybrid cloud solution, sensitive information can be placed in a private area of the cloud, and less sensitive data can take advantage of the benefits of the public cloud
- A hybrid public/private cloud solution can be particularly attractive for smaller business





	Private	Community	Public	Hybrid
Scalability	Limited	Limited	Very high	Very high
Security	Most secure option	Very secure	Moderately secure	Very secure
Performance	Very good	Very good	Low to medium	Good
Reliability	Very high	Very high	Medium	Medium to high
Cost	High	Medium	Low	Medium

**Table 13.1**  
**Comparison of Cloud Deployment Models**