Managing Microsoft Hybrid Clouds

Hybrid cloud is the number one deployment model for the near future. Microsoft Azure connected to Windows Server and System Center offers benefits such as cost-effective backup, disaster recovery, and agility.

Discover the full power of cloud computing and Microsoft Azure Infrastructure Services (IaaS) with this easy-to-follow guide. We take you through each step, all the way from giving you a good understanding of cloud computers to being able to connect Azure with your on-premises data center. Using clearly illustrated examples, you are taken through how to manage a Microsoft Hybrid Cloud.

Beginning with how to set up site to site VPN connections to Azure, we move on to creating virtual machines and networks and automate this. Managing Microsoft Hybrid Clouds will answer all your questions on Azure and how to benefit from a hybrid cloud. This book will teach you how to connect on-premises Windows Server and System Center to Azure. It shows the strength of Azure but also explains that you might expect features that are not yet available.

Who this book is written for

If you’re an IT professional, manager, consultant, or architect who wants to learn about hybrid cloud computing using Azure, then this is the book for you.

What you will learn from this book

- Understand every aspect of cloud computing, from deployment to service models
- Deep dive into virtual machines, networks, and Azure storage
- Create secure connections to Azure
- Manage virtual machines and networks with Azure
- Discover how to back up and perform disaster recovery orchestration for on-premises virtual machines using Azure
- Migrate physical servers, VMware, Hyper-V, and Amazon virtual machines to Azure
- Learn about new and upcoming features of Azure

Marcel van den Berg

Managing Microsoft Hybrid Clouds

Benefit from hybrid cloud scenarios through this detailed guide to Microsoft Azure Infrastructure Services (IaaS)
In this package, you will find:

- The author biography
- A preview chapter from the book, Chapter 1 'An Introduction to Cloud Computing'
- A synopsis of the book’s content
- More information on Managing Microsoft Hybrid Clouds

About the Author

Marcel van den Berg is an experienced IT professional with 25 years of experience. He is well known in both the VMware and Hyper-V community for his sharing of knowledge, mainly via his blog. He currently works as a consultant for PQR in the Netherlands, deploying many Microsoft solutions such as Microsoft Azure, Windows Server, Hyper-V, System Center, and StorSimple.

His career started in 1990 as a system administrator for Unix systems. As his career progressed, he was later responsible for managing Windows NT to infrastructures based on Windows Server 2008. About 6 years ago, Marcel focused on server virtualization and moved to the role of a consultant. Marcel designed and built numerous infrastructures based on VMware and Hyper-V for midsized and large organizations. He has experience in working with numerous VDI, SBC, backup, and disaster recovery solutions.

Cloud computing is one of the most exciting shifts we have ever seen in how we use IT. Marcel is really keen to understand new developments in cloud computing, especially on Infrastructure as a Service. In his current job, he has designed several infrastructures hosted on Microsoft Azure. By reading this book, you will learn from his experiences and save hours of work by preventing common mistakes.

He shares a lot of his knowledge on his website, http://up2v.nl. Marcel was awarded VMware vExpert for the help he has been giving the community since 2011.

You can follow Marcel on Twitter at @marcelvandenber.
Managing Microsoft Hybrid Clouds

Microsoft Azure offers many new scenarios for providing applications, data, and infrastructure services. In this book, you will learn how to manage the infrastructure services offered by Azure and how to extend your on-premises infrastructure to the cloud.

What This Book Covers

Chapter 1, *An Introduction to Cloud Computing*, introduces the concepts of cloud computing and compares cloud to the usage of electricity as a utility.

Chapter 2, *An Introduction to Microsoft Cloud Solutions*, provides an overview of the Microsoft solutions that are used to build a hybrid cloud.

Chapter 3, *Understanding the Microsoft Azure Architecture*, explains the Azure components that are used to offer the Azure services. This chapter provides a look under the hood of Azure to understand how things work.

Chapter 4, *Building an Infrastructure on Microsoft Azure*, explains how to create storage and networking required to build your first virtual machine on Azure.

Chapter 5, *Connecting to Microsoft Azure*, deals with establishing connections with the Azure datacenter.

Chapter 6, *Managing the Microsoft Hybrid Cloud*, shows you how to manage the Azure Active Directory and carry out efficient management. This chapter will explain how PowerShell can be used to automate tasks.

Chapter 7, *High Availability, Protection, and Recovery using Microsoft Azure*, explains how Azure can be used to both protect on-premises servers and servers running on Azure.

Chapter 8, *Migrating to Microsoft Azure*, explains the tools that are available for the migration of servers to Azure.

Chapter 9, *Summary and a Look into the Near Future*, concludes this book and provides a look into the future of Azure.

Appendix, *Configuration Maximums*, provides an overview of the configuration maximums of Microsoft Azure.
An Introduction to Cloud Computing

In this chapter, we will learn about what cloud actually is, what services are available, what benefits are delivered, and the concerns and barriers for adoption.

We will focus on the benefits and barriers of hybrid cloud and provide a high-level overview of cloud computing.

We will then dive into the features and technologies of Microsoft System Center, Windows Server, and Microsoft Azure in the following chapters.

Here are some of the topics that will be discussed in this chapter:

• How electricity became a utility and how cloud could evolve
• The essential characteristics of cloud
• Service delivery models
• Benefits of cloud and barriers for adoption
• An introduction to Microsoft Cloud OS
The way electricity became a utility

Let’s first start with a look at another technology that developed over the years and enabled efficiency, agility, and many other benefits namely electricity.

In the early days of the industry in U.S.A., at the end of the 18th century, each factory had its own power plant. Factories were located close to rivers so electricity could be generated from the flowing water. A waterwheel converted the power of moving water to a rotation, which drove a power generator. This worked but it was a fragile system of cables running everywhere and it was hardly scalable.

Thomas Edison decided to start Edison Illuminating Company and build an electricity generation station in New York City. That was realized in 1882. His thoughts were based on the principle that if enough factories used electricity generated by his power plant, the costs of electricity would be much lower than on-premises, self-made electricity. Also, the available capacity would be unlimited. There was however one issue to solve. At that time, electricity was only available as direct current. The problem with direct current was that it could be economically transported only within one and a half miles (about 2.4 km) from the generating station. Nikola Tesla, a brilliant scientist who was working for Edison, got into an argument with him. Tesla eventually developed a way to generate alternate current (AC). AC could be transported over very long distances using thinner cables. Tesla later sold his patent on AC to George Westinghouse. Soon, a war of currents started in the United States between Edison and Westinghouse. In the end AC won, which finally resulted in a victory for AC and enabled a widespread usage of power plants. Electricity became a utility. Westinghouse is currently one of world’s largest companies in the electrotechnical business. General Electric Company started in 1892 as a merger between Thomson-Houston and Edison General Electric.

The development of generating and consuming electricity is very similar to the way we consume computing services now. Before the Internet, each company had its own IT infrastructure and locally installed applications. In the first half of the 90s, more and more personal computers were used and the first Internet browser was launched. I will never forget the place and time when I first saw the browser Netscape being demonstrated by a co-worker. In July 1996, Microsoft launched Hotmail—the first free, web-based e-mail service. This could be considered the first-ever cloud service.

So, here we are in 2015—but what is cloud? Nowadays, cloud is used by about every vendor in IT. They all offer cloud services, if we have to believe the sales pitches. However, what is the cloud or cloud computing?
I remember the first time I heard about the cloud was during VMworld in Cannes. That was in 2009. VMware was looking for a way to make IT services more consumable for businesses. However, a couple of years before 2009, the cloud was already available.

The original provider of large-scale cloud computing targeted at organizations was Amazon. Amazon started as a book-selling company. Selling of books is very much driven by peaks. The highest peak in number of book sales is in the weeks before Christmas and New Year. To be able to cope with the demand, Amazon had to invest in large computing capacity just to cover the peaks of a couple of weeks. The rest of the year, a major part of the IT infrastructure was not used. Then, someone working at Amazon had a smart idea: let's rent out our excess capacity to others. This is how Amazon Web Services (AWS) started in 2006.

Nowadays, each and every IT vendor lets their customers believe that they sell some sort of cloud-compatible solution. Pretending something is the cloud while in fact it is not is called cloud washing.

A virtual infrastructure where an IT professional needs to manually provision a new virtual machine is not a cloud. A hosted, single-tenant Exchange Server infrastructure running in a remote data center with fixed costs per month is also not cloud.

Many definitions of cloud computing are available. The definition given by National Institute of Standards and Technology (NIST) is one of the best:

"Cloud computing is a model for enabling 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."

While this describes the characteristics of the cloud, it does not describe the value. What is the driving force for organizations to use cloud computing?

For me, the cloud is not a new technology, but a service. It enables a much more efficient consumption of IT services than using traditional IT, which still has a lot of human intervention, limited resources, strictly IT control, slow delivery, and focus on delivering a platform (keeping the lights on) instead of delivering services that enable the businesses to reach their goals.

Cloud is for IT consumption what electricity is for a household appliance. Just plug it in and you can use it. There is no need to call the electrician to have a new wall outlet built into the house when you buy a new appliance.
An Introduction to Cloud Computing

The essential characteristics of cloud

The definition of NIST mentions a couple of the essential characteristics of cloud. If a service does not have all of those characteristics, it cannot be called cloud. The essential characteristics are:

- **On-demand self-service**: The consumer has to be able to provision the service themselves without any human intervention. The service is provisioned almost instantly. So, an infrastructure using server virtualization that needs an administrator to manually provision a new virtual machine is not cloud. Having to wait days to make a service available to the requester is not cloud.

- **Resource pooling**: The resources of the cloud provider are pooled and can be consumed by multiple customers. The subset of the pool that consists of storage, processing, and networking is assigned to the consumer and can be configured when needed/requested.

- **Rapid elasticity**: The capacity delivered by the cloud service must easily and quickly be scaled up or scaled down to meet the changes in demand.

- **Measured Service (with pay-per-use characteristics)**: The usage of the cloud services must be measured and reported on so that the customer and the cloud provider have insight into the usage. It must provide reports that can be used for billing. The pay-per-use characteristic is not a NIST characteristic but seen by Microsoft as essential. In practice, not all cloud providers have a pay-per-use model.

- **Broad network access**: The cloud service must be accessible over the network (Internet) and can be accessed using different types of clients (like PC, smartphone, or tablet).

Service delivery models

Now that we know the essential characteristics of cloud computing, let’s take a look at what kind of services are offered by cloud computing and how they are delivered.

Cloud computing services can be categorized into three service delivery models:

- **Software as a service (SaaS)**
- **Platform as a Service (PaaS)**
- **Infrastructure as a Service (IaaS)**
SaaS allows the consumer of the service to use a specific functionality delivered by an application running in the cloud. Basically, this means consumption of cloud with no management involved. The consumer is not aware of and is not able to manage and adjust any of the components of application and infrastructure. There are many vendors offering SaaS solutions, for example Microsoft Office 365, Salesforce, and Google Apps.

PaaS offers the consumer a set of software tools to develop and publish applications over the Internet. The consumer, mostly software developers, do not have or need control over the infrastructure (networking, storage, and compute) but are able to manage at the application and data level.

IaaS gives the consumer the most amount of control of the three cloud computing delivery models. The provider offers a physical infrastructure that consists of compute, storage, and networking. The provider also manages the virtualization layer. The consumer can than manage workloads (operating system and applications) over which the consumer has full control. Microsoft Azure and Amazon EC2 are just two examples of many cloud IaaS services.

The following figure shows the three delivery models and their responsibilities:
Besides the three service delivery models that are mentioned here, there are many other XaaS offerings:

- **Desktop as a Service**: This focuses solely on delivering cloud-hosted virtual desktops.
- **Disaster Recovery as a Service**: This delivers resources that can be temporarily used to host the IT infrastructure and services not available anymore in the primary location.
- **Communication as a Service (CaaS)**: This is a rapid expanding service in which Voice over IP services and Unified Collaboration services is offered from the cloud.

However, this book will fully focus on the IaaS part of Microsoft Azure. While Microsoft Azure started as a PaaS platform and most of its functionality was targeted at developers, Microsoft Azure IaaS has rapidly evolved towards a mature full infrastructure service offering.

## Cloud deployment models

In the previous sections, you learned about characteristics and services. Now, it is time to understand where these characteristics and services live and where the services are made available.

The most commonly used cloud deployment model is public. A **public cloud** means the service is run by an organization that is not a part of the organization to which the consumer belongs. The business objective of a public cloud provider, in most cases, is to make money. Another characteristic of a public cloud is that it is open to multiple consumers. This so-called multitenant usage is offered in data centers that are only accessible to employees working for the operator of the service.

A **private cloud** is the opposite of a public cloud. Services offered in a private cloud are typically consumed by a single organization. The infrastructure can be located either on premise or in a data center owned and operated by a service provider. The provider of the private cloud service is the IT department. It is also possible that the cloud management is outsourced to a vendor while the IT department handles the governance. A private cloud, in most cases, exists in large organizations that have frequent demands for new IT services. Organizations with a lot of software developers are use cases for private cloud, as developers have frequent requests for new virtual machines.
A **community cloud** is an offspring of a private cloud. This kind of cloud is used by a limited number of organizations that offer the same kind of service to their customers. Think about nonprofit organizations, schools, healthcare, or multiple municipalities sharing the same IT infrastructure. Saving on costs while delivering efficient IT services is the main goal of a community cloud.

A **hybrid cloud** is a combination of public cloud services and private clouds. It is not necessary to have a private cloud in order to use hybrid cloud. A hybrid cloud can be a combination of virtualized, on-premises data centers and public cloud services as well. Hybrid cloud can be done on the IaaS or SaaS level. Hybrid cloud can also be seen as a bridge between the public and private clouds, which enables moving workloads between those deployments based on policy, costs, and so on.

Enabling hybrid cloud became the main focus of many vendors such as VMware and Microsoft from 2012 onwards. They both share the vision that organizations will not move to the public cloud in one big bang. The public cloud, especially when using IaaS, still has a lot of uncertainties and many decision-makers do not know the risks and capabilities of a public cloud.

Hybrid cloud will be a way to get over the security and compliancy concerns that many organizations have on public cloud. Hybrid cloud allows them to enjoy the many benefits of public cloud, while still allowing control over the IT infrastructure and protecting critical services by running those on premise.
Benefits of public cloud

Public cloud has clear benefits that are hard to achieve when using a private cloud. Let's take a detailed look at the benefits of public cloud. These benefits are the reason for all the attention that is being given to cloud computing:

- Scalability and unlimited capacity
- Agility or elasticity
- Insight in costs and no capital expenditure
- Availability
- Business process transformation
- Allows to focus on business, not on management of IT infrastructure or applications

One of the major benefits is the seemingly unlimited number of resources available in a public cloud. We call this cloud characteristic scalability. Additional processing power or storage is available on demand when requested; no need to order hardware and licenses, no need to wait for delivery, and no need to install hardware and software. Resources are ready by pressing a couple of buttons.

This offers great opportunities to deal with peaks in demand for resources. Think about a company that starts a new marketing campaign that will run for a couple of weeks. Instead of purchasing additional compute capacity to cover the peak, they just rent the capacity in the cloud: own the base, rent the peak.

Another benefit is agility, or elasticity as it is often called. Using cloud for your IT services means capacity is in sync with demand. Suppose your organization acquires another organization; you need 100 extra desktops and have two weeks to get this organized. Using cloud, the provisioning of those additional desktops is a matter of minutes. The same applies when demand is reduced. Suppose your organization needs to fire 100 employees; if the desktops of those employees are running virtually in the cloud, you can delete the desktops instantly. You are not stuck with assets you paid for but don't need anymore.

Scalability and elasticity is often used interchangeably. However, they are different as explained earlier. Scalability is a feature of the infrastructure that allows the addition of resources to cope with future demand.

Elasticity is the ability of a platform to automatically adapt to changing demand, either by adding workloads or removing workloads.
Chapter 1

Availability is another big benefit of cloud. Does your organization have a secondary data center? Is data replicated to another location? Does your data center have enough resiliency when critical components fail? It might have all of these things, but this comes at a high cost. As resiliency is shared by many customers of the cloud service, the provider can offer this in a much more cost-effective way than single-tenant infrastructures.

Another benefit of cloud computing is outsourcing management of the physical infrastructure to the cloud provider. As a cloud consumer using an IaaS service, you only have to worry about managing the operating system and application with its data; there's no need to manage switches, firewalls, routers, servers, load balancers, and so on. To use SaaS, you don't have to worry about managing IT, except maybe managing identity management.

Last but not least, using cloud computing means a shift from investing an amount of money once (CapEx) to operational costs spread over multiple periods (OpEx). It also involves a shift from ownership to subscription. Because costs are now paid on a monthly basis, there is a much better insight into the costs. However, due to the complex cost structure and ease of deployment, there is a high risk that costs will be hard to manage. You have to make sure procedures are in place to monitor the consumption of new services. Most service providers do not offer a possibility to place a limit on the amount of costs per month (spending limit).

Some of the benefits mentioned previously are enablers for business process transformation. Cloud computing allows organizations to make it easier to meet their business goals. For example, because IT services are made available very quickly, products can be brought to market faster or cheaper. Alternatively, as the virtual desktops are running in the cloud, employees can work at any time or any place and are more productive and motivated.

While the benefits mentioned are clear and measureable, other so-called benefits are less clear. Many organizations believe that public cloud is cheaper than doing IT yourself. This is a typical case of it depends. For small deployments, cloud might be cheaper. However, for large deployments and especially when large amounts of high performance storage is needed, on-premises IT might be cheaper. It does pay off to do fair cost comparisons.

Cloud computing costs are constructed using the components that are consumed. The components are compute, storage usage, storage transactions, network traffic leaving the data center, support, additional services, and so on.

Keep in mind that when purchasing a storage solution, you pay only once. When consuming cloud storage, you pay each month for the storage and—in many cases—for transactions and data leaving the cloud as well.
An Introduction to Cloud Computing

Barriers for the adoption of the public cloud
While cloud computing offers many advantages, there are also some barriers for adoption. Some of the top concerns organizations have when using cloud for their IT are:

- Security
- Loss of control
- Compliance
- Network
- High availability
- Inability to audit or examine
- Vendor lock-in

Security is by far the biggest concern especially for organizations outside the United States. Who has access to my data when it is stored in the cloud? In 2013, we discovered that NSA had access to data in data centers of Microsoft and Google, for example. However, what about other tenants using the same shared infrastructure? What about firewalls and other security appliances? Are they safe? Can they be trusted?

Loss of control is another barrier many organizations see as a hurdle to take on their way to public cloud. All of a sudden, you no longer have physical access to your infrastructure. You cannot touch servers and storage. When something breaks, you have to wait and see whether the service provider is able to fix the issue within the limits as agreed in their Service Level Agreement. You have no means to prioritize actions or get extra people or the information needed to solve the issue faster. Basically, customers have to wait till the provider solves the issue. You may need inbuilt resiliency so that your workloads continue to run somewhere else.

Using public cloud services is only possible using network connections, mainly through the Internet. If the network connection fails, can I still have access to my critical applications? Many organizations are worried about this network dependency.

There have been quite a few outages of public cloud offerings; Amazon AWS had those and Microsoft Azure as well. A leap year bug brought down many Azure services on February 29, 2012. While cloud infrastructures are made highly redundant, when things go wrong, they go badly wrong. Customers are concerned about this. Luckily, some cloud providers are very open about causes of outages. They are willing to learn from mistakes and improve.
Many organizations, such as banks, are only allowed to outsource their IT services when an external auditing firm is allowed to audit the facilities and procedures. This means auditors need physical access to the data center facilities, which is often not allowed.

Microsoft agreed with De Nederlandsche Bank (Dutch central Supervisor for Banks) the right to examine. This means the staff of De Nederlandsche Bank is able to examine procedures of the Microsoft Azure infrastructure. It is also allowed to enter facilities of Microsoft to check if Microsoft indeed complies to policies.

**Vendor lock-in** is a situation in which a customer will find it very difficult in time, effort, or costs to move to another vendor. Basically, the consumer is involuntary tied to the vendor and has to accept price changes, less than wanted product innovation, or bad customer service. This is sometimes called the "Hotel California" mentality of cloud vendors. "You can check out any time you like, but you can never leave!", the lyrics of the famous song by The Eagles, an American rock band.

Cloud providers are very well aware of this and offer features that give the customer the freedom to move to other offerings.

**Challenges of hybrid cloud**

Besides the mentioned concerns or fears, there are some additional challenges of using cloud. This section will discuss some aspects of hybrid cloud and public cloud that an organization has to think about before moving to the cloud:

- Control and ownership over data
- Performance
- Feature misalignment
- Application compatibility with cloud platform
- License mobility
- Networking

Data is the main asset of each organization using IT. Without access to data, almost all organizations will sooner or later have serious difficulties in conducting business.

While many cloud vendors make sure data is replicated inside the same data center or even to other data centers, it is still stored on hardware owned by the provider. Also, there is just one logical copy of the data—one copy is not a backup. If the data gets corrupted, the replicas will be corrupted too.
An Introduction to Cloud Computing

So, every organization needs to make backups. This can be done by storing data on storage provided by the cloud vendor. However, it is still in the same environment run by the same vendor. So, it is better to have an offsite backup. This is a challenge. Not many cloud vendors, especially the larger ones, offer backup to removable media such as tape or external disks. Some software vendors have software that can transfer data between different clouds and an on-premises data center.

If the vendor does not support removable media handling, the only way to have an offsite backup is to transfer backup data over a wide area network to another location — preferably a location managed by another provider or a secondary on-premises location. This might add additional costs for network transfer costs. Microsoft, for example, charges for data leaving the Azure data center. There is no charge for data transfer into the data center.

Guaranteed performance is another challenge. In a multitenant infrastructure without proper measures, there is a risk of meeting the "noisy neighbor." A noisy neighbor is a process run by a single tenant that consumes so much resources that other tenants experience a degraded performance.

Think about a cloud tenant that runs a very IO-intensive database query once a month. As a cloud provider, you do not want other customers to suffer from that query. So, cloud providers need to make sure there is some sort of quality of service on especially storage and on networking.

In most cases, organizations that use hybrid cloud will discover that the features offered by their own on-premises virtual infrastructure are different than the ones offered in the public cloud. Advanced features such as the migration of virtual machines to another host, snapshots, changing virtual disk size, and so on are limited or nonexistent in many public cloud offerings. In the following chapters, we will find out the differences in management experience between on-premises Hyper-V and Microsoft Azure.

So, the integration of private and public cloud and establishing new procedures can be a challenge.

There is a difference in features of on-premises and public cloud, and the underlying virtual infrastructure is very likely to be different.

Basically, there are two architectures used in IaaS platforms: one designed on the principle that the application should deliver resiliency and one that has a lot of resiliency built into the platform.
Software licenses are many times tied to physical servers or CPUs. Vendors still need to do a lot of work to teach customers how licenses can be moved to a different infrastructure. So what if you move your Oracle license to a public cloud? Do you have to make sure that license covers all of the physical CPUs the licensed workload can potentially run on? In the following chapters, we will learn about the strategic partnering between Oracle and Microsoft and what this means for license mobility.

Hybrid cloud potentially allows the movement of workloads between on-premises infrastructures (not private cloud per se) and the public cloud. As explained before, hybrid cloud could be seen as a bridge. However, the network IP addresses used in the public cloud infrastructure will be different than the ones used on premise. Do we need to reconfigure IP addresses in the virtual machines when a virtual machine is moved? In the following chapters, we will learn about technology that enables workload mobility.

Later in this chapter, we will also discuss what happens if your organization needs to exit the cloud provider. However, what if your own organization goes bankrupt and all of the financial data is stored in the cloud? Who is going to pay the cloud provider to make that data available to organizations such as the tax bureau or the curator?

**Cattle versus pets**

While the infrastructure is important, at the end the application is what matters. Basically, we can divide applications into two categories:

- Those that depend on the resiliency offered by the infrastructure
- Those that have inbuilt resiliency

A famous analogy for this is pets and cattle. Humans have a special relationship with pets. They give their pet a name and have a special bond with the animal. Most people do not have such a bond with cattle. Cattle are for production of meat or milk. If an animal dies, nobody really cares. It is regarded as economic damage but does not affect an individual's emotions.

A "pet type" of application is one where administrators knows the specific name and role of the server by heart. Administrators have a special bond with a "pet type" of application. If the server fails, the application is likely to fail. Examples of such server names are Zeus or Fileserver01.
A "cattle type" of application has multiple instances for the same role. If a server with a middleware role fails, the application will continue to be available because there are multiple servers with same role. Application data is nonpersistent and can easily be provisioned if the server is lost.

Public IaaS architectures are not all the same although they all look similar at first glance; most of them offer a self-service portal, the ability to create/modify/delete virtual machines, and so on. However, there are differences under the hood. Each provider has its own unique sauce added to the IaaS service.

Microsoft Azure was originally designed as a PaaS platform. Business-critical applications that are developed on Azure are resilient by design at the application level. Basically, it means each role (web tier, application tier, database tier, and so on) has at least two nodes. If one node fails, the application will remain available.

Netflix, a US company delivering films and series streamed over the Internet, has a great way to test the availability of their applications. They developed the so-called Chaos Monkey tool. Netflix believes the best way to defend against failures is to deliberately create failures, fix them, learn from them, and improve. Chaos Monkey will randomly shut down virtual machines in the Amazon cloud that is used by Netflix to deliver their streaming service. When Chaos Monkey terminates a virtual machine, the Auto Scaling group function of Amazon makes sure an identical virtual machine will be booted up to replace the failed one.

So, Chaos Monkey is a nice way to see whether your application really is cloud-ready (cattle category) or it is a legacy enterprise application (pet).

Later in this book, we will learn about the architecture of Windows Azure and see what kind of applications are most suited to run on Azure.

Using cloud successfully

Many organizations have already started using cloud. Some succeeded in reaching their goals and many failed. This is because designing and building a cloud is seen by many as a technical operation. Cloud is not technical; it is about having the right tools at the right price and moment to be able to do business. IT departments should embrace cloud to make a shift from being a cost center (keeping the lights on) to adding value to the business. They can do that by delivering services, which for instance reduces the time to market for products.

The role of internal IT will change over time from being a supplier of IT services to being a broker. IT will have a more strategic and control function.
Cloud exit plan

We have discussed many of the benefits of cloud computing. However, the balance between benefits and disadvantages might at some time shift to a situation where an organization wants to stop using cloud or switch to another cloud service provider.

There may be many reasons to not continue the cloud service. The reasons can be categorized into voluntary leave or involuntary leave.

Reasons for a voluntary leave can be:

- If the cloud consumer is not satisfied with the quality of the service delivered by the cloud provider—think about performance, response times, available features, and so on
- Not satisfied with the costs of the services
- A merger with another company
- A change in long-term IT strategy

Discontinuing the services of a cloud provider can be involuntarily as well. The main reason for that to happen is when the cloud provider goes broke or decides to discontinue their service.

This happened, for example, in 2013 when Nirvanix ran out of money. Nirvanix had a limited portfolio. It offered only storage as a service. Customers initially got two weeks’ notice to transfer their data from the Nirvanix data centers to another location, but the time was later extended to 4 weeks. Some customers had 10 to 20 petabytes of data in use, which was be difficult to migrate within two weeks—especially if there is no plan and when data needs to be moved over limited bandwidth connections.

In April 2011, Iron Mountain, another cloud storage provider announced it would discontinue its cloud-based services. However, customers were given over 12 months to move data to another location.

One of the steps any organization that intends to use cloud-based services should take is to prepare their cloud exit strategy. However, less than half of the customers of cloud services actually have an exit strategy. Why is this? Probably it is not cool to have such a plan. The same applies for disaster recovery, backup verification, and so on. Those are all on a top priority to-do list but are the first items to be removed or demoted when time and or budget become issues. A cloud exit strategy should contain information that makes it clear when to exit and how to exit.
An Introduction to Cloud Computing

Organizations should think about when enough is enough and it is better to exit—think about maximum loss of data, maximum loss of availability, or lost revenue. These need to be monitored to be able to judge whether the service level is breached or not. Do not test only on outages but also on performance. However, in most SLAs of cloud service providers, there is no mention of a guarantee of performance.

Also, try to determine the future of the provider. What is the roadmap? Are new features being added at the same pace as other providers? How frequently does the provider publish press releases announcing these new features? If there is silence for many months, something could be wrong.

So if you decided to move out, there are two options: either back source (bring the workloads back to your on premise infrastructure, the opposite of outsourcing) or find another provider.

One of the advantages of using IaaS over PaaS and SaaS is that you probably do not have to perform any conversion of data. Your data is included in virtual disk files that also contain the application and the operating system. As long as your new cloud provider is able to host that type of virtual disk, file migration is not that difficult. The only challenge is moving the data out and into another location and changing network configuration.

Organizations considering cloud should make sure they are able to import and export data to cloud providers’ data centers using external media such as a NAS or a bunch of USB drives. This is the only way to import of evacuate large amounts of data in an efficient and timely matter. Make sure the data on that external media is encrypted when unauthorized staff needs to have access to that media for import or export. Check for RAID compliancy when all the data is on USB drives and one fails.

Export and import operations of data would mean that virtual machines most likely need to be shut down during the export and import operation. It will be very difficult to perform some sort of virtual to virtual conversion between different cloud providers while workloads remain active.

Hybrid cloud to the rescue

Hybrid cloud is seen by many as a way to overcome fear, concerns or barriers preventing the adoption of public cloud computing. A hybrid cloud is one step into the cold water of cloud without getting your feet too wet, and having a way out when things go wrong.

Compare it to starting a relationship with someone without selling your house and moving in with your new partner. Hybrid cloud is like a two-household family; you enjoy each other’s company but still have your own habitat that you have control over. It is also a matter of not putting all of your eggs in the same basket. If it is the love of your life you can always start living together.
Using hybrid cloud is the same. It enables you to withdraw virtual machines if services of cloud providers are not meeting expectations or are even terminated like in the case of Nirvanix we mentioned earlier. There is an escape plan.

Another benefit of hybrid cloud is that the organization still employs people with knowledge on infrastructures. Suppose an organization moves its IT fully to a public cloud. It's likely that the number of staff with infrastructure knowledge will be reduced, as the organization does not require that knowledge anymore.

Using a hybrid cloud, IT departments are able to control their IT while at the same time are able to provide an unlimited capacity to their business without having to spend a lot of money on buying new infrastructure.

Hybrid cloud also enables a controlled move towards public cloud. Not many organizations are willing and able to perform a kind of big bang migration scenario in which all of their IT services are moved to the cloud in a short time frame.

It helps when both infrastructures can be managed using the same tools to provide a single pane of glass. In the ideal world there is no difference between features offered by your on premise platform, and the features offered by the platform of the service provider. However, we will soon find out there are some differences.

Hybrid cloud also offers a choice of where to run the virtual machines. Some virtual machines, like those with sensitive data, rather run in the on premise data center that organizations have full control over. Other types of workloads, such as testing and development, can perfectly run in a public cloud.

One of the clearest examples of a hybrid cloud scenario is one where compute capacity is consumed from a public cloud while the data for that compute is located on on-premises storage systems. Microsoft ExpressRoute which offers up to 10 Gbps connections enable these kind of scenarios.

In the next section, we will learn what the vision of Microsoft is for hybrid cloud and what solutions are available to create and operate a hybrid cloud.

**Introducing Microsoft Cloud OS**

Microsoft strongly believes organizations benefit from using public cloud services mixed with their on premise infrastructure. Connecting on premise with public clouds will give organizations much more efficiency, cost reduction, scalability and agility compared to making use of just an on premise infrastructure. Steve Ballmer, former CEO of Microsoft, called it *the power of AND.*

Microsoft translated their vision on hybrid cloud computing into a marketing campaign in which they mention the Microsoft Cloud OS.
Microsoft Cloud OS is not a product. It is a vision, strategy that is delivered by services and products. The most important ones are:

- Microsoft Windows Server 2012 with Hyper-V
- Microsoft System Center 2012 including Windows Azure Pack
- Microsoft Azure
- SQL Server 2014
- StorSimple

These solutions are either running on premise, in Azure data centers, or in data centers run by service providers. The combination of those solutions is the power of AND. The three locations where IT services can be running is a very important part of the vision.

On-premises infrastructures enable control by the IT department. Microsoft Azure enables the cost-effective usage of an unlimited capacity. Service providers offer public cloud services so that customers have a choice of which provider to use, thereby preventing a vendor lock in. Service providers also provide customer intimacy.

So, IaaS services like that of Azure will not be offered by Microsoft exclusively. Any service provider will be able to deliver IaaS with the Azure look and feel and features in their data center. This allows customers to switch from Microsoft Azure to another service provider without changes in the application, data, management, knowledge, and procedures.

Vendor lock-in is pretty much taken away by this. The solution that enables this, that is, Microsoft Azure Pack, will be discussed in the next chapter.

**Microsoft hybrid cloud use cases**

In this section, you will learn how Microsoft created real value out of their cloud OS vision.

The use cases can be grouped into a couple of categories:

- Test and development
- Backup, archive, and disaster recovery
- Deployment of public-facing applications or split application architecture
- Running desktops
- Cloud bursting
In the following chapters, we will learn a lot more about how to use Microsoft solutions that enable hybrid cloud. For now, I will give you a high-level overview of possible use cases.

Backup and disaster recovery is one of the most common reasons for organizations to use cloud. Instead of owning and maintaining a secondary data center, recovery services can be used on a subscription basis.

Microsoft Azure offers a number of backup and disaster recovery services. Azure Recovery Services enables the storage of backup data on cloud-based storage. It is very easy to direct a Windows Backup agent or a Microsoft DPM agent running in an on-premises Windows Server to cloud-based storage. The advantages of cloud-based storage are an unlimited amount of available storage and cost-effective pricing.

Microsoft StorSimple is a storage appliance that is positioned between the application and Microsoft Azure cloud storage. It has two tiers of fast performance disks inside the appliance that is used on-premises. The third tier is disk storage offered by Microsoft Azure. This tier can be used for archiving purposes. It is still online, but access is slower than the on-premise storage.

Microsoft Azure Site Recovery is a cloud-based orchestration tool for disaster recovery. It enables the orchestrated restart of Hyper-V virtual machines in a secondary data center. This secondary data center can either be a customer managed data center or a Microsoft Azure data center. The execution and configuration of orchestration is done by Azure. Recovery Manager will use a run book to start virtual machines in a predefined order and will perform checks and pauses when manual actions need to be taken. This enables an almost fully automated execution of a recovery.

Besides storing backup data, Azure can also be used as a secondary site for live production data. Active Directory, SQL Server, and DFS file shares can be replicated from on-premise to virtual machines running in Azure data centers. So, all the data available in the primary site is replicated to Azure. If the primary site is unavailable, the services are still available in Microsoft Azure.

Hybrid cloud creates the possibility to create a split application architecture. This enables to run nonpersistent workloads in public cloud, while the critical backend servers are running in a controlled on-premise data center. This gives processing capacity and control over data at the same time.
Another recently added hybrid scenario is the ability to run virtual desktops in Azure. Citrix XenDesktop, a VDI software solution, is now supported on Microsoft Azure. This means it can deliver virtual desktops to end users. Microsoft only allows the usage of Windows Server as a desktop in a multiuser hosted infrastructure. The Microsoft license policy does not allow to use Virtual Desktop Infrastructure (VDI) using a Windows client operating system, such as Windows 7 and 8, in a hosting provider scenario when hardware is shared between multiple customers.

Another use case is cloud bursting, which means public cloud capacity is used during short and mostly infrequent intervals to cope with demands in peaks. Think about a railway operator who has a timetable that is published online. On a snowy day, when trains are being cancelled, many passengers will be using their mobile devices to query the timetable to check whether their train will be running. This sudden high demand puts a lot of stress on the web server’s capacity. It is very cost-effective to have those requests for information temporarily handled by servers running in the cloud. This can quickly be provisioned when demand increases and scaled down when demand drops.

Azure is typically suited for current Microsoft customers using Windows Server, Active Directory, SharePoint, and SQL Server. Microsoft made it easy to connect on-premise instances of these products to instances running in Azure.

**Summary**

In this chapter, you learned about the development of delivering computing services, which is similar to the way production and distribution of electricity developed from the 1880s until now. We now know the different service and deployment models of cloud computing. Also, Microsoft’s vision of hybrid cloud computing and its solutions to enable this vision should be clear now.

In the next chapter, we will focus on and explain the Microsoft solutions that enable organizations to benefit from their on-premise computing resources and those provided in the public cloud by Microsoft Azure.
Where to buy this book
You can buy Managing Microsoft Hybrid Clouds from the Packt Publishing website. Alternatively, you can buy the book from Amazon, BN.com, Computer Manuals and most internet book retailers.
Click here for ordering and shipping details.