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Microsoft Azure Fundamentals - Terminology, Hierarchy, and Resources

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Azure Terminology

The first step in building an MSP cloud practice with Microsoft Azure is deeply familiarizing yourself with Microsoft Azure's fundamentals: its terminology, elements, and hierarchy. Here we will list and define the most critical Azure elements and discuss how they interrelate with each other.

In this section, we will focus exclusively on Azure Resource Manager (ARM), which is Microsoft's latest and more current implementation of Azure. Prior to ARM, Azure used a "Classic" model, which had significantly different terminology associated with it and is not relevant to the MSP community today.

Microsoft Azure is a diverse cloud platform that contains hundreds of **products** (also known as SKUs). Azure to Cloud is like Apple to devices--each has many products within multiple categories.

Azure Categories

These products fall into many categories. For instance:

- Infrastructure-as-a-Service (user-managed, raw resources that can be used to build IT environments) . For example:
  - Virtual Machines
  - Storage
  - Networking
- Platform-as-a-Service (Microsoft-managed, use-specific, packaged offers designed to be the building blocks of applications). For example:
  - Azure SQL – Microsoft managed SQL service without a "server running SQL" that can be used as the database back-end for a new or existing application
  - Azure Files – Microsoft managed SMB (CIFS) file share service that behaves just like a Windows file server but without a server to manage
- Data Services – things like machine learning, analytics, and cognitive services
- Software-as-a-Service – fully usable, end-user applications written, hosted, and managed by Microsoft
  - Office 365
  - Dynamics 365

We will focus on IaaS, SaaS, and somewhat on PaaS -- as those are the most fundamental building blocks an MSP needs to build a cloud practice in Azure.

Accounts, Tenants, and Subscriptions

At the highest level is an Azure **account**, also known as a **tenant** or **directory** (these terms will be used interchangeably). An Azure account is uniquely associated with an **Azure Active Directory (AAD)**, where user objects that access the Azure Portal exist. An Azure tenant is free to create, and by itself is simply a container for subscriptions and AAD objects. You cannot run anything in an Azure account without a subscription. Azure tenant names must be globally unique (i.e. no one else in the world can use the same name) and each one has a TenantName.onmicrosoft.com domain associated with it.

Inside an Azure tenant there are **subscriptions**. A single Azure tenant can contain multiple subscriptions, but each subscription must be contained within a single tenant. A subscription is the "billing container". You obtain a subscription directly from Microsoft or through an Azure reseller and you can create resources inside of that subscription. The monthly Azure invoice will contain the consumption of every resource you run inside of a subscription. If you don't run any resources and therefore have no consumption—your bill is $0.

NERDIO TIP:

It is possible to use a single Azure tenant for all your customers' infrastructure. We will discuss below the advantages of doing so for flexibility of compute reservations.

Subscriptions come in many flavors, but the easiest way to think about them is an agreement between you and Microsoft that you will use any of the available Azure products under the terms of your subscription and you agree to pay for them after you've used them. A good comparison is electrical power service in your home. You open an account with the electricity provider (subscription), agree on a rate for electricity and delivery, use the electricity during a month, and then pay the bill once the power company tells you how much you have used or consumed.

Subscriptions obtained directly from Microsoft will typically be Pay-as-you-go, Free, EA, CSP, or Sponsored.

- **Pay-as-you-go (PAYG)** – if you sign up to use Azure on www.azure.com you will be required to put in a credit card. This will be the agreed upon payment method for any resources consumed inside of your subscription and it be billed automatically on a monthly basis – at Azure's list prices.
- **Free** – this is limited subscription that you can obtain directly from azure.com to play around with Azure for a limited time and to consume up to $200 in resources usage. This type of subscription is too limited to use for anything but a simple VM or two and is not recommended for MSPs looking to build cloud practices in Azure.
- **EA (Enterprise Agreement)** – if your customer is a larger organization, they will likely have a direct volume licensing agreement with Microsoft that gets negotiated every few years with annual "True Ups". As part of this EA, the customer will have prepaid for a certain amount of Azure consumption (monetary commitment) and will be able to use resources in the subscription up to this amount. Any overages will be reconciled at the time of the customer's True Up with Microsoft.
- **CSP** – if you are a Direct CSP with Microsoft, you can provision a CSP subscription for Azure inside of your customer's tenant or your own tenant. Microsoft will bill you for the usage (i.e. consumption) inside of this subscription – at your discounted reseller rate - and you will in turn bill your customer. This is one of the most flexible and powerful types of subscription.
- **Sponsored** – if you are part of the Microsoft Partner Network (MPN) and have Silver or Gold competencies, Microsoft may provide you with a sponsored Azure subscription that you can use to hone your Azure skills, do demos for customers, and use internally. Each subscription will have a preset monetary limit and you'll be required to add a credit card to be used once you exceed the preset limits. The details on your sponsored subscriptions, if you have any, can be obtained in your Partner Center under MPN or your Partner Development Manager (PDM). A word of caution: do not use sponsored subscriptions for customer workloads. Once you exceed your sponsored subscription limit, you will be billed at list rates on your credit card and there is no easy way to convert this subscription to CSP. You will be forced to migrate actual resources to another subscription, which is a disruptive process.

Most MSPs, however, purchase Azure through a CSP Provider (like Pax8, Sherweb, Ingram, Techdata, etc.). The MSP in this scenario is known as a "CSP Reseller". Using the CSP Provider's own portal, the MSP will be able to create a subscription to consume resources inside this subscription. The CSP Provider will get a bill from Microsoft for the consumption and will in turn bill the MSP. The MSP will then bill its customer for the Azure consumption.

Subscriptions have globally unique IDs (GUID) associated with them. They also have a friendly name that you can set to anything you want, and this name does not have to be unique. As a matter of fact, you can have subscriptions with the same friendly name inside of the same tenant. However, try to assign logical, unique names to each of your subscriptions to make things easier to manage.

Carefully consider your subscription options before starting to deploy Azure resources, as changing subscription types later can be challenging or even impossible.

NERDIO TIP:

Become a CSP Reseller with your provider of choice and create a dedicated subscription for each of your customers under a single tenant. This will provide you the optimal segregation of billing information on a per-customer basis but will allow you to take advantage of portability of Azure reservations between customers, since all subscriptions will be in the same account.

Resource Groups and Resources

Below the subscription are **resource groups (RG)**. These are logical groupings of resources in Azure that allow you to easily view and manage sets of resources associated with a single function. For example, if you have two complex, multi-component applications A and B, you will want to split them up into resource groups (e.g. RG-A and RG-B) to logically group all the compute, storage, and networking for each application with other related components.

Resource groups are not billing units. You won't be able to easily answer the question of "how much are the resources in resource group RG-A costing me" by looking at your Azure invoice. These RGs are there for ease of management, resource organization, and isolation. There are lots of resources in every Azure deployment so keeping things nice, tidy, and logical is very important.

There could be multiple resource groups within a single subscription, but any one resource group can only be part of only one subscription. Resource group names do not have to be globally unique, but must be unique within a single subscription.

Finally, **resources** are created inside of a resource group, which is inside a subscription, which is inside a tenant. What are resources? It's everything that does something in Azure. Examples are virtual machines, virtual networks, disks, network cards, VPN gateways, IP addresses, etc.

Usage and Billing

There are many categories of resources and each one has different configuration, usage and billing characteristics. We will explore the most important elements in this and future write-ups. For now, let's focus on billing.

Some resources will be billable while others won't. For example, a virtual machine (compute resource) will be billable while a virtual network interface (network resource) attached to a virtual machine will not be billable.

Billing in Azure typically has a **unit** and **frequency**. The easiest way to think about this is to go back to our electricity at home example. Electric power is a resource, the unit is kWatt and frequency is hour. We therefore have a pre-defined cost per kWatt-hour. As we use electricity, there is a meter running that measures how many kWatt-hours we've used up and then the electric company sends us a bill for what we used. Azure works the same way. For instance, a virtual machine (VM) is billed for compute capacity (unit) on a per-second basis (frequency). Every time we start up (provision) a VM, a meter starts up and keeps track of how long this VM is running. At the end of the month our invoice will show how many hours we used a particular type of VM and that's what we owe either Microsoft directly or via a CSP.

The key takeaway here is that each billable resource has a virtual "meter" that's running any time the resource in "used" (this is defined differently for each type of resource). If we stop the resource, we stop the meter and we are no longer billed.

Azure Object Hierarchy Overview

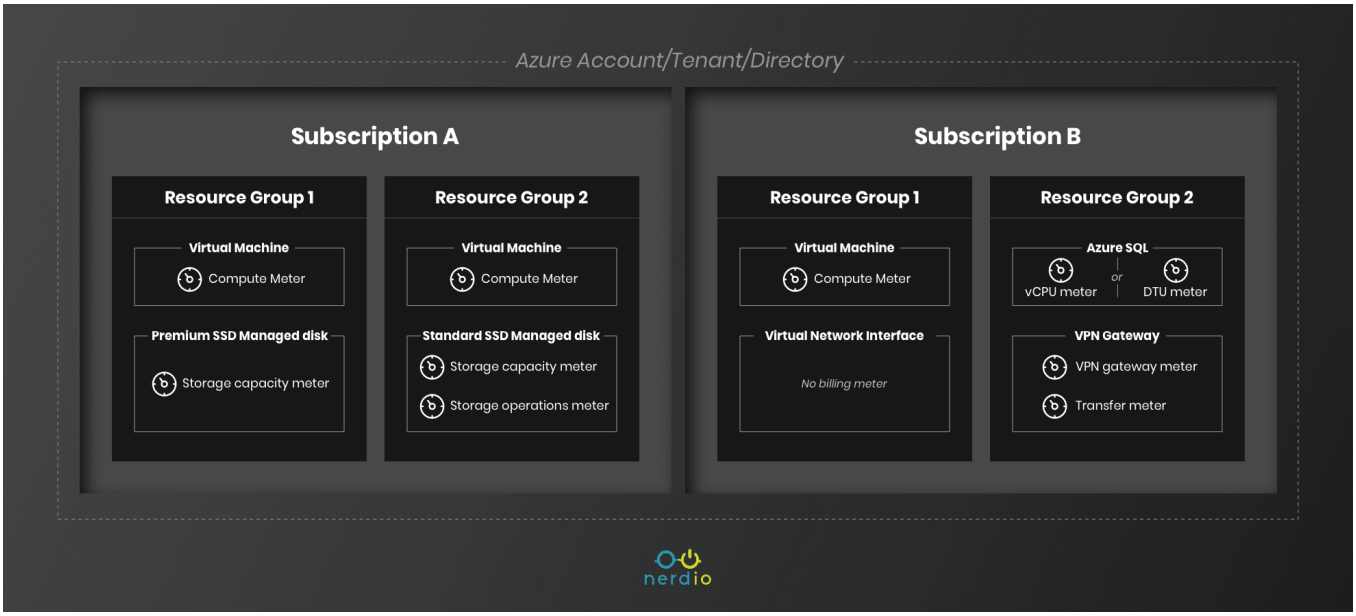
To summarize, we learned the hierarchy of Azure objects and how the interact with each other:

Azure account/tenant/directory

- **Subscription A**
  - Resource Group 1
    - Virtual machine (resource)
      - Compute meter
    - Premium SSD Managed disk (resource)
      - Storage capacity meter
  - Resource Group 2
    - Virtual machine (resource)
      - Compute meter
    - Standard SSD Managed disk (resource)
      - Storage capacity meter
      - Storage operations meter

- **Subscription B**
  - Resource Group 1
    - Virtual machine (resource)
      - Compute meter
    - Virtual Network Interface (resource)
      - No billing meter
  - Resource Group 2
    - Azure SQL (resource)
      - vCPU meter OR
      - DTU meter
    - VPN Gateway (resource)
      - VPN gateway meter
      - Transfer meter

Here's a diagram to help you understand it all at a glance:



Familiarizing yourself with this set of core building blocks including Accounts, Tenants, Subscriptions, Resource Groups, Resources, and Billing options is the first step an MSP should take in determining the most efficient and cost-effective way to build a cloud IT practice in Microsoft Azure.

Now, let's dive deeper in Azure Resources.

Azure Resources

As we stated above, the building blocks of an Azure IT environment are Resources. These resources are organized into Resource Groups inside of an Azure subscription. There are billable and non-billable resources. Billable resources have a Meter attached to them that runs while the resource is provisioned.

In this section, we will explore the three most common types of Azure resources used by MSPs when deploying IT environments: Compute (virtual machines), Storage, and Network.

Every resource used in Azure must be deployed in a geographical location known as a Region. An Azure region is a grouping of data centers located in a specific geographic location. Microsoft is constantly growing its global footprint and adding data centers and regions. At the time of this article, there are 54 regions available in 140 countries and the list is growing. The most up-to-date map of regions can be viewed here.

Resources deployed in the same region are interconnected with high speed connectivity (think LAN speeds). Resources in different regions can still communicate with each other but are subject to additional WAN latency. The latency depends on how far the regions are from each other.

You can also download our complete guide to Azure resources here:

AZURE RESOURCES OVERVIEW - COMPUTE STORAGE AND NETWORKING

Compute (Virtual Machines)

Virtual Machines (VMs) in Azure come in predefined sizes that are called **families** or **series**. An individual VM is often referred to as an **instance**. Different VM families are designed for common use-cases and are comprised of certain amounts of CPU cores and GB of RAM. It's not possible to arbitrarily mix and match CPU cores and GB of RAM as can be done with Hyper-V and VMware. Here, we will focus on the four most commonly used VM families by MSPs: Ds-series, B-series, Esv3-series, and NV-series.

Ds-series

These are "general purpose" VMs that can be used for a wide variety of workloads. There are three versions of the DS-series: v1, v2, and v3. Only v2 and v3 should be used.

- Purpose: general applications (domain controllers, file servers, application servers, etc.)
- CPU clock speed: 2.4Ghz – 3.0GHz (with Intel Turbo Boost)
- CPU-to-RAM ratio
  - V2 – 1:3.5GB (each CPU core gets 3.5GB of RAM)
  - V3 – 1:4.0GB (each CPU core gets 4.0GB of RAM)
- Storage supported: Standard and Premium
- Approximate average list price per CPU
  - V2 - $85/month
  - V3 - $77/month
- Difference between V2 and V3
  - V2 VMs use non-hyperthreaded vCPUs (1 vCPU per 1 physical CPU core), which is why they are slightly more expensive. V2 VMs start at a single core size (DS1v2).
  - V3 VMs use hyperthreaded vCPUs (2 vCPUs per 1 physical CPU), which is why they are less expensive. V3 VMs start at a minimum of two vCPUs (D2sv3).

Ds-series VMs are a good fit for workloads that require consistent CPU usage and are not very RAM hungry.

Esv3-series

These are "general purpose, high-memory" VMs that can be used for many workloads that are more RAM hungry rather than CPU hungry.

- Purpose: general, RAM bound applications (database servers, application servers, desktops, etc.)
- CPU clock speed: 2.3Ghz – 3.5Ghz (with Intel Turbo Boost)
- vCPU-to-RAM ratio: 1:8.0GB (each CPU gets 8.0GB of RAM)
- Storage supported: Standard and Premium
- Approximate average list price per CPU: $88/month

Esv3-series VMs are very similar to Dsv3-series but have double the RAM per CPU and are about 15% more expensive. They are ideal for workloads that consistently utilize the CPU and are memory hungry. Examples are database servers and RDS session hosts.

B-series

These are known as "burstable" VMs. They are very useful but the way they work is a bit complicated. B-series are used for non-CPU intensive workloads (e.g. domain controllers, file servers) and cost about 50% of an equivalently sized Ds-series VM. The reason they're cheaper is because Azure imposes a quota on how much of the total CPU cores can be used. This quota is usually a fraction of the total available CPU.

For instance, B2m's quota is 60% of a single CPU, which is 30% of the 2 CPUs visible in the VM. Every second that the VM is using less than its quota (less than 60% of a single CPU) it is "banking credits". These banked credits can be used to burst up to the total available CPUs (100% of 2 CPUs, in this example) when needed. While bursting, the VM is consuming its banked credits. Once credits run out, the VM's CPU utilization is throttled down to its 60% quota.

Why use B-series VMs? They are cheaper. For approximately the same price that you would pay for a Ds-series VM, you can get a B-series with double the CPUs and double the RAM. However, they should only be used for workloads that are either not CPU intensive or "bursty", meaning they only occasionally need all the CPU but most of the time the CPU is idle.

For instance, an Active Directory domain controller is not utilizing its CPU very heavily on a regular basis. However, when Windows Updates run, the VM will use all its available CPU horsepower. B-series are perfect for Domain Controllers since they bank credits while idle and then consume them when needed to update or do some other CPU intensive task.

- Purpose: General, non-CPU intensive workloads (e.g. AD domain controllers, file servers)
- CPU clock speed: varies
- vCPU-to-RAM ratio: varies from 1:1 to 1:4 for VMs larger than B2s
- Storage supported: Standard and Premium
- Approximate average list price per CPU: ranges from $13/month to $40/month

NERDIO TIPS:

- ***Don't use B-series VMs for CPU intensive workloads***
- ***When a B-series VM is first provisioned, it doesn't have any banked credits and is subject to its quota limit on the CPU, which means it's slow. Once the VM is running idle for some time, credits get banked and the VM performance improves when it needs to burst.***
- ***Don't shut down B-series VMs overnight when they are not in use. This will not allow the VMs to bank credits for the following day of usage.***

NV-series

These VMs are intended for special use-cases when a dedicated GPU is needed. They include an NVIDIA GRID 2.0 Tesla GPU and are ideal for running graphically intensive workloads like AutoCAD, SolidWorks, and Revit. These are very large and expensive VMs (starting at 6 CPUs and 56GB of RAM) and need to be used with caution and with a specific purpose in mind to not generate unpredictably large Azure compute consumption bills.

- Purpose: Graphically heavy, visual workloads inside of virtual desktop sessions
- vCPU-to-RAM ratio: 6:56GB (each 6 CPUs get 56GB of RAM)
- vCPU-to-GPU ratio: 6:1 (each 6 CPUs get 1 M60 GPU)
- Storage supported: Standard ONLY (note that Premium is not supported)
- Approximate average list price per CPU: $165/month

NERDIO TIPS:

- ***Smallest VM is NV6 (6 CPU / 56GB RAM / 1 GPU)***
- ***Since only Standard storage is supported, disk performance is not fast***
- ***Not available in all Azure regions***
- ***New NVv2 VMs are currently in preview and are going to have the following notable improvement once they are generally available. They will confer:***
  - ***40% price reduction***
  - ***2X RAM increase per CPU***
  - ***Support for Premium storage***

Anatomy of a VM

Now that we understand the different types of VMs, let's talk about how to use them. The first important thing to understand is that VMs are not stand-alone resources. For example, a VM must have an OS disk (and optionally data disks) attached to it, as well as a virtual network interface (vNIC). A new VM can be created (deployed) using an existing OS disk and vNIC or new disk and vNIC can be created together with the VM. If a VM is deleted, its data (i.e. OS and Data disks) are not deleted. They remain as resource objects in Azure that are not attached to any VM. More on Storage resources later.

When deploying a VM, its OS disk must be based on an existing image and cannot be blank. Since you don't have console access to VMs in Azure, the OS cannot be installed on a "blank" OS disk. The OS disk must already have the OS on it. Images could be pulled from the Azure image library or you can create and upload your own custom image as a VHD file to Azure to be used for deploying a VM.

All VMs also come with a temporary D: drive that has locally attached fast storage (SSD). Keep in mind that this disk is temporary, and any data stored on it will likely be erased if the VM is ever shut down or moved to another Azure host in the background.

NERDIO TIP:

Use this disk for the pagefile and temporary data, but be sure to never store anything you need to retain on the temporary disk.

Allocated vs. Deallocated

After you deploy a VM it becomes **provisioned** or **allocated**, meaning it is running on an Azure host, consuming Azure resources and you're consequently being billed for every second that the VM is allocated. To stop being billed for a running VM, you must stop it. This process causes the VM to become **deallocated**, which means it is effectively powered off and is not consuming Azure resources. It is possible to shut down a VM and still be paying for it because it stays allocated. When you power off a VM from inside of the OS it shuts down, but Azure still sees it as allocated and you are being billed. Be sure to stop VMs at the Azure level even if you shut them down at the OS level.

Subscription Core Quotas

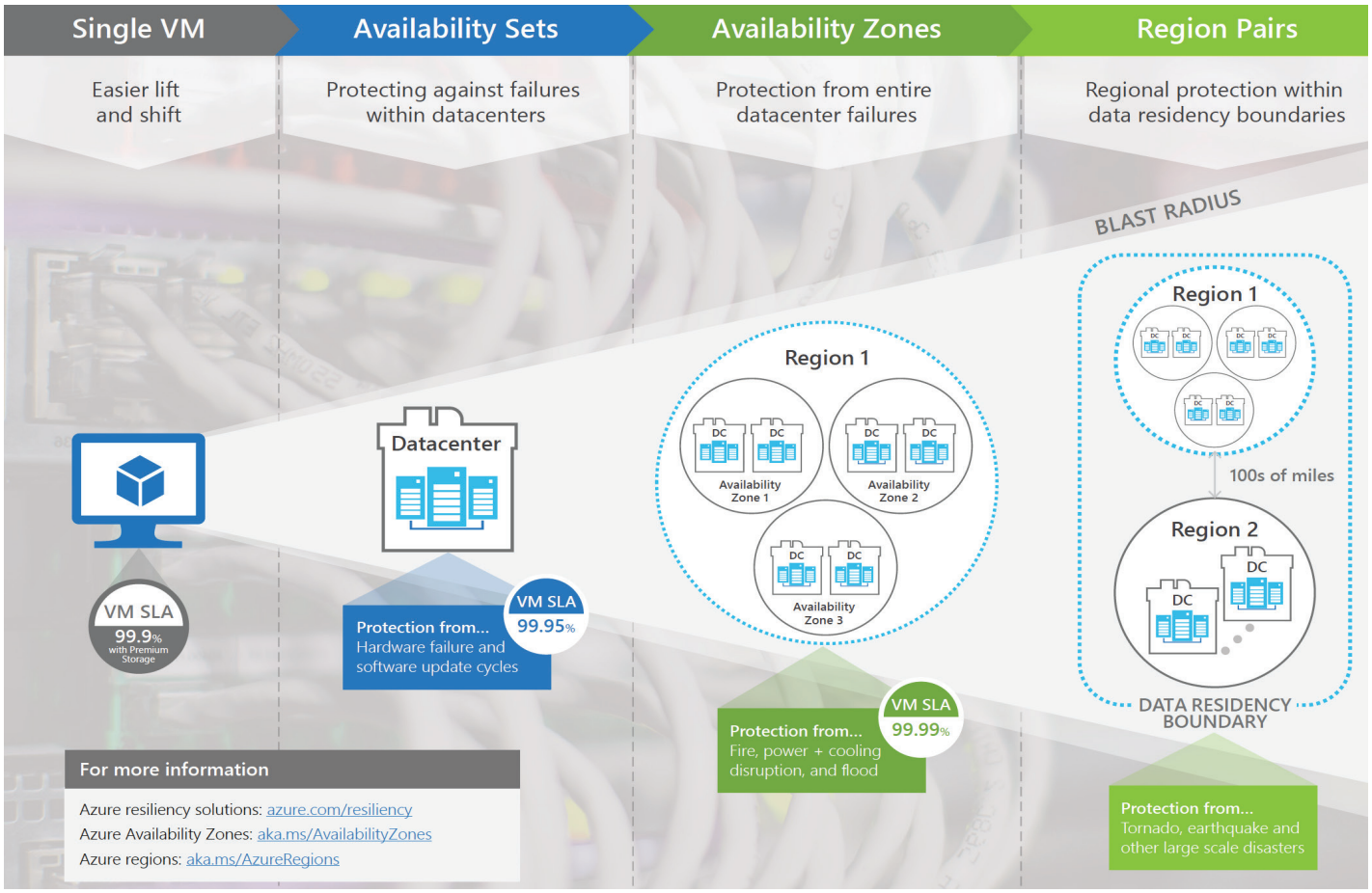
Another important concept to mention when discussing VMs is **subscription core quotas**. To prevent accidental or malicious use of Azure where many VMs are created and a large amount of consumption occurs, Microsoft imposes core quotas on subscriptions by default.

The number of CPU cores that can be provisioned in a subscription in total and per VM family are limited. For instance, a Free subscription has an overall core quota of 4. Direct Pay-As-You-Go subscriptions have a default core quota of 10 and CSP subscriptions have a core quota of 20. This means that with a CSP subscription you cannot provision more VMs whose total CPU cores exceed 20. Be mindful of this limit. To increase the core quota limit, you need to submit a request to Microsoft via the Azure portal for a core limit increase.

Service Level Agreement

Finally, it is important to be aware that only some Azure VMs' availability is covered by Microsoft's Service Level Agreement **(SLA)**. VMs not covered by an SLA could be unexpectedly rebooted due to underlying Azure infrastructure upgrades or hardware failure. It has become exceedingly rare to see VMs reboot in Azure, but it was not uncommon in the past.

Presence of an SLA and the availability guarantee (e.g. 99.9% vs. 99.95% vs. 99.99%) is based on several factors that have to do with the type of storage the VM uses for its OS and data disks, as well as if it is deployed in an availability set or an availability zone. You can learn more about the specifics here. The diagram below summarizes the available protection options.



Source: https://azure.microsoft.com/features/resiliency/

For most situations relevant to an MSP, it is important to know that individual VMs ("Single VM" in Microsoft terms) that use any Standard storage disks are not covered by any SLA. The chance of outage is very small and even if the VM reboots due to an underlying hardware failure it will restart very quickly elsewhere. However, it is important to remember that no SLA applies.

Critical VMs should use **Premium** storage only, which will provide them with a 99.9% availability guarantee and improved performance. For additional availability guarantees, distributed workloads that can have multiple VMs participating in the same application, can be placed inside **Availability Sets** and will then be subject to 99.95% availability guarantee.

An example of such a deployment may be Active Directory. You can have two AD domain controllers in an Availability Set and your AD, as a whole, will have a guarantee of 99.95%. This doesn't mean that each domain controller VM has this guarantee. Rather, the "application" (i.e. AD), as a whole, is guaranteed to be available 99.95% of the time.

Storage

Azure offers multiple storage options with different performance, redundancy, location and price characteristics. It's easy to get lost in all the available options and to clearly understand what type of storage should be used when.

We will focus on three storage resources that are most commonly used by MSPs when deploying IT environments in Azure: **Managed Disks**, **Backup Vaults**, and **Files**.

In addition to considering the type of storage resource, we need to understand the **Data Redundancy**, **Performance**, and **Cost** for each type of storage object.

Data Redundancy

- **LRS – Locally Redundant Storage**
  - Three redundant copies of data stored in one data center
  - 99.99999999% (yes, 11 9's) durability
- **GRS – Geo-Redundant Storage**
  - Six total redundant copies of data; three copies stored in one region and another three copies are asynchronously replicated to a second region
  - 99.99999999999999% (that's 16 9's) durability
- **ZRS – Zone-Redundant Storage**
  - Three redundant copies of data stored across two or three data centers within the same Azure region
  - 99.9999999999% (12 9's) durability
- **RA-GRS – Read Access GRS.** This redundancy type is not relevant to the storage objects in this discussion

Performance Tiers

There are three Performance tiers: **Standard**, **Premium**, and **Ultra**.

Standard storage utilizes inexpensive and slow HDD and recently Microsoft added Standard SSD, which doesn't increase the average performance but makes it more consistent than HDD.

Premium storage uses SSD disks and is fast. This type of storage is best for most disk IO intensive applications such as databases and virtual desktops.

Ultra SSD is a new type of storage for very high-performance, disk IO intensive applications.

Storage Resources

Now that we understand the redundancy and performance characteristics of Azure storage, let's dive into the actual storage resources.

Managed Disks are by far the most commonly used type of storage when deploying an IT environment in Azure using virtual machines. Recall that each VM must have, at a minimum, an OS disk and sometimes one or more additional data disks. These disks that get attached to a VM are known as Managed Disks in Azure. There is an older type of disk called Unmanaged Disk, but for the purposes of our discussion we will stick to Managed Disks.

If you're interested in learning more about the differences between managed and unmanaged disks, click here.

Managed disks are only available with LRS data redundancy since they are attached directly to VMs, and these VMs must be able to communicate with disks in a very high throughput, low latency way. This is why managed disks and the VMs they're attached to must be in the same region. Disks come in Standard HDD, Standard SSD, Premium SSD, and Ultra SSD performance flavors.

Let's explore each type of managed disk in detail:

- **Standard HDD** (S-type disk – e.g. S4, S10, S20, etc.)
  - Available sizes: 32GB – 32TB in discreet increments (e.g. 32GB, 64GB, 128GB, etc.)
  - Billed on allocated space, not used space. Creating an S-type disk of a certain size will result in a bill for the entire size, even if it completely unused.
  - What you're billed for:
    - Capacity – approximately $0.048/GB/month
    - Operations - $0.0005 per 10,000 transactions
    - Performance: Up to 500 IOPS and up to 60MB/sec throughput (performance varies significantly and can often be far below this limit)
  - When to use?
    - Very low disk IO applications (e.g. ADFS proxy server)
    - Test environments
    - When VM is deallocated but you still want to keep it around, changing it to an S-type disk saves on storage costs

- **Standard SSD** (E-type disk – e.g. E4, E10, E20, etc.)
  - Available sizes: 32GB – 32TB in discreet increments (e.g. 32GB, 64GB, 128GB, etc.)
  - Billed on allocated space, not used space. Creating an E-type disk of a certain size will result in a bill for the entire size, even if it completely unused.
  - What you're billed for:
    - Capacity – approximately $0.075/GB/month
    - Operations - $0.002 per 10,000 transactions
  - Performance: Up to 500 IOPS and up to 60MB/sec throughput (more consistent performance than S-type disks)
  - When to use?
    - Best for most non-disk IO heavy applications because of nice balance between performance consistency and cost (e.g. domain controllers, file servers). Not a good fit for high IO database servers.
    - Production environments, if no SLA is needed
    - Most VDI desktop workloads for typical users
- **Premium SSD** (P-type disk – e.g. P4, P10, P20, etc.)
  - Available sizes: 32GB – 32TB in discreet increments (e.g. 32GB, 64GB, 128GB, etc.)
  - Billed on allocated space, not used space. Creating a P-type disk of a certain size will result in a bill for the entire size, even if it completely unused.
  - What you're billed for:
    - Capacity – approximately $0.15/GB/month
    - Operations – no transaction costs
    - Performance: 120 – 7500 IOPS and 25MB/sec – 250MB/sec throughput
  - When to use?
    - Best disk performance for any disk IO intensive applications such as databases
    - Great for power user virtual desktops and RDS session hosts with many users
    - Expensive for data storage only when the VM is powered off. Consider converting P to S or E disk if VM is being deallocated and data stored for archival purposes.
- **Ultra SSD**
  - High performance and high cost disk option for very disk IO intensive workloads
  - Complex billing structure based on provisioned IOPS and throughput in addition to capacity storage
  - Not commonly used with typical MSP workloads in Azure

Backup

Backup Vaults, as the name implies, are used by the Azure Backup service to store backup snapshots. It is a **Block Blob** storage container and its cost is based on actual consumption. Currently, Azure backup supports only Standard HDD performance tiers and LRS and GRS data redundancy options. The cost of backup vault storage is approximately $0.024/GB/month for LRS and 2X that amount for GRS storage.

Azure Backup is most commonly used by MSPs to protect data on VMs running inside of an Azure IT environment but can also be used to back up data from on-premises systems. To protect Azure VMs, the backup vault must reside in the same region as the VMs that are being backed up to it.

Azure backup can be used to achieve compliance with requirements to save data in multiple geographic locations by selecting the GRS redundancy option when creating the backup vault. This way, there will be multiple copies of the backup data in the same datacenter where the VMs reside as well as multiple copies in another paired region. With GRS, Microsoft has pre-defined region pairs. More information is available here.

Azure Files

Azure Files is a PaaS offering. The easiest way to think about it is as a Microsoft-managed file server where you can create Windows shares and publish them out to the world. These shares can then be mounted directly on Windows, Linux, and macOS devices, either on-premises or in cloud VMs without any special drivers.

Azure Files supports LRS, ZRS and GRS storage and costs range from $0.06/GB/month to $0.10/GB/month plus the cost of operations ($0.015 to $0.03 per 10,000 transactions). Azure Files is currently available with Standard storage only, which significantly limits its performance. However, Premium storage support is in preview and should be available soon.

In summary, Azure offers an almost endless list of storage options with varying redundancy, performance, and cost characteristics. For MSPs, it is important to focus on the storage types that are commonly used for typical IT workloads (managed disks for VMs, Block Blob for Azure Backup and Azure Files for creating SMB shares) and avoid confusion around other storage types that are designed for developers creating applications and repositories.

Network

Azure's flexibility when it comes to networking is vast and not without complexity. Many network resources are for advanced use cases and for developers who are designing new applications.

We will focus on 4 network resources that are most relevant to an MSP and the way they interrelate with each other: **Virtual Networks**, **Public IP Addresses**, **Network Security Groups**, and **VPN Gateways**.

Before delving into the specifics of these network resources, we need to understand how Azure charges for **data transfer** (aka **bandwidth**). The basic rule is that any data coming into an Azure data center is free while going out of an Azure region will be charged on a per GB basis. It doesn't matter if the data is leaving a region and going into another region or leaving a region and going into some other, non-Azure location. In both cases, there is a charge. However, data transfer within the same Azure region (even across different data centers) is free.

Costs of Data Transfer

How much does outbound data transfer cost? The first 5GB in any given month are free and then it's $0.05 to $0.087 per GB after that. Let's put things in perspective; a 10GB file being downloaded from an Azure hosted VM to your laptop will cost $0.87.

It is important to note that Azure data transfer is not charged per mbps (using 95% percentile or some other method), but rather per transferred GB of data. Let's compare the two methods.

Colocation Provider A charges $50/month for 1mbps of bandwidth using the 95% percentile method. Assuming the line is utilized 95% for the entire month straight, that's equivalent to 60sec/min*60min/hr*24hr/day*30.5days/month * (0.95 * 1mbps) = 2,503,440 megabits per month, or 305GB/month. For the same amount of data transfer, Azure cost will be $26.48.

Therefore, a useful number for cost comparison between "GB transferred" and "mbps" based pricing is $26 per fully utilized mbps line. Since in a typical hosted IT environment the line is utilized only fractionally the cost of bandwidth in Azure is relatively low compared to the way other hosting and colocation providers charge for bandwidth.

Networking Structure

With the cost of data transfer out of the way, let's delve into the way networking is structured in Azure. At the top level there is a **Virtual Network** (vNet). A vNet has an address space that you as an MSP can define (e.g. 10.1.0.0/16). All objects within a vNet must fall inside of this address space. vNet also contains **Subnets**. These subnets are a way to segment the vNet into smaller sections. For instance, you could have a LAN and DMZ subnets within a vNet.

- vNet – 10.1.0.0/16
    - LAN subnet – 10.1.0.0/17
    - DMZ subnet – 10.1.254.0/24

Subnets that are part of a vNet can have virtual **Network Interfaces** (vNIC) attached to them. These vNICs are then attached to a VM and this is the way VMs communicate with each other and the rest of the world.

VM->vNIC->Subnet->vNet.

Each vNIC has an assigned private IP address (or addresses), DNS settings, an optional public IP address and other network interface properties. In Azure, IP address and DNS settings are not set at the Windows level inside of a VM. Rather, they are set at the vNIC level in Azure. In Windows, the network adapter is set to DHCP and receives its settings from the vNIC that's attached to it. The vNIC itself could have a statically assigned IP address or a dynamic one given to it by Azure via DHCP.

You can **Peer** (i.e., connect) different vNets together. These vNets can be in the same Azure region or you can use **Global vNet Peering** to connect vNets in different regions.

Public IP addresses are billable Azure resources that can be assigned to a vNIC. There are **dynamic IP addresses** and **static IP addresses**. Dynamic ones have a persistent DNS name that resolves to a dynamic IP, while a static IP address has a fixed IPv4 address and DNS name. The cost of a public dynamic IP address is $3/month while the cost of a public static IP address is about $4/month. Assigning a public IP address to a vNIC does not automatically expose the VM to the internet. In order to make it accessible from the internet a Network Security Group rule must be applied.

Network Security Groups (NSGs) are Azure's basic network firewall. They are non-billable network resources. NSGs are groups of firewall rules that specify what's allowed or denied into and out of a vNet. If an NSG is assigned to a subnet its rules will apply to all VMs whose vNICs are part of this subnet. Alternatively, NSGs can be assigned directly to a vNIC. In that case, the NSG firewall rules will apply to this single VM only.

VPN Gateway is a service that allows encrypted, site-to-site IPSec VPN connectivity from an on-premises network or another cloud to an Azure vNet. VPN Gateways are Microsoft managed resources that get added to a special subnet in a vNet called the Gateway Subnet. VPN Gateway is a billable network resource and pricing starts at $26/month for a basic gateway with a throughput limit of 100 mbps and support for up to 10 site-to-site VPN tunnels. The largest VPN Gateway is $912/month and supports 1.25 Gbps of throughput with up to 30 tunnels.

Microsoft Azure Fundamentals: Complete!

Nerdio empowers MSPs to build successful cloud practices in Azure. We'll continue to keep up on the latest Azure news and releases and will keep this document up-to-date in the process. Hopefully, these Microsoft Azure fundamentals helped you to get your head around what is, admittedly, a very complicated subject.

Microsoft Azure made easy

Nerdio for Azure empowers MSPs to build successful cloud practices in Microsoft Azure.

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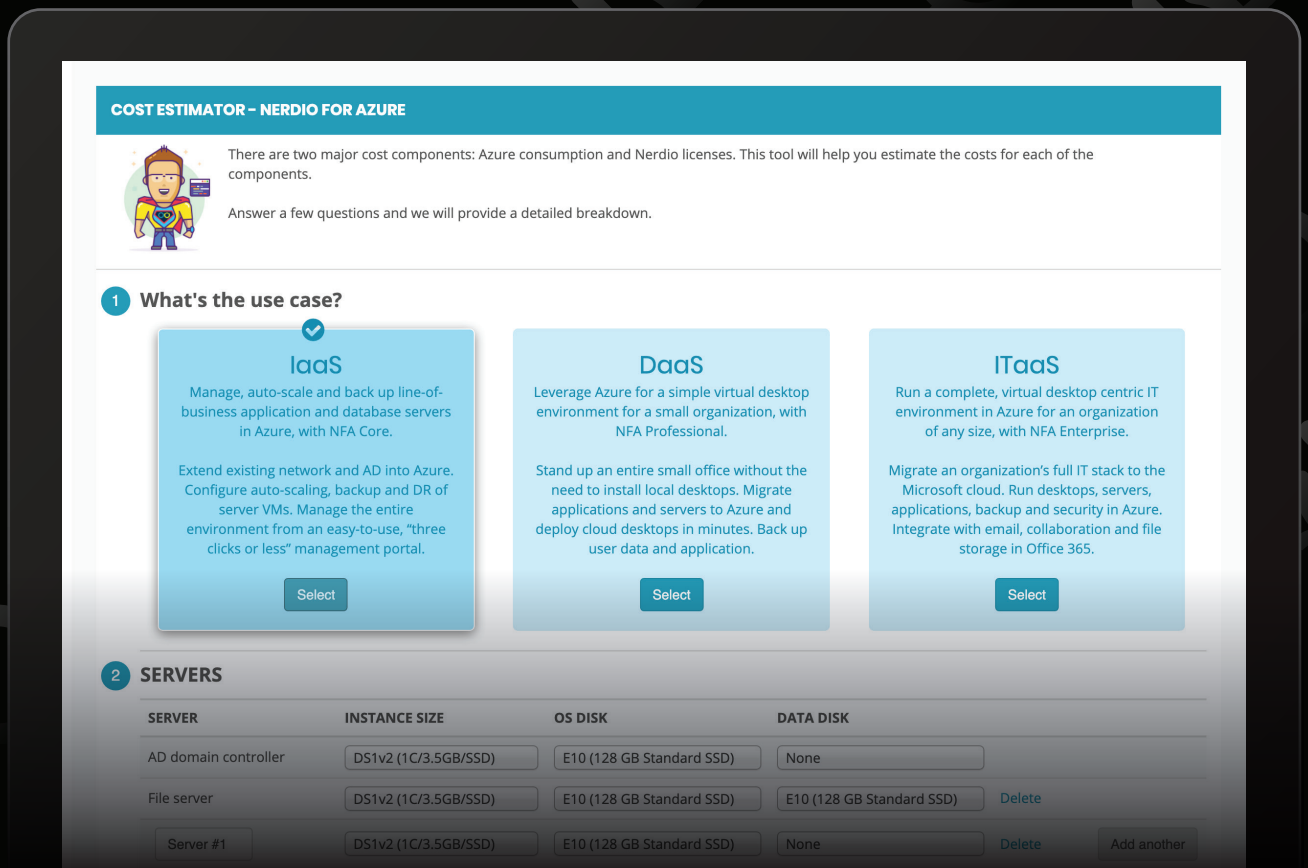

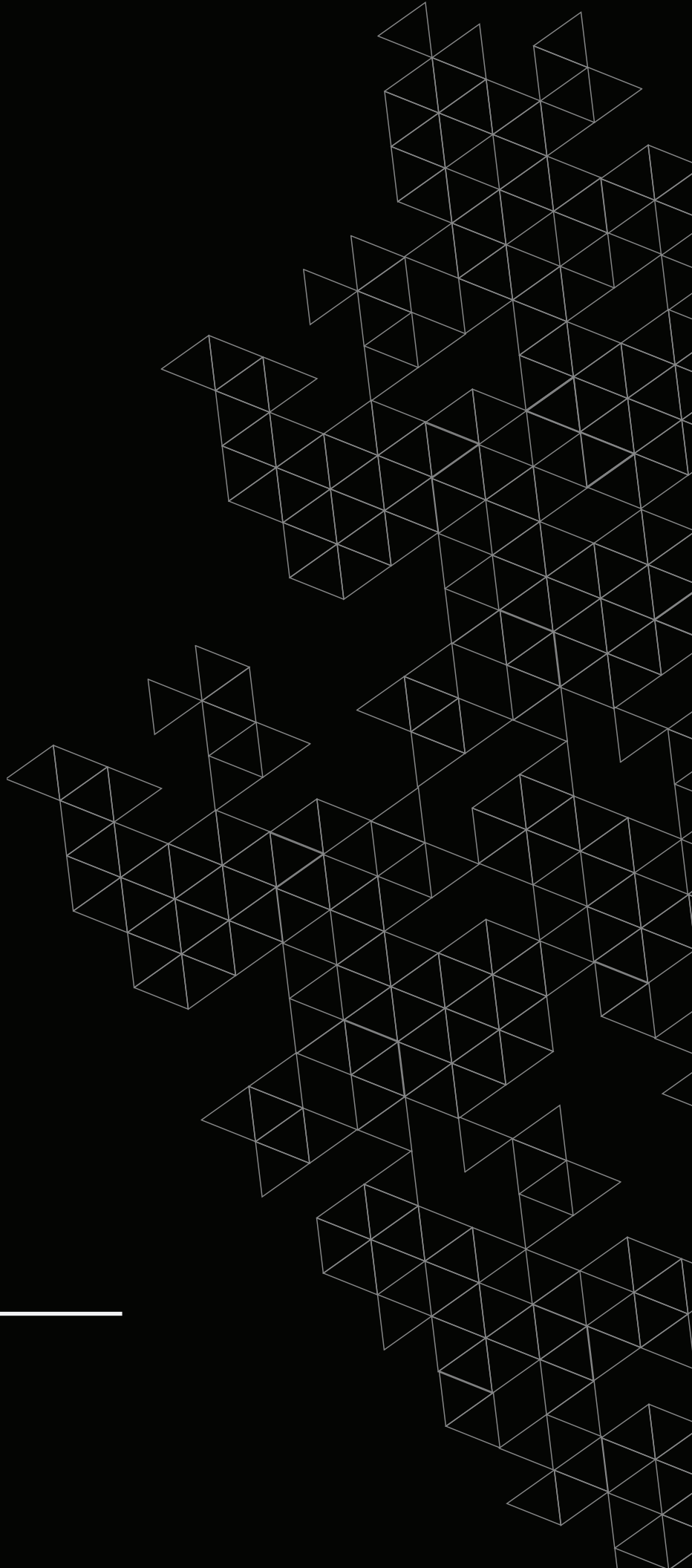

Contact Us:

Email: hello@getnerdio.com
Website: getnerdio.com