Deep Azure

Lecture 01

Introduction to Cloud Computing & Azure

Topics

- What is Azure
- What is Cloud
- Key Driver
- Usage Patterns
- Benefits
- Market Size
- Main Providers
- Azure Portal
- Main Azure Services
- Creating an Account
- Creating first Resources, Linux and Windows VMs

What is Azure

az·ure /ˈaZHər/

adjective

1. bright blue in color, like a cloudless sky.
   "white beaches surrounded by azure seas"
   synonyms: sky-blue, bright blue, blue; *literary* cerulean
   "she wears contacts that make her eyes azure"

noun

1. a bright blue color.
2. a small butterfly that is typically blue or purplish, with color differences between the sexes.

More of Côte d'Azur

What is Cloud

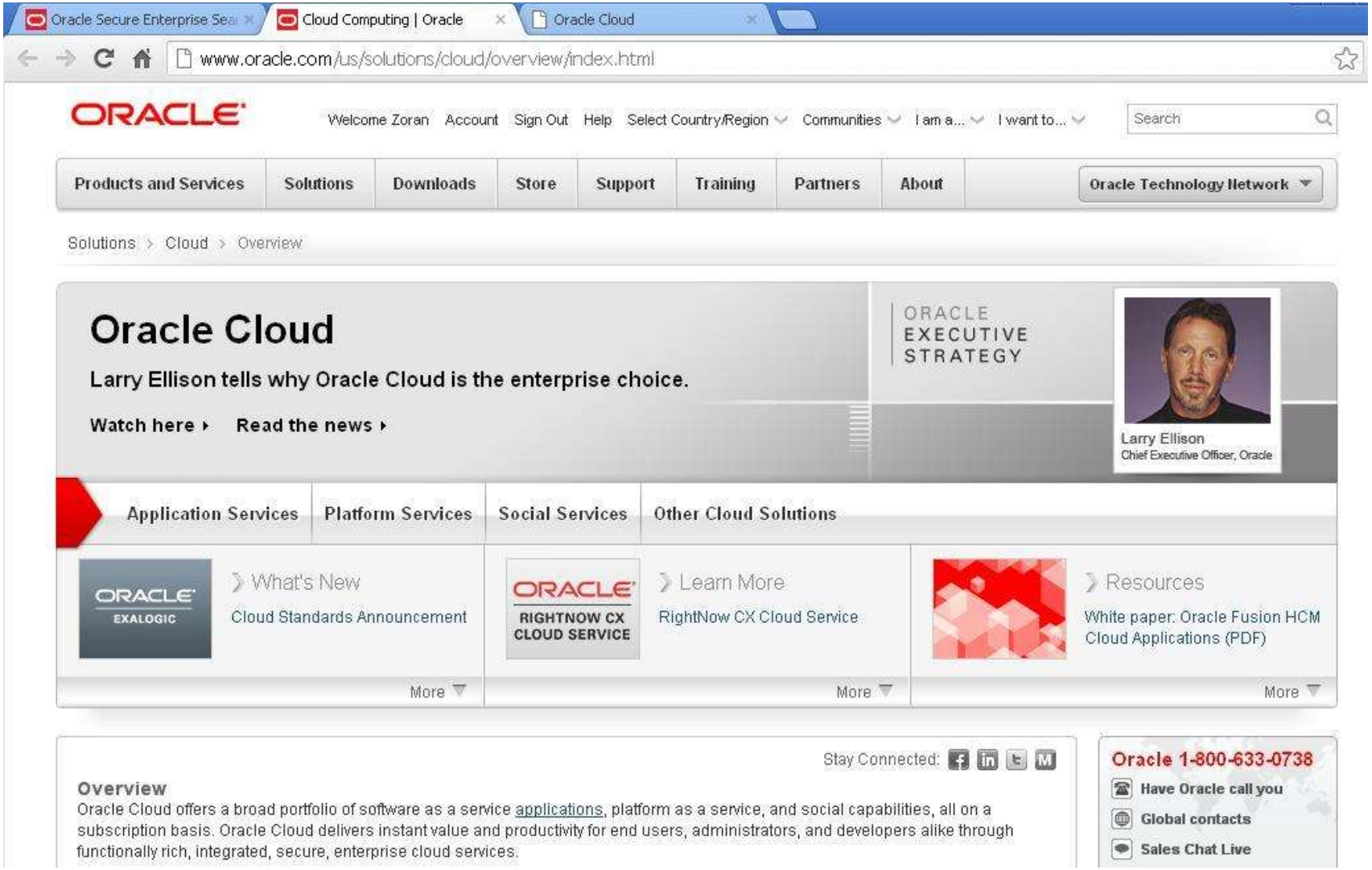
- noun: **cloud computing**; ~~plural noun: **cloud computings**~~
  - the practice of using a network of remote servers hosted on the Internet to store, manage, and process data, rather than a local server or a personal computer.

  Warning: “Everyone is going to the Cloud.

  Do not be left on the ground” (Konica-Minolta site).

- Who invented Cloud:
  - Amazon Web Services (AWS)?
  - Google?
  - Salesforce.com?
  - Oracle? (you are right!!)

Oracle Cloud

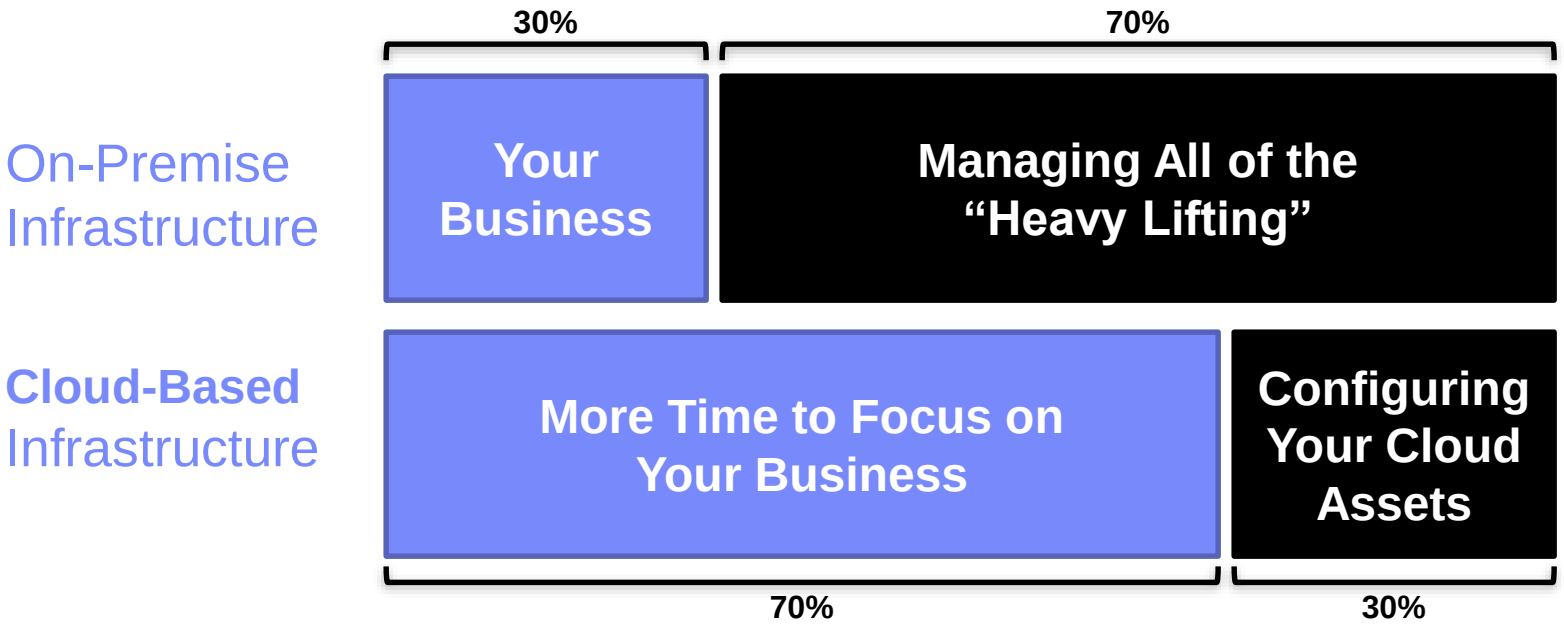


- Larry Ellison was a true visionary and tried hard to promote so called Network Computer and Utility Computing as early as early 199o's. The names are different but those concepts were full equivalent to today's Cloud Computing.

Cloud Computing is a Mature Industry, Existing Facilities

Another Mature Industry, Ford MC Assembly Plant

Some of the Drivers for The Cloud

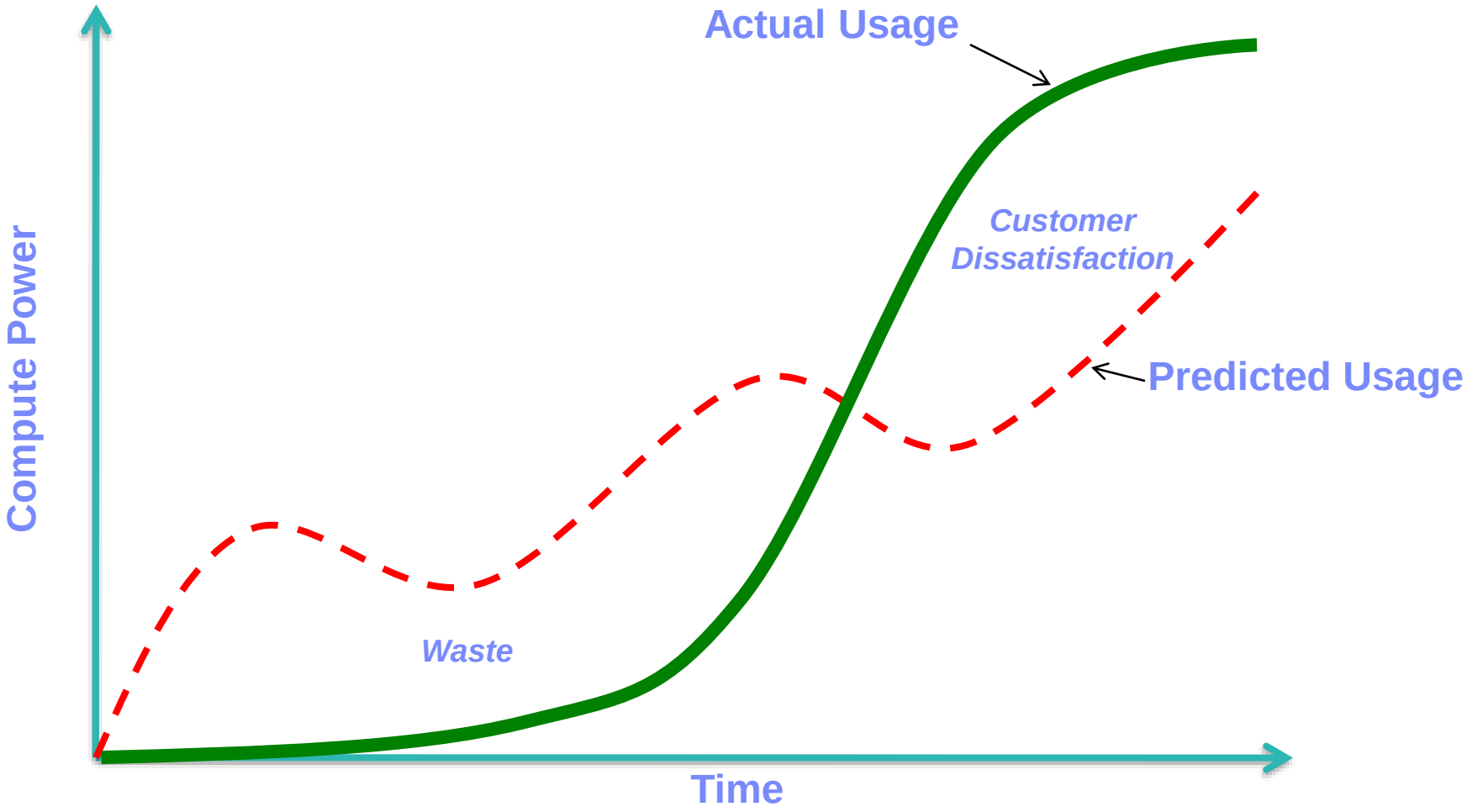


- Cloud provides reliable and dependable on-demand infrastructure that frees time and expense for you to focus on innovating for your business.

Key Business Benefits of the Cloud

- **Almost zero upfront infrastructure investment**: If you have to build a large-scale system it may cost a fortune to invest in real estate, physical security, hardware (racks, servers, routers, backup power supplies), hardware management (power management, cooling), and operation personnel. Because of the high upfront costs, the project would typically require several rounds of management approvals before the project could even get started. Now, with utility-style cloud computing, there is little fixed cost or startup cost.
- **Just-in-time Infrastructure**: In the past, if your application became popular and your systems or your infrastructure did not scale you became a victim of your own success. Conversely, if you invested heavily and did not get popular, you became a victim of your failure. By deploying applications in-the-cloud with just-in-time self-provisioning, you do not have to worry about pre-procuring capacity for large-scale systems. This increases agility, lowers risk and lowers operational cost because you scale only as you grow and only pay for what you use.
- **More efficient resource utilization**: System administrators usually worry about procuring hardware (when they run out of capacity) and higher infrastructure utilization (when they have excess and idle capacity). With the cloud, they can manage resources more effectively and efficiently by having the applications request and relinquish resources on demand.

Cloud Rational, **Elasticity** of Infrastructure



Key Benefits of Cloud

- **Usage-based costing:** With utility-style pricing, you are billed only for the infrastructure that has been used. You are not paying for allocated but unused infrastructure. This adds a new dimension to cost savings. You can see immediate cost savings (sometimes as early as your next month's bill) when you deploy an optimization patch to update your cloud application. For example, if a caching layer can reduce your data requests by 70%, the savings begin to accrue immediately and you see the reward right in the next bill. Moreover, if you are building platforms on the top of the cloud, you can pass on the same flexible, variable usage-based cost structure to your own customers.
- **Reduced time to market:** Parallelization is the one of the great ways to speed up processing. If one compute-intensive or data-intensive job that can be run in parallel takes 500 hours to process on a single machine, with cloud architectures, it would be possible to spawn and launch 500 instances and process the same job in 1 hour. Having available an elastic infrastructure provides the application with the ability to exploit parallelization in a cost-effective manner reducing time to market

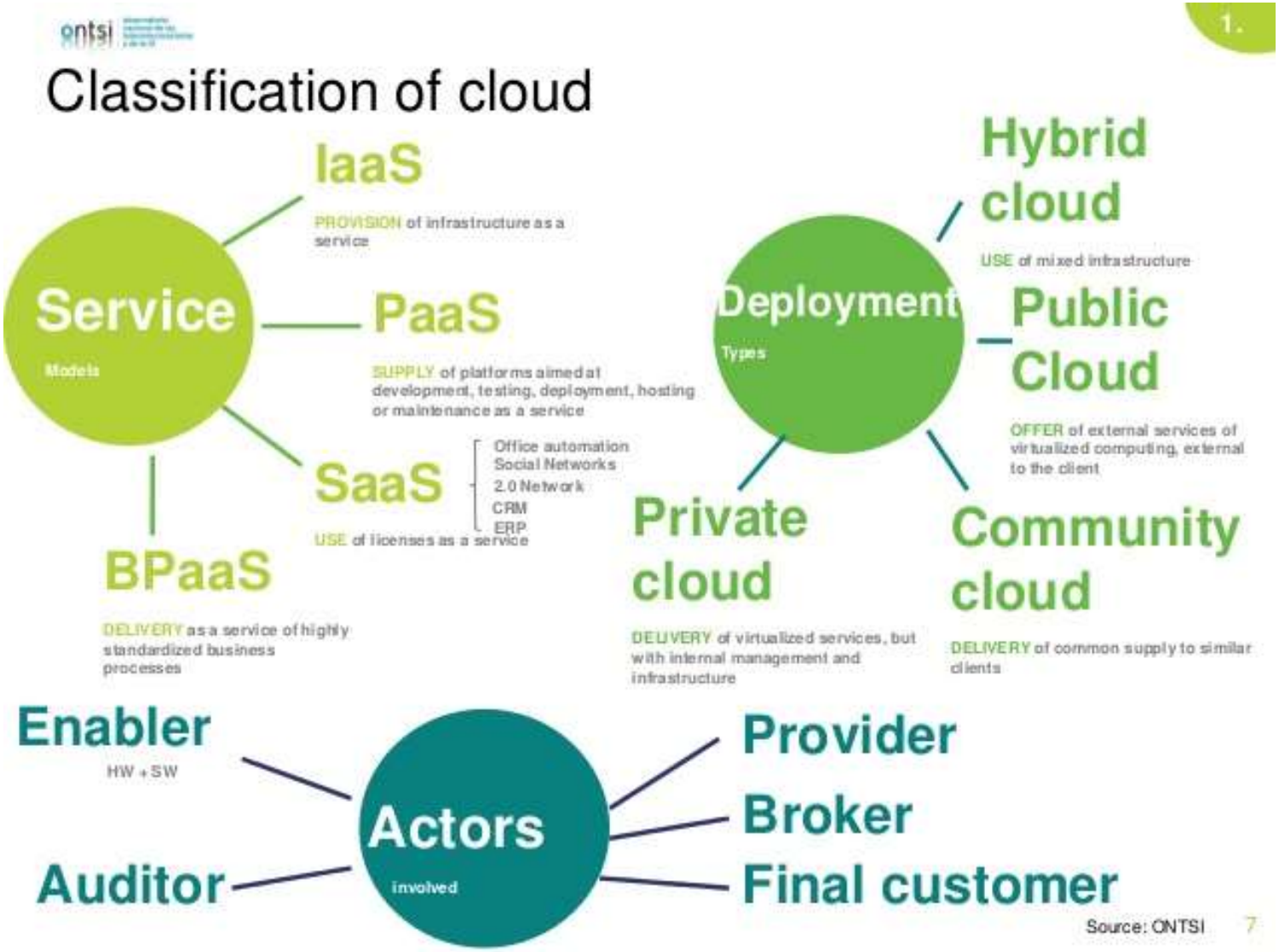
Key Technical Benefits of the Cloud

- **Automation** – “Scriptable infrastructure”: You can create repeatable build and deployment systems by leveraging programmable (API-driven) infrastructure.
- **Auto-scaling**: You can scale your applications up and down to match your unexpected demand without any human intervention. Auto-scaling encourages automation and drives more efficiency.
- **Proactive Scaling**: Scale your application up and down to meet your anticipated demand with proper planning understanding of your traffic patterns so that you keep your costs low while scaling.
- **More Efficient Development lifecycle**: Production systems may be easily cloned for use as development and test environments. Staging environments may be easily promoted to production.
- **Improved Testability**: Never run out of hardware for testing. Inject and automate testing at every stage during the development process. You can spawn up an “instant test lab” with pre-configured environments only for the duration of the testing phase.
- **Disaster Recovery and Business Continuity:** The cloud provides a lower cost option for maintaining a fleet of DR servers and data storage. With the cloud, you can take advantage of geo-distribution and replicate the environment in other location within minutes.
- **“Overflow”** the traffic to the cloud: With a few clicks and effective load balancing tactics, you can create a complete overflow-proof application by routing excess traffic to the cloud**.**

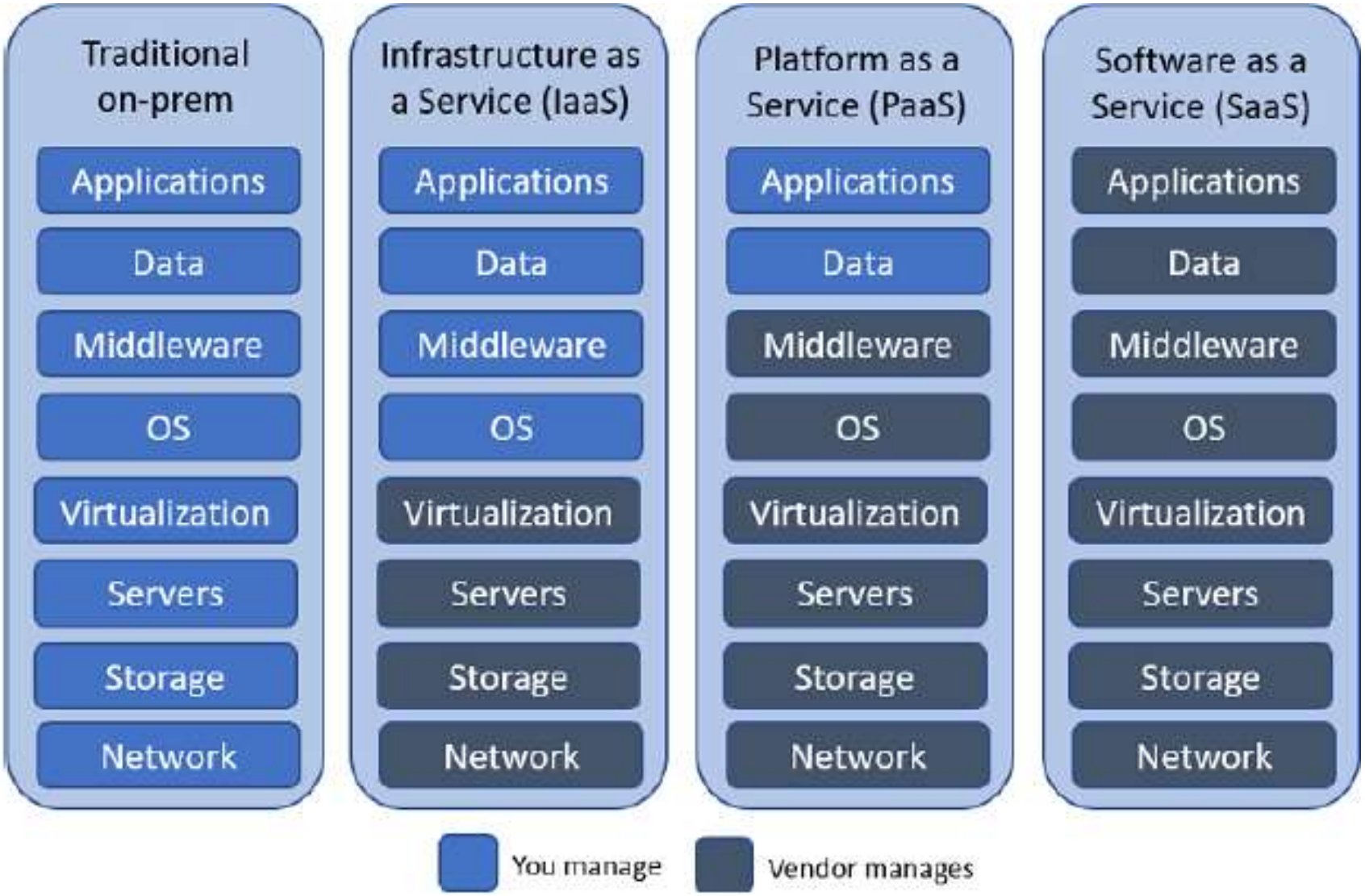
Many Uses of the Cloud

- Software as a Service Platform
- Portal Applications – Consumer and Business
- Elastic Computing
- Media Distribution
- Scalable Web Sites
- Business Continuity (Backup/Recovery)
- Financial Applications
- High-Performance Computing
- Software Development/Testing
- Back Office Applications
- Regular IT Plants

Classifications of Clouds and Services



Classification of Cloud Services



Classification of Services

- **On-premises** – you configure and manage the whole datacenter, from the network cables, storage, and servers, up to the data and applications.
- **Infrastructure as a Service (IaaS)** – you purchase the base compute resources from a vendor that manages the core infrastructure. You create and manage the VMs, data, and applications.
- **Platform as a Service (PaaS)** – you purchase the underlying platform stack from vendor that manages up to the OS and patches, and bring your applications and data.
- **Software as a Service (SaaS)** – you just need access to software, with a vendor providing everything else.
- Most of what we use in Azure falls into the IaaS and PaaS area. The main use cases include VMs and virtual networking (IaaS), or Web Apps, Functions, and Cosmos DB (PaaS).

Trends Driving Cloud Growth

- **Huge volumes of data** generated in:
  - Commercial Application (Amazon, eBay, e-commerce of all kinds) ,
  - Social Media (Facebook, Twitter, Netflix …),
  - Scientific Applications (Genomic, Astronomy, Nuclear Physics,…)
  - Light weight clients**:** smart phones, tablets, home use and industrial sensors are producing massive volumes of data and are requiring massive processing support (Number of smart devices is already beyond 20 billion and growing fast.)
- **Advances in Machine Intelligence, Big Data Analytics**
- **Advances in Parallel Computing**
- **Continuous Drop in** Hardware and Storage **Costs**
- **Growing Complexity of Software Application and IT Systems**

Illustrative Data Sizes, Facebook

September,2017 (https://zephoria.com/top-15-valuable-facebook-statistics/)

- Worldwide, there are over 2.01 billion monthly active Facebook users for June 2017 (Facebook MAUs) which is a 17 percent increase year over year.
- There are 1.15 billion mobile daily active users (Mobile DAU) for December 2016, an increase of 23 percent year-over-year. Mobile advertising revenue represented approximately 87 percent of advertising revenue for Q2.
- 1.32 billion people on average who log onto Facebook daily active users (Facebook DAU) for June 2017, which represents a 17 percent increase year over year
- There are 1.74 billion mobile active users (Mobile Facebook MAU) for December 2016 which is an increase of 21% year-over-year (Source: Facebook as of 02/01/17).
- On average, the Like and Share Buttons are viewed across almost 10 million websites daily. (Source: Facebook as of 10/2/2014)
- In Europe, over 307 million people are on Facebook. (Source: Search Engine Journal)
- Age 25 to 34, at 29.7% of users, is the most common age demographic.

Illustrative Data Sizes, Facebook

- Facebook users are: 76% of all females and 66% of all males.
- Highest traffic occurs mid-week between 1 to 3 pm.
- On Thursdays and Fridays, engagement is 18% higher.
- There are 83 million fake profiles.
- Photo uploads total 300 million per day.
- Average time spent per Facebook visit is 20 minutes. .
- Every 60 seconds on Facebook: 510,000 comments are posted, 293,000 statuses are updated, and 136,000 photos are uploaded.
- 4.75 billion pieces of content shared daily as of May 2013 which is a 94 percent increase from August 2012. (Source: Facebook)
- 50% of 18-24 year-olds go on Facebook when they wake up.
- One in five page views in the United States occurs on Facebook.
- 42% of marketers report that Facebook is critical or important to their business.
- 16 Million local business pages have been created as of May 2013 which is a 100 percent increase from 8 million in June 2012.

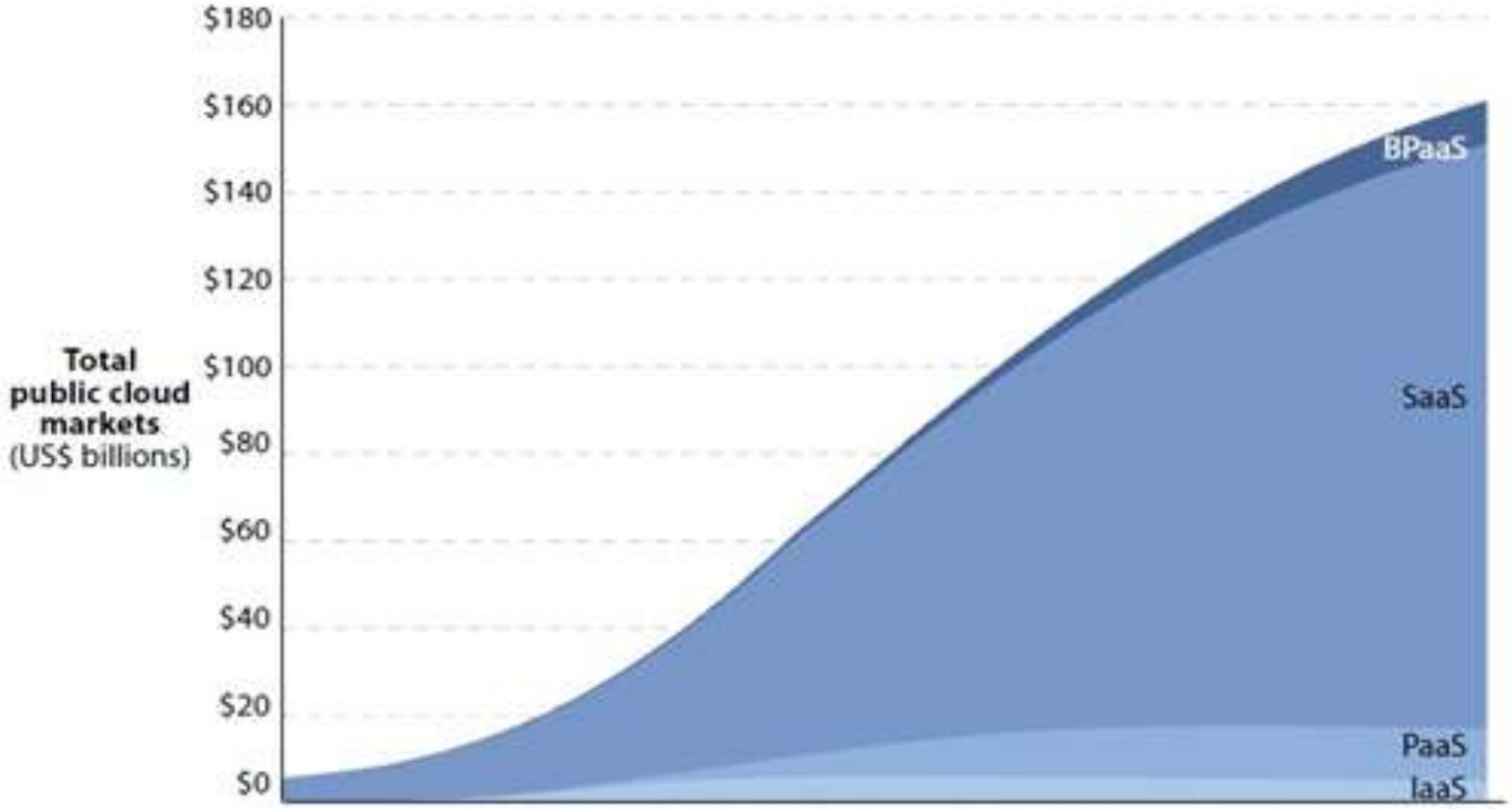
Some Twitter Statistics (zephoria.com)

- Twitter Monthly Active Users (MAU) Worldwide: 328 million Q2 2017 an increase of over 9 million quarter-over-quarter.
- Twitter has increased their year over year Daily Active Users (DAU) by 14 percent year-over-year marking the fourth consecutive quarter of accelerating growth (source: Twitter)
- Twitter Monthly Active Users (MAU) United States 68 million Q1 2017 (source: Twitter)
- Twitter Monthly Active Users (MAU) International is 260 million Q2 2017 which is a five percent increase over the previous year. (source: Twitter)
- Advertising cost-per-engagement for Twitter has decreased by 21 percent for Q4 2016 (source: Twitter – http://bit.ly/2oirtys)
- Twitter ad engagements for 2016 was 151 percent higher than it was for the previous year (source: Twitter – http://bit.ly/2oirtys)
- According to eMarketer nearly 66 percent of the businesses who have 100 or more employees have a Twitter account and expect it to rise in 2017.

Illustrative Data Sizes, Beyond Facebook

- **LHC** (Large Hadron Collider) 15 petabytes per year
- **Radiology** 69 petabytes per year
- **Square Kilometer Array Telescope** will acquire 100 terabits/second
- **Earth Observation** acquiring ~4 petabytes per year
- **Earthquake Science** – few terabytes **total** today
- **PolarGrid** – 100's terabytes/year ice-sheet radar
- **Exascale simulation** data dumps – terabytes/second (30 exabytes per year)
- We need tools to process those data volumes.
- Processing needs and desired features are beyond capacity of most IT organizations.
- Cloud is the only place where practical processing could be done

Global Public Cloud Market, Forecast



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
BPaaS ($)	0.15	0.23	0.35	0.53	0.80	1.26	1.95	2.93	4.28	6.00	7.66	9.08	10.02
SaaS ($)	5.56	8.09	13.40	21.21	33.09	47.22	63.19	78.43	92.75	105.49	116.39	125.52	132.57
PaaS ($)	0.05	0.12	0.31	0.82	2.08	4.38	7.39	9.80	11.26	11.94	12.15	12.10	11.91
IaaS ($)	0.06	0.24	1.02	2.94	4.99	5.75	5.89	5.82	5.65	5.45	5.23	5.01	4.78

58161

Source: Forrester Research, Inc.

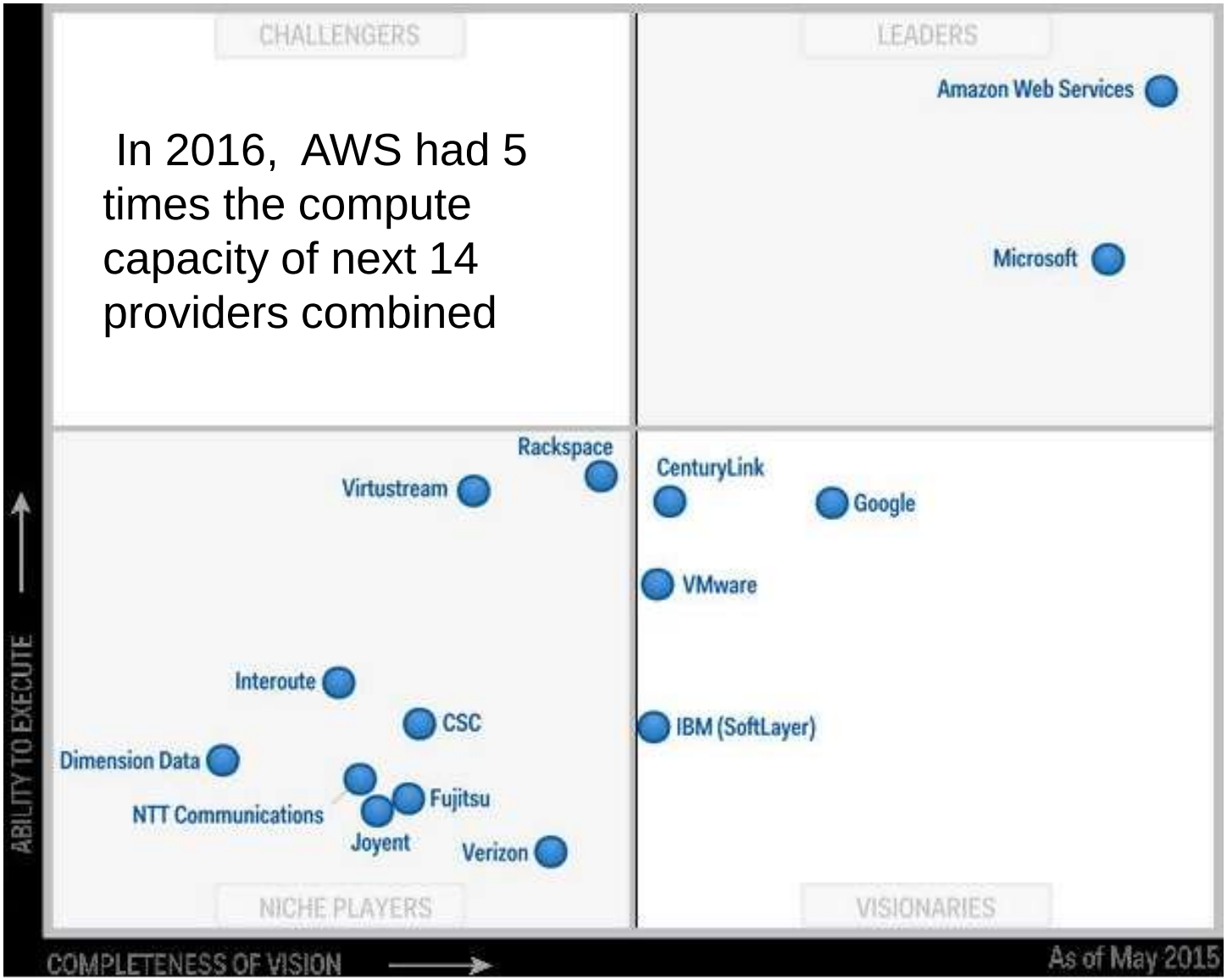
Cloud Providers and Vendors

- Amazon Web Services (AWS). AWS started in 2006 as the first major Cloud Provider. There are many more major providers:
- Microsoft with Azure
- Google with Gmail and Google App Engine and Google Cloud Platform
- IBM
- Verizon
- Oracle
- Salesforce
- HP
- EMC
- Dell

Every major firm in the IT world claims to be a Cloud Provider

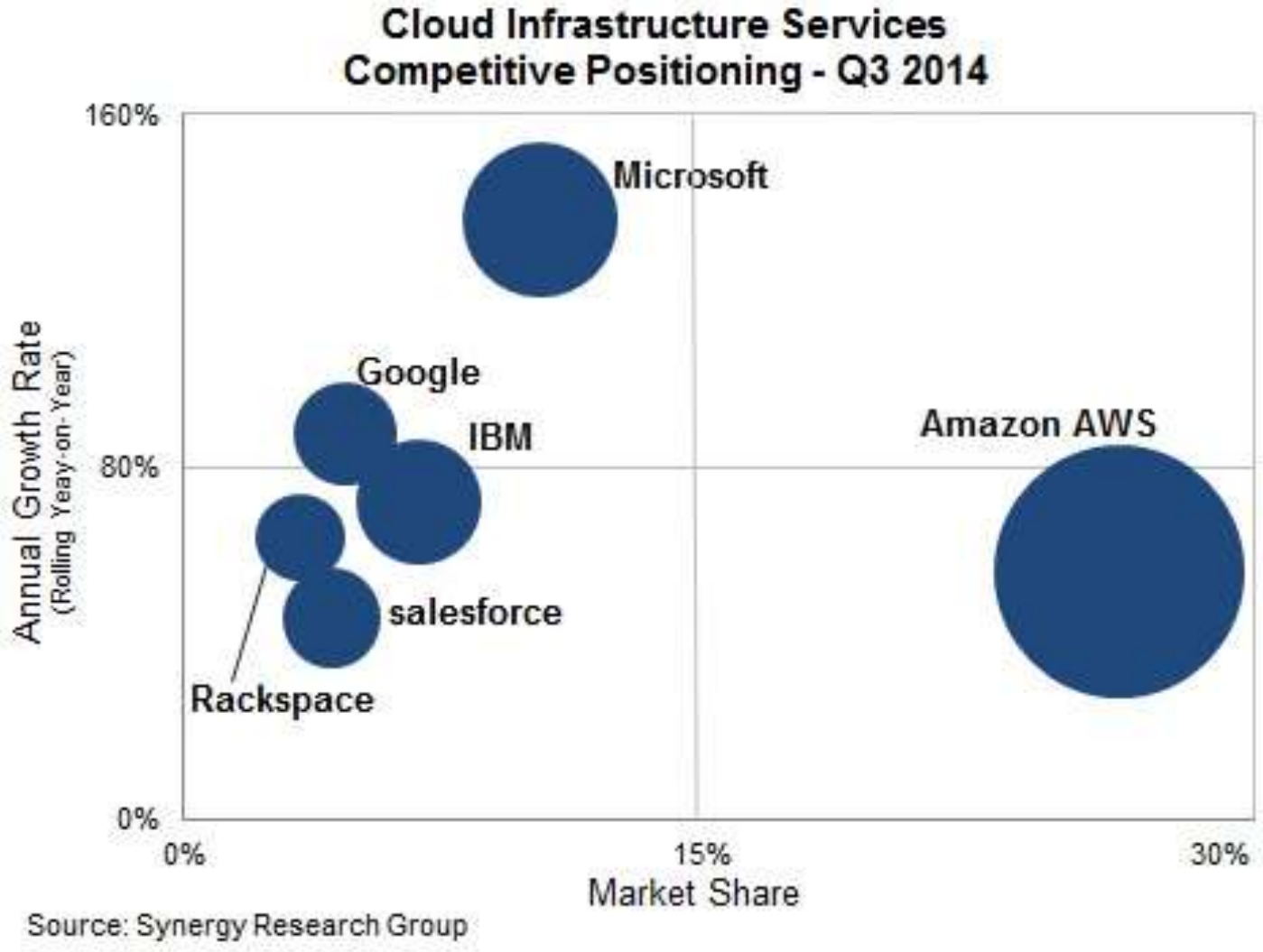
Gartner Magic Quadrants, the Race, 2013

Gartner Magic Quadrants, Catching Up, 2015

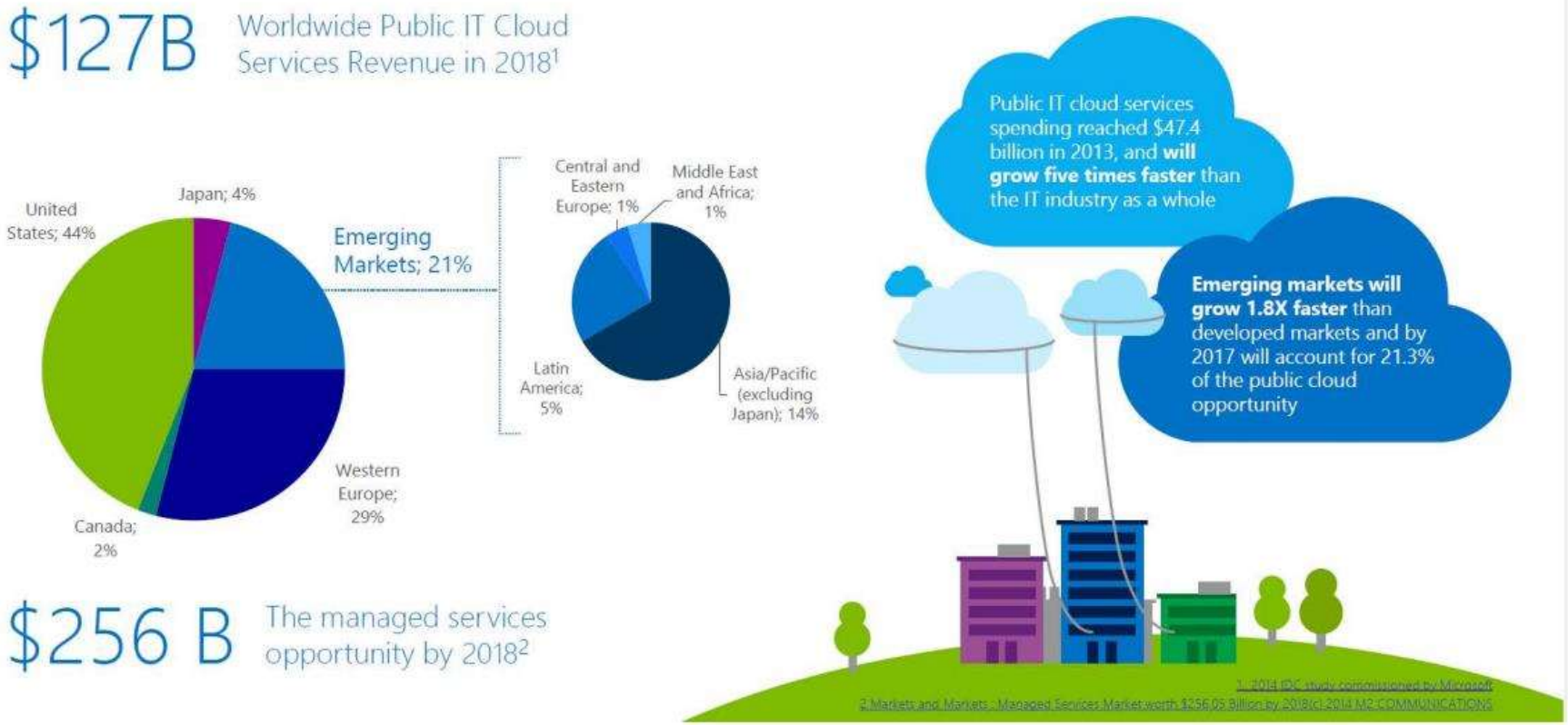


Gartner Magic Quadrant, Still Catching Up, 2017

Another View, Another Leader



Distribution by Markets



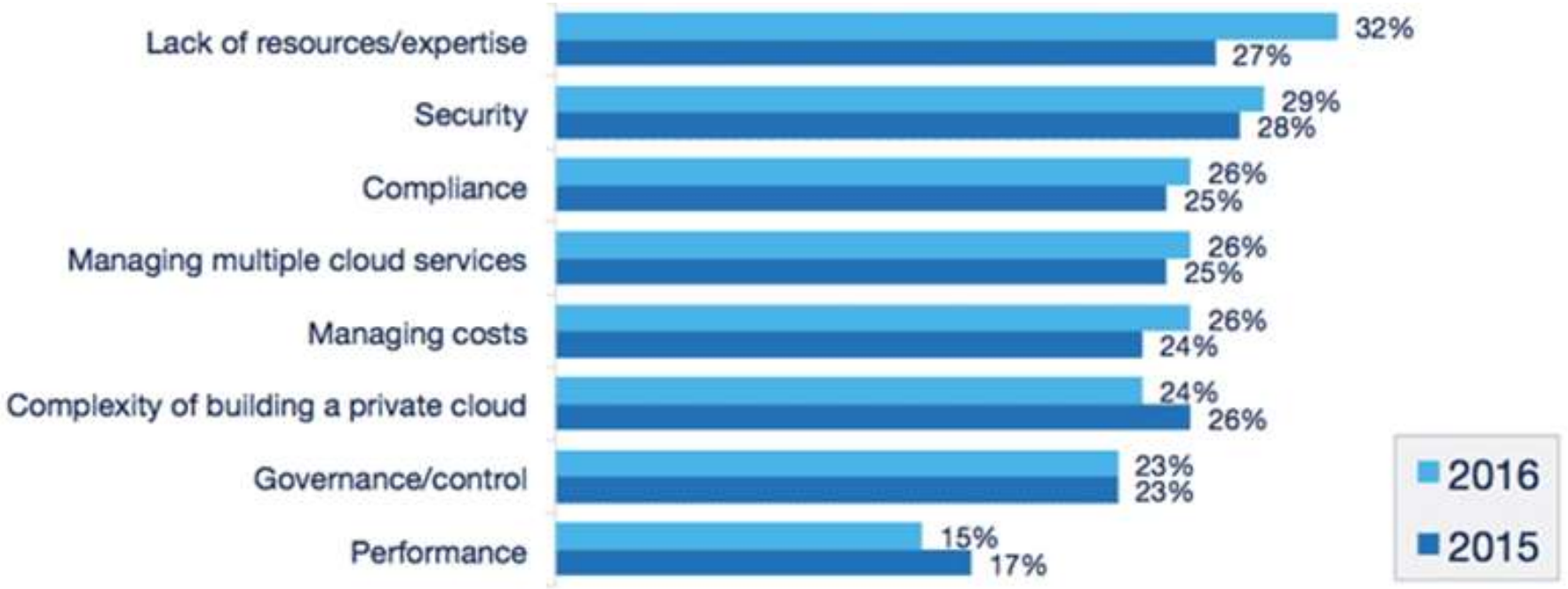
Cloud is Green, Some Additional Qualities

- Cloud wins by efficient resource use and efficient data centers
- GMAIL Example, http://www.google.com/green/pdfs/google-green-computing.pdf

Business Type	Number of users	# servers	IT Power per user	PUE (Power Usage effectiveness)	Total Power per User	Annual Energy per user
Small	50	2	8W	2.5	20W	175 kWh
Medium	500	2	1.8W	1.8	3.2W	28.4 kWh
Large	10000	12	0.54W	1.6	0.9W	7.6 kWh
Gmail (Cloud)	∞	∞	< 0.22W	1.16	< 0.25W	< 2.2 kWh

Data Center Part	Cost in small-sized Data Center	Cost in Large Data Center	Ratio
Network	**$95 per Mbps/month**	**$13 per Mbps/month**	**7.1**
Storage	**$2.20 per GB/month**	**$0.40 per GB/month**	**5.7**
Administration	**~140 servers/Administrator**	**>1000 Servers/Administrator**	**7.1**

Real or Perceived Challenges 2016 vs 2015



Source: RightScale 2016 State of the Cloud Report

Fear Mongering

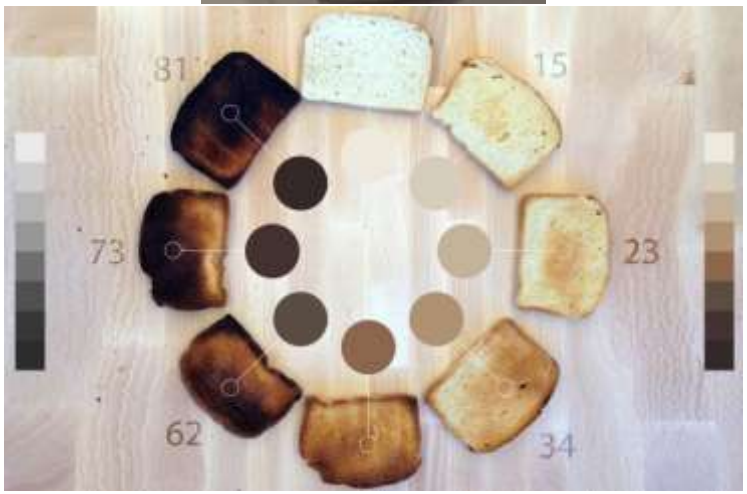
- Uncertainty related to novelty of Cloud Computing should be gone by now. Cloud is not a novelty any more.
  - Security problems are similar or identical to the ones on premise.
  - There are few new rules of regulatory compliance
- General fear of loss of control in the Cloud is not justified
  - Auditability is not an issue.
  - Regulatory compliance requires transparency into Cloud
- CREDIBILITY and TRUST of Cloud Provider are still critical issues
- Large enterprises are not testing the waters any more.
- GE will be completely in the Cloud.
- One has impression that only losers stay back.
- All US software based startups are in the Cloud.

Another Big Driver, Internet of Things

- The **internet of things** (**IoT**) is the network of physical devices, vehicles, buildings and other items embedded with electronics, software, sensors, actuators, and network connectivity that enable these objects to collect and exchange data. (Wikipedia.org).
- 2013 Global Standards Initiative on Internet of Things (IoT-GSI) defined the IoT as "the infrastructure of the information society."
- The IoT allows objects to be sensed and/or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems.
- When IoT is augmented with sensors and actuators, the technology becomes an instance of the more general class of computer-physical systems, which also encompasses technologies such as smart grids, smart homes, intelligent transportation and smart cities.
- Each THING is uniquely identifiable through its IP address and embedded computing system but is able to interoperate within the existing Internet infrastructure.
- Experts estimate that the IoT will consist of 50 billion objects by 2020

IoToasters, Nests and other Things

- When asked for an example of those Internet connected Things, most experts point to Toasters.

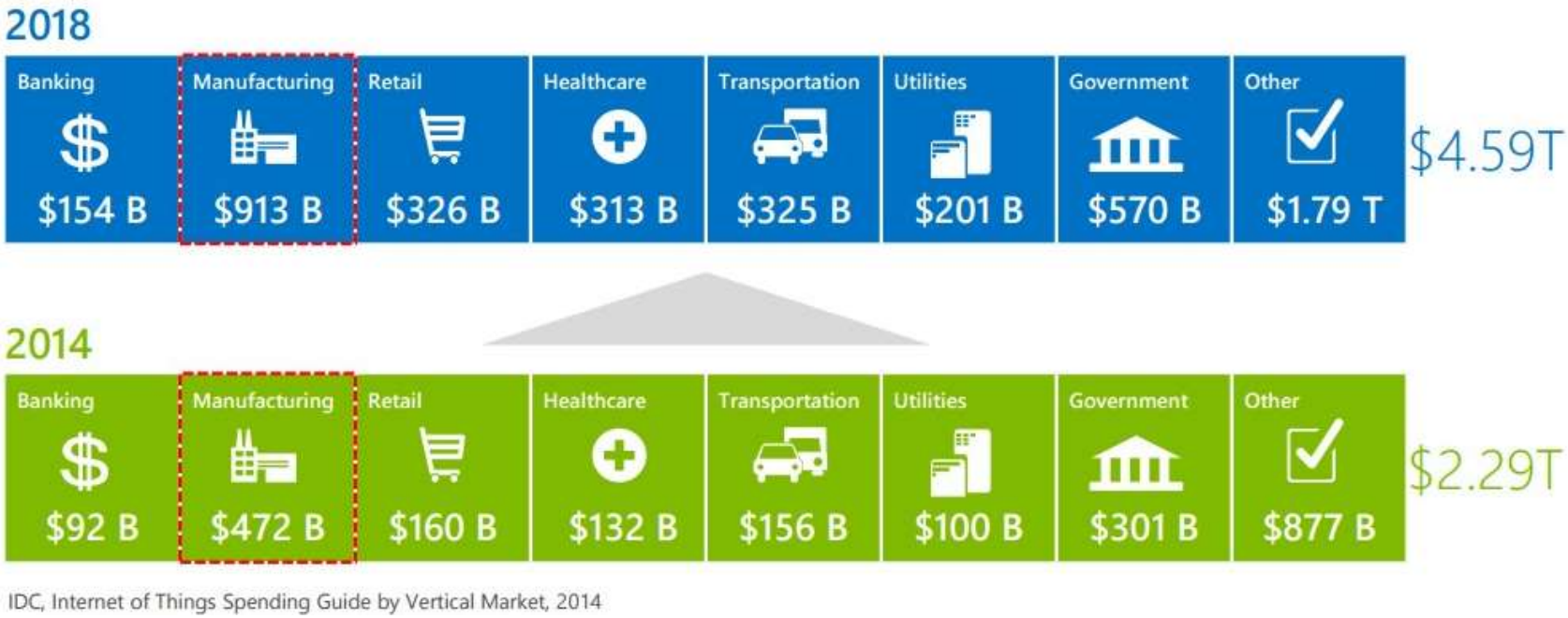


- By some sources, by 2025 there will be 5(0) billion Internet Enabled Toasters?
- As you are waking-up the toasters are toasting your bread to the color you prefer. Nests will raise the temperature of your home to your favorite temperature.

Things

- "Things," in the IoT sense, refer to a wide variety of devices such as heart monitoring implants, biochip transponders on farm animals, electric clams in coastal waters,[automobiles with built-in sensors, DNA analysis devices for environmental/food/pathogen monitoring or field operation devices, machine sensors and similar.
- These things (devices) collect useful data with the help of various existing technologies and then autonomously flow the data to and from other devices.
- Current market examples include smart thermostat (Nest) systems and washer/dryers that use Wi-Fi for remote monitoring.
- IoT is also expected to generate large amounts of data from diverse locations, with the consequent necessity for quick aggregation of the data, and an increase in the need to index, store, and process such data more effectively.
- IoT is one of the platforms of today's Smart City, and Smart Energy Management Systems.

More Forecasts, Revenue Opportunity

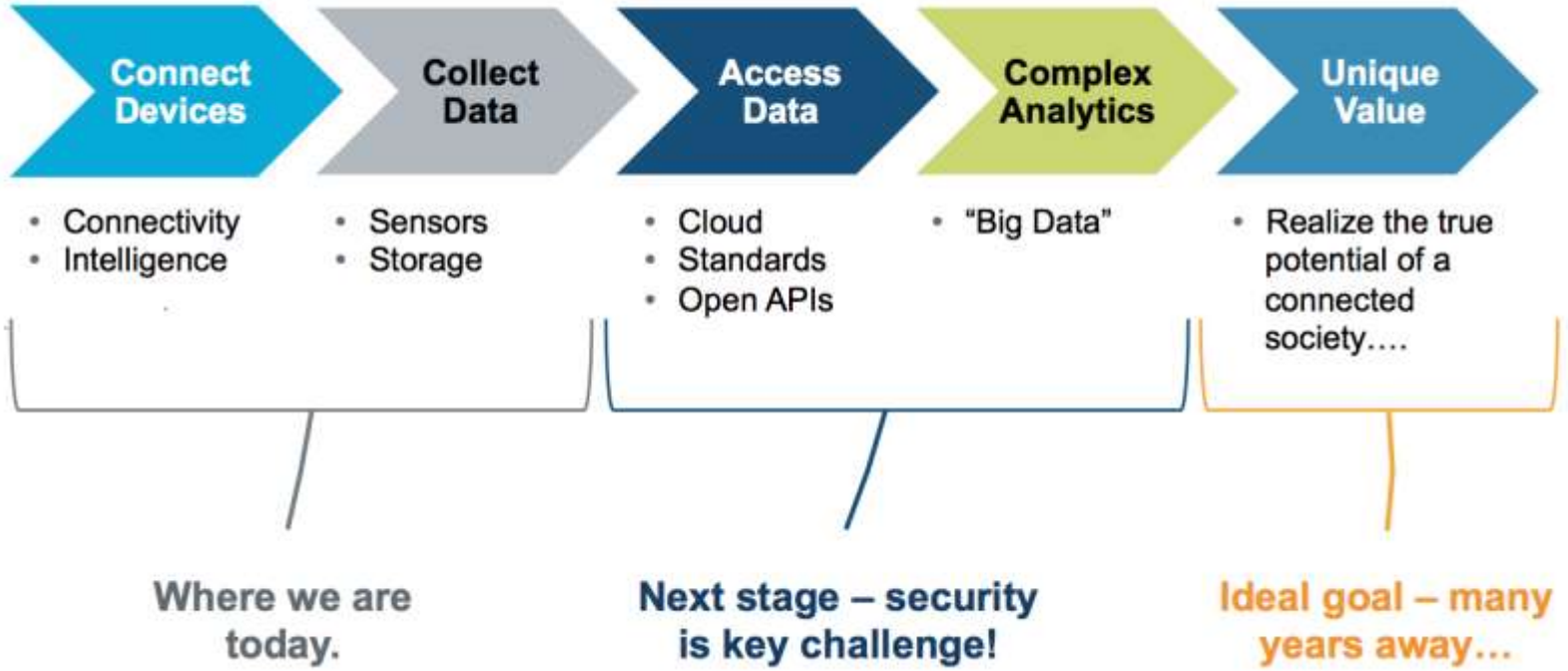


IDC, Internet of Things Spending Guide by Vertical Market, 2014

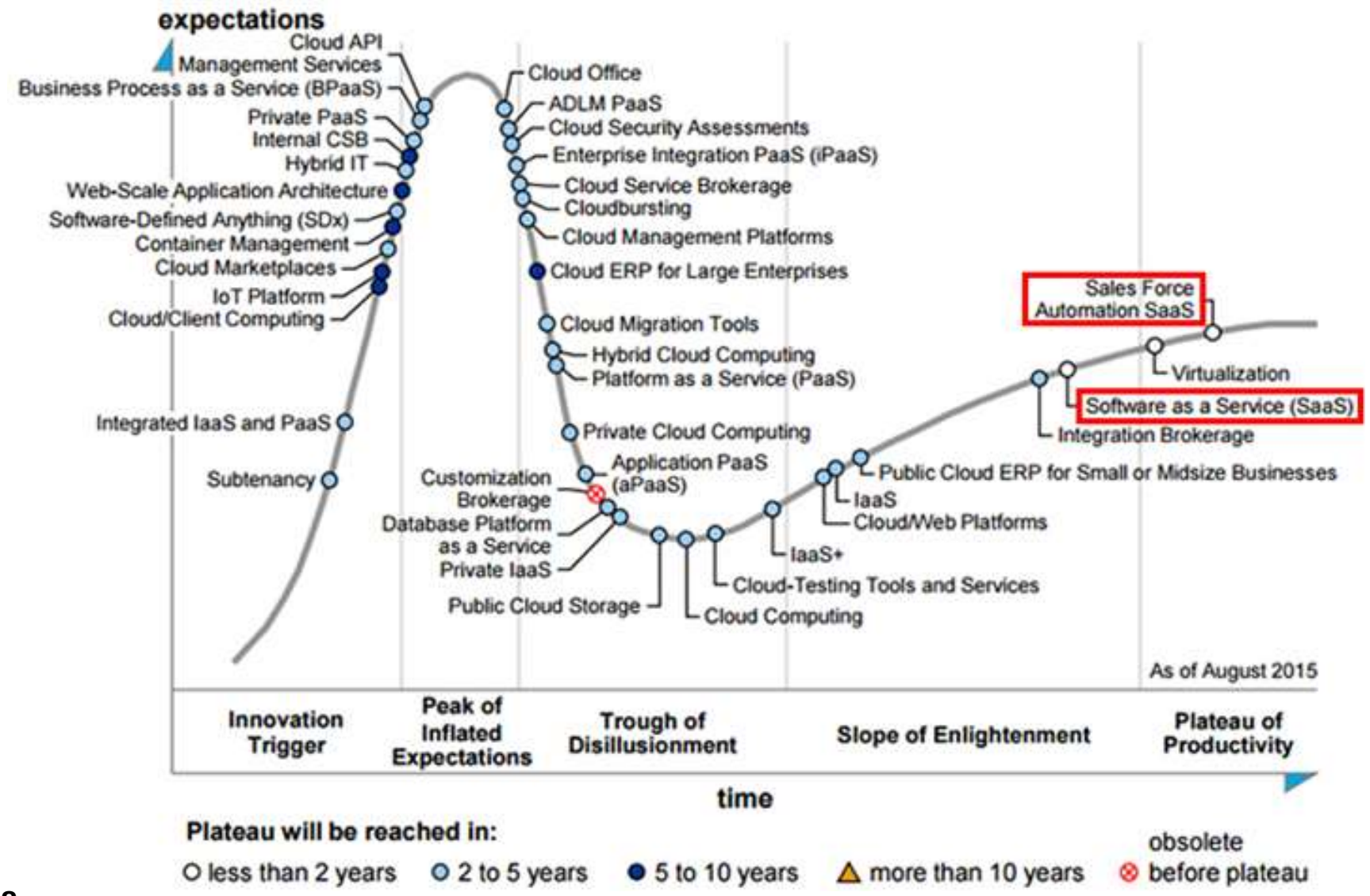
- These forecasts probably include everything that has I, O, or T in its name.

Evolution Stages, Io(Every)Thing

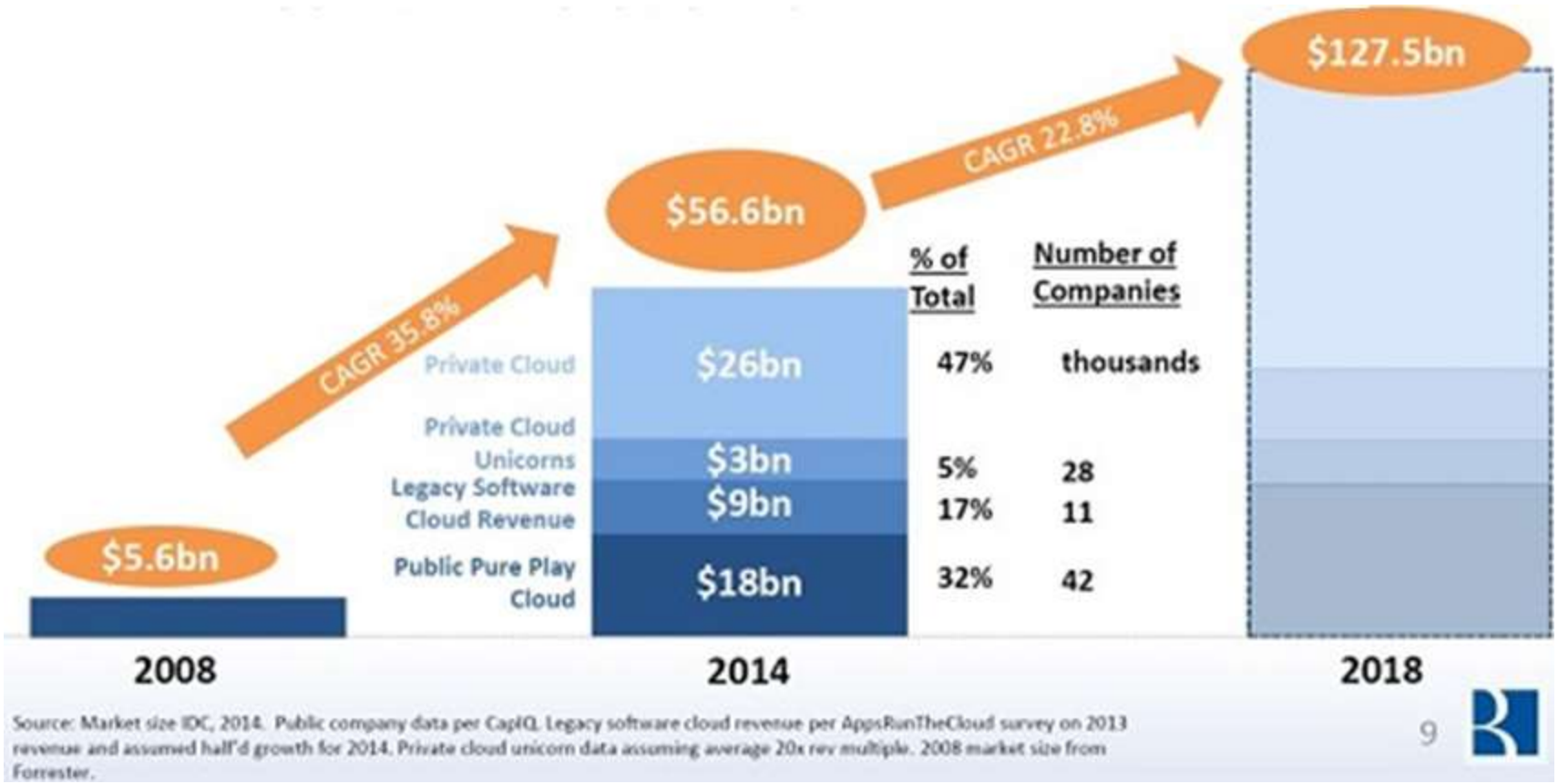
- Eventually we will all have chips embedded in most parts of our body and Insurance-Medical-Education Complex will be able to extract the Unique Value from all of us.



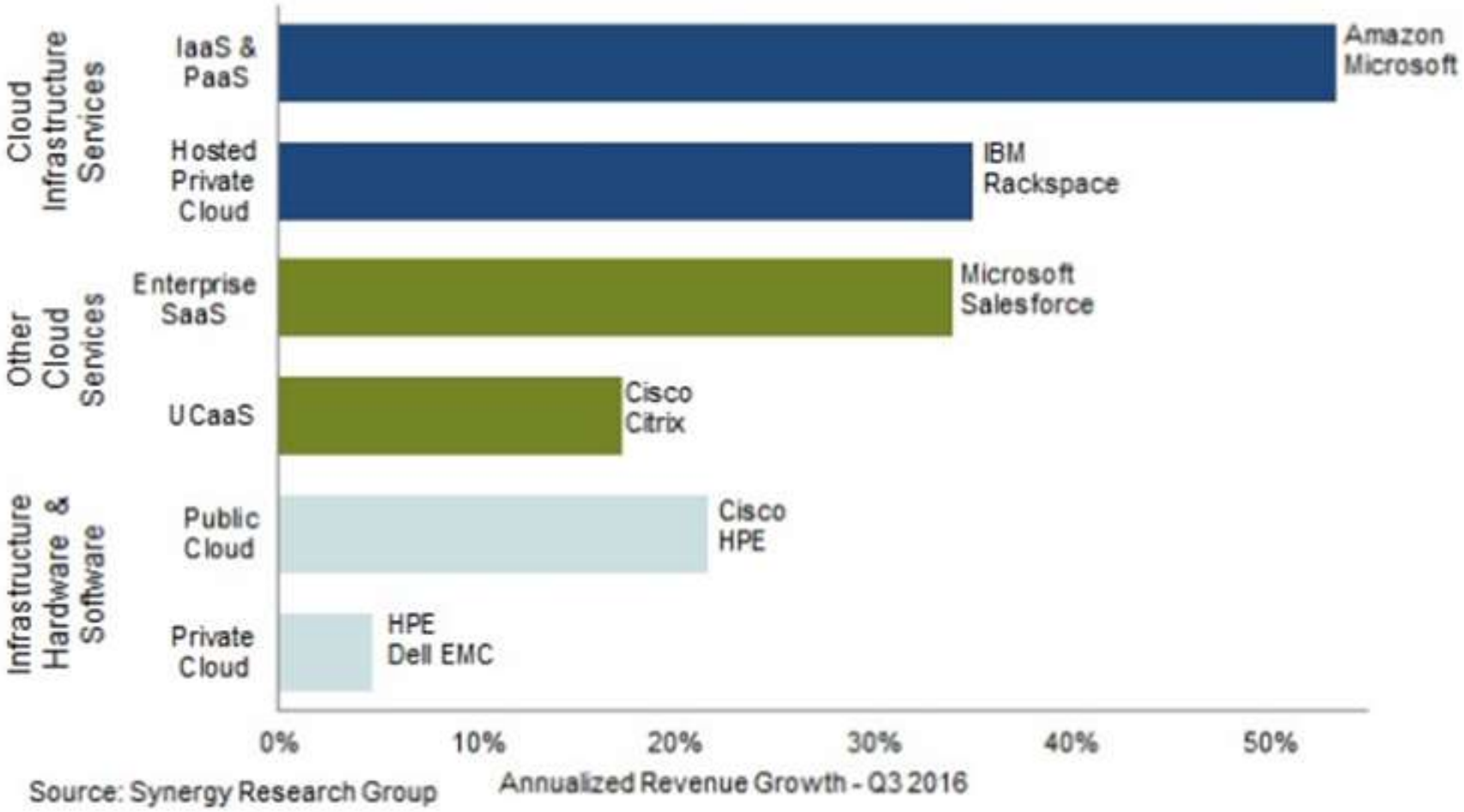
Gartner Hype Cycle for Cloud Computing 2015



Cloud Revenue, Up 10X in 6 years, 2X in next 4



Cloud Growth by Segments, Market Leaders



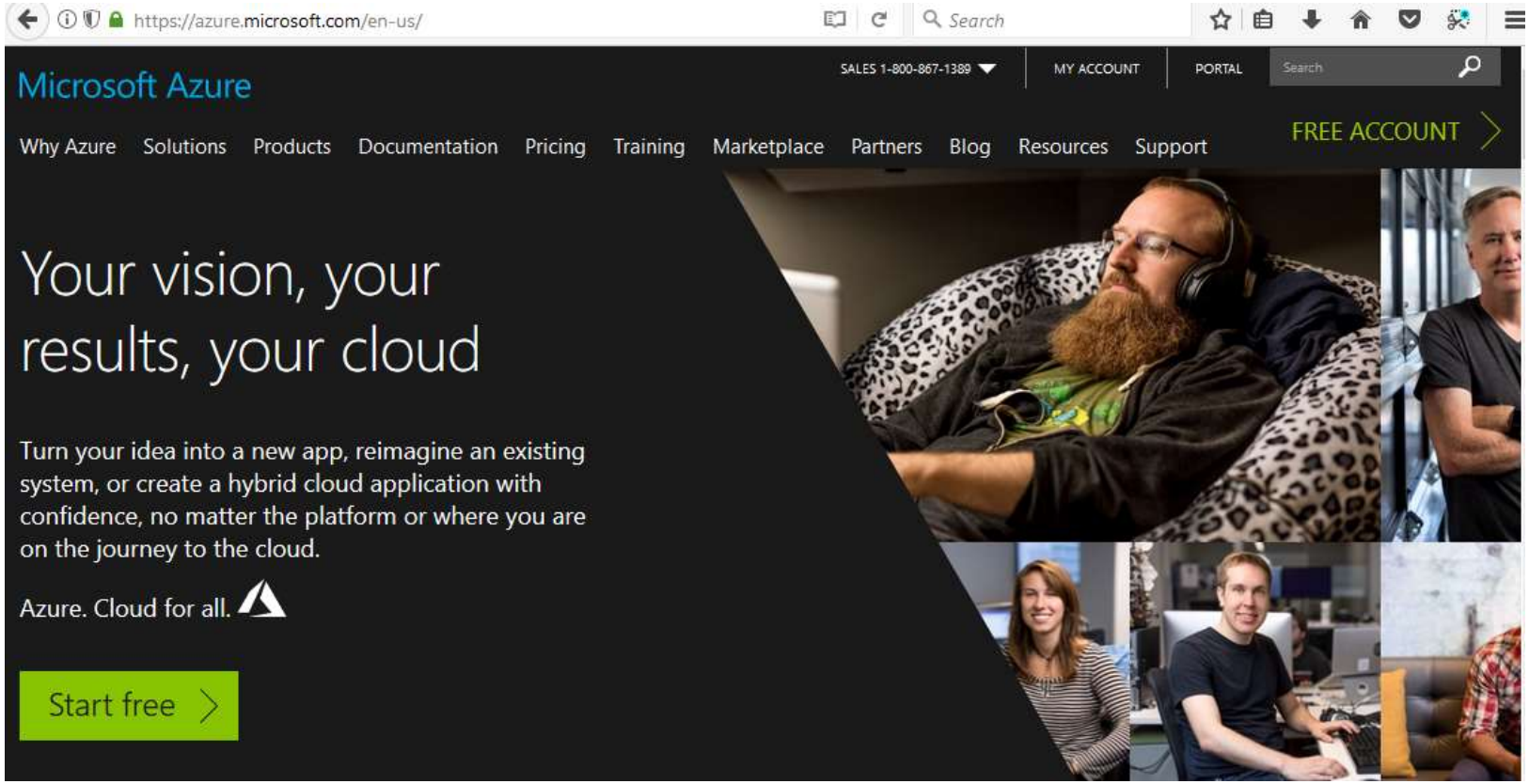
Microsoft Azure Itself

What is Microsoft Azure, wikipedia.org

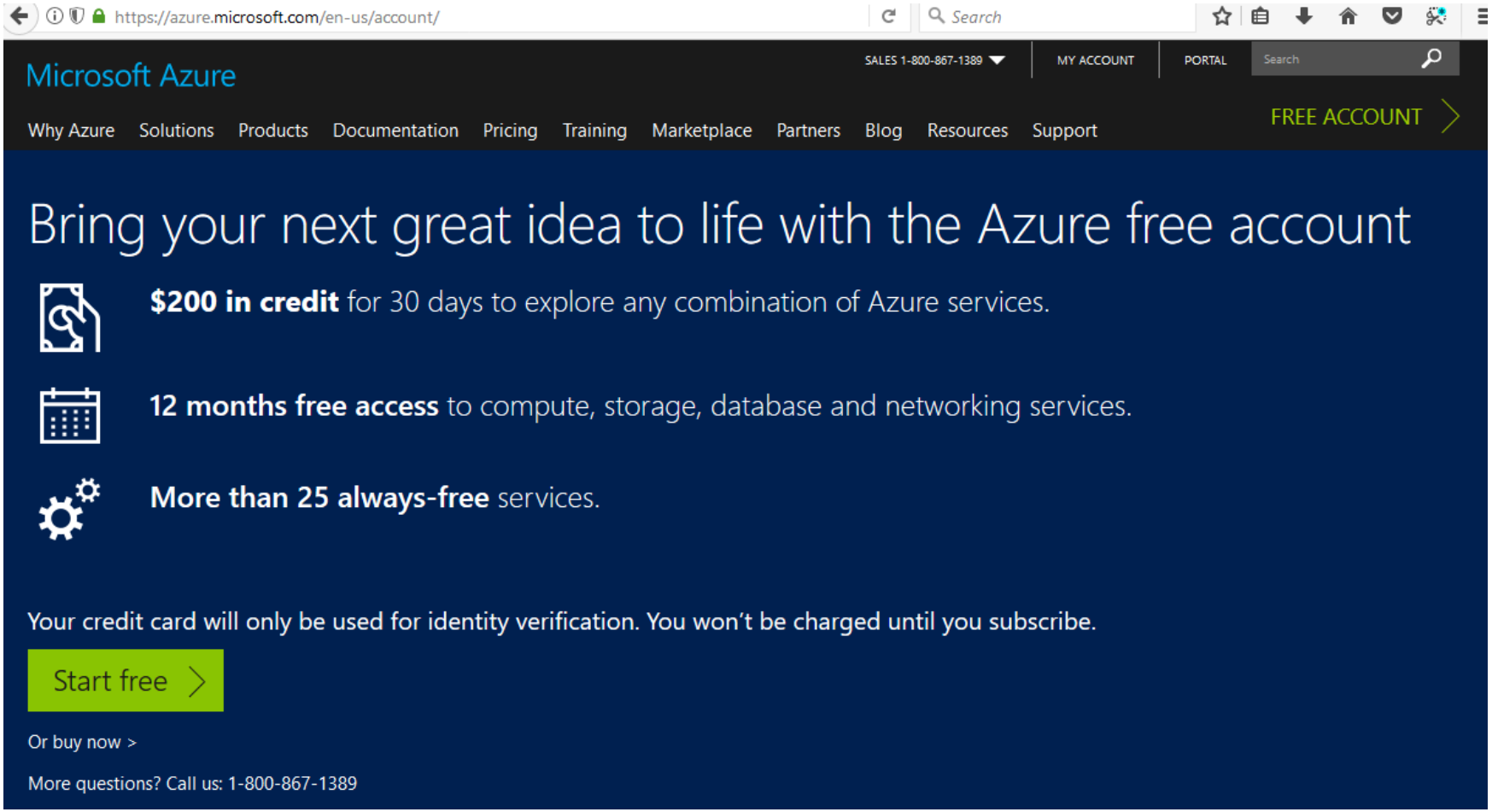
- **Microsoft Azure** (formerly **Windows Azure**) /ˈæʒər/ is a cloud computing service created by Microsoft for building, testing, deploying, and managing applications and services through a global network of Microsoft-managed data centers. It provides software as a service (SaaS), platform as a service and infrastructure as a service and supports many different programming languages, tools and frameworks, including both Microsoft-specific and third-party software and systems.
- Azure was announced in October 2008 and released on February 1, 2010 as "Windows Azure" before being renamed "Microsoft Azure" on March 25, 2014.

Azure Home Page

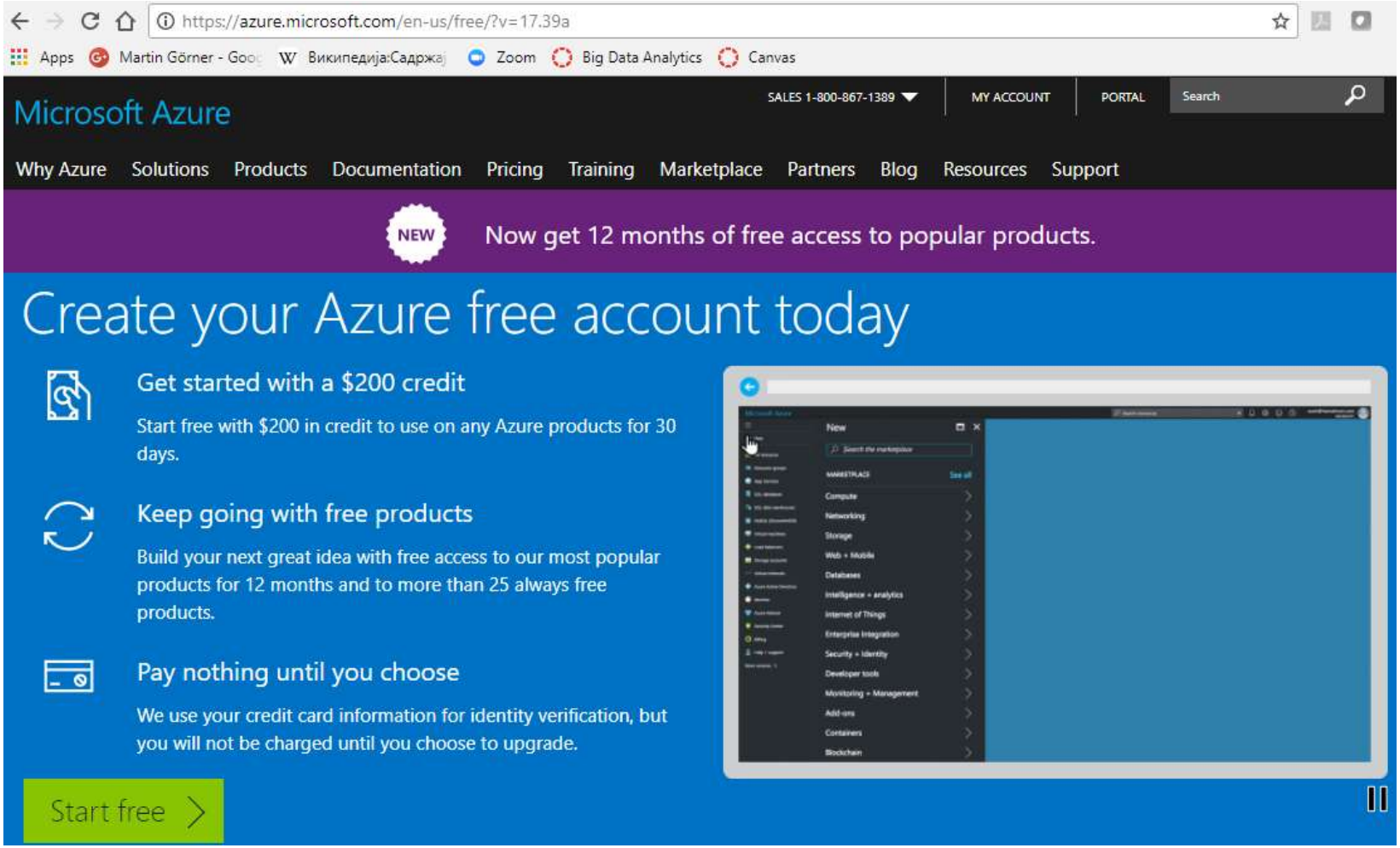
- To learn to use Azure, just go to `azure.com`, or `azure.microsoft.com`
- If you have doubts, select FREE ACCOUNT>



Azure free account

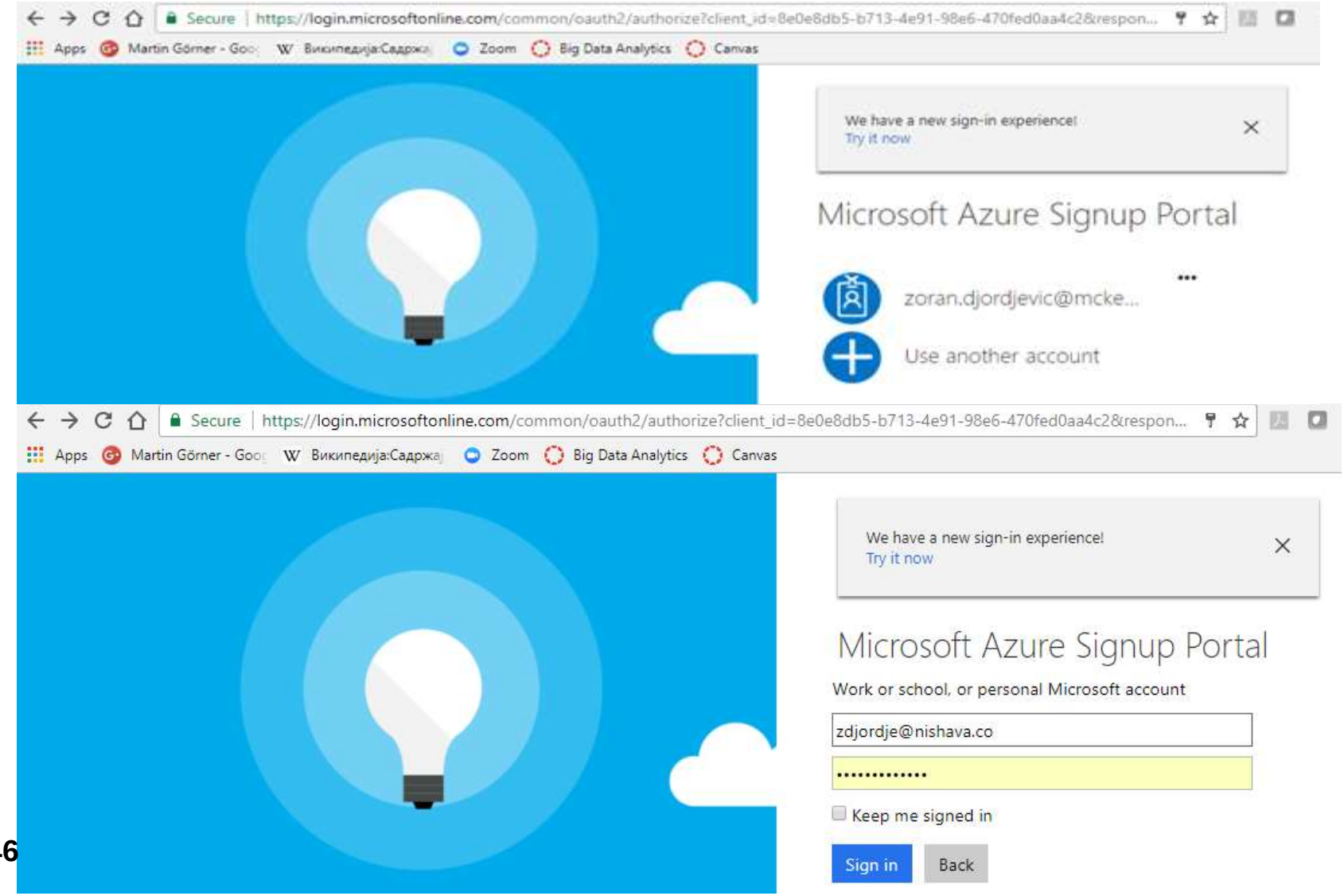


Free Account



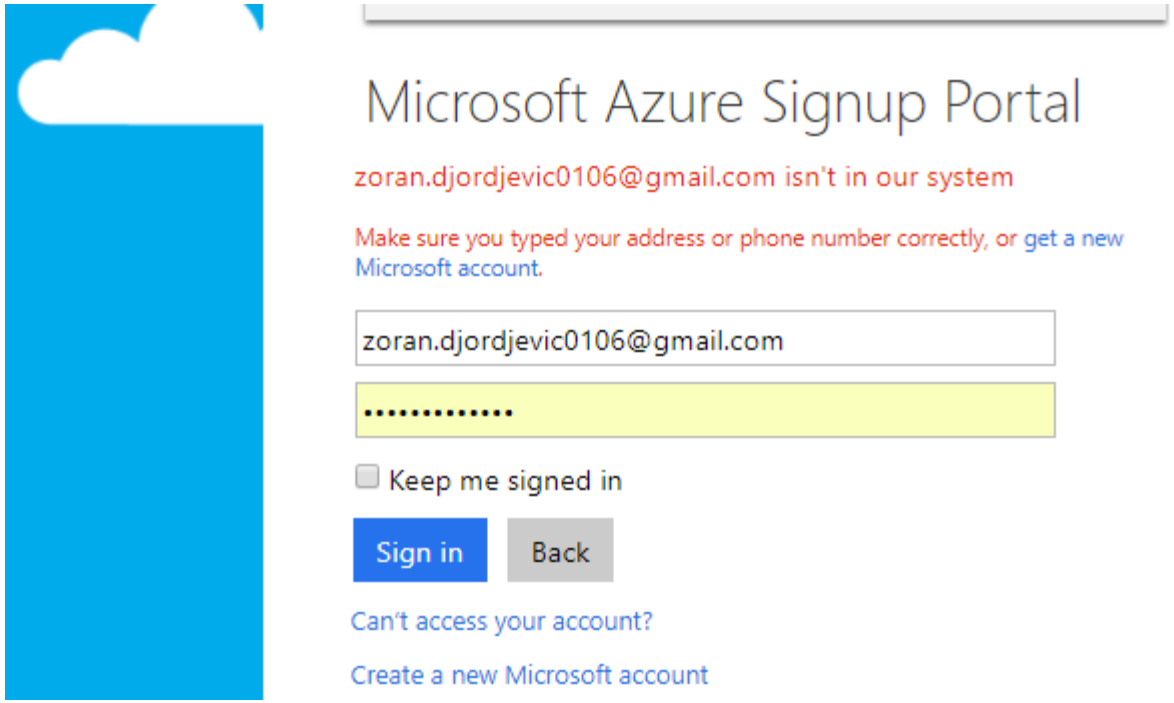
Use another account

- To get to the account you want, you might have to use another account



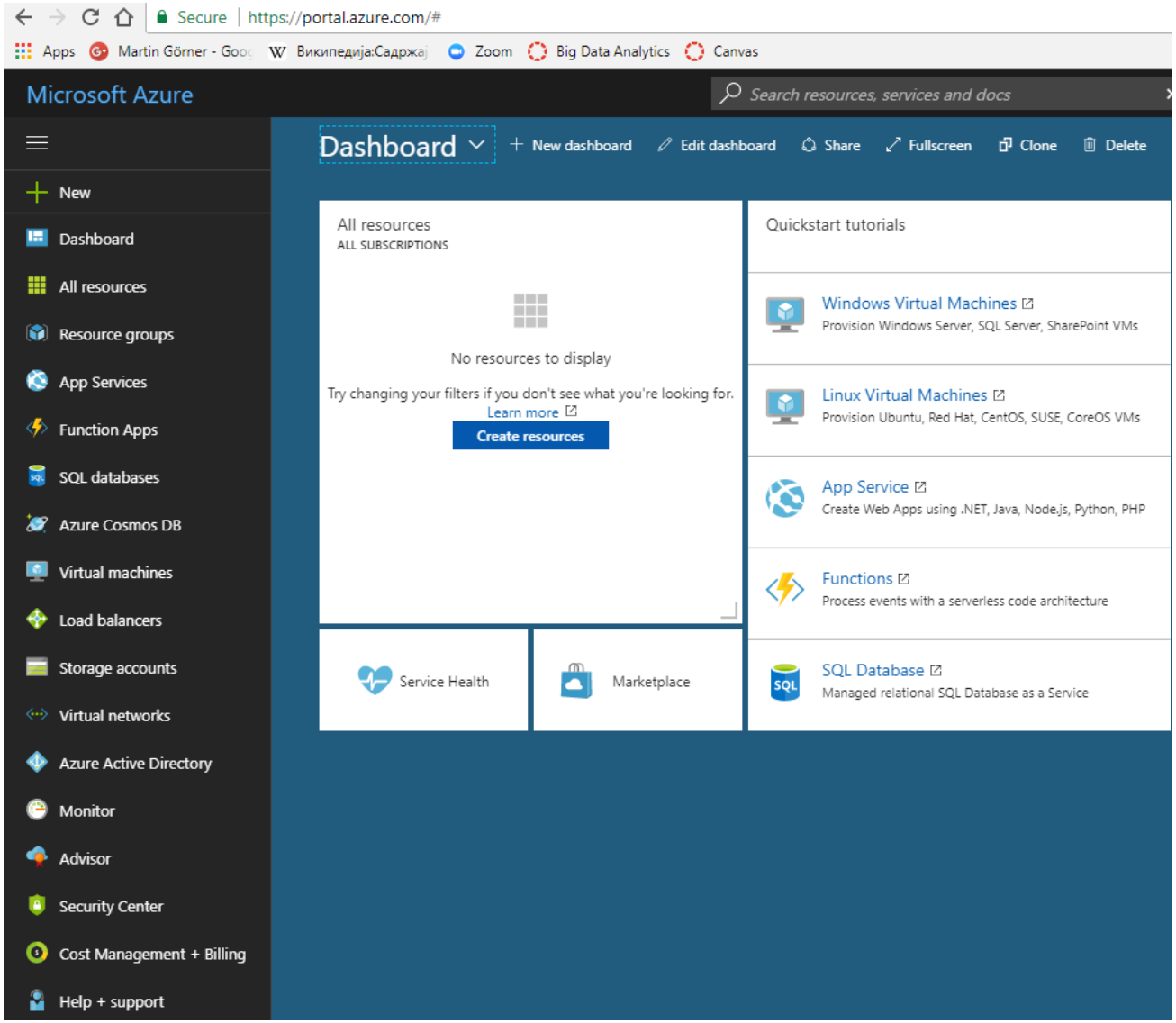
If you want to use free Azure offering

- If you are attempting to get into Azure Free Account, you might have to create a new Microsoft account.
- None of this is particularly painful. You just need a bit of patience.



Once you have an account, go to Portal

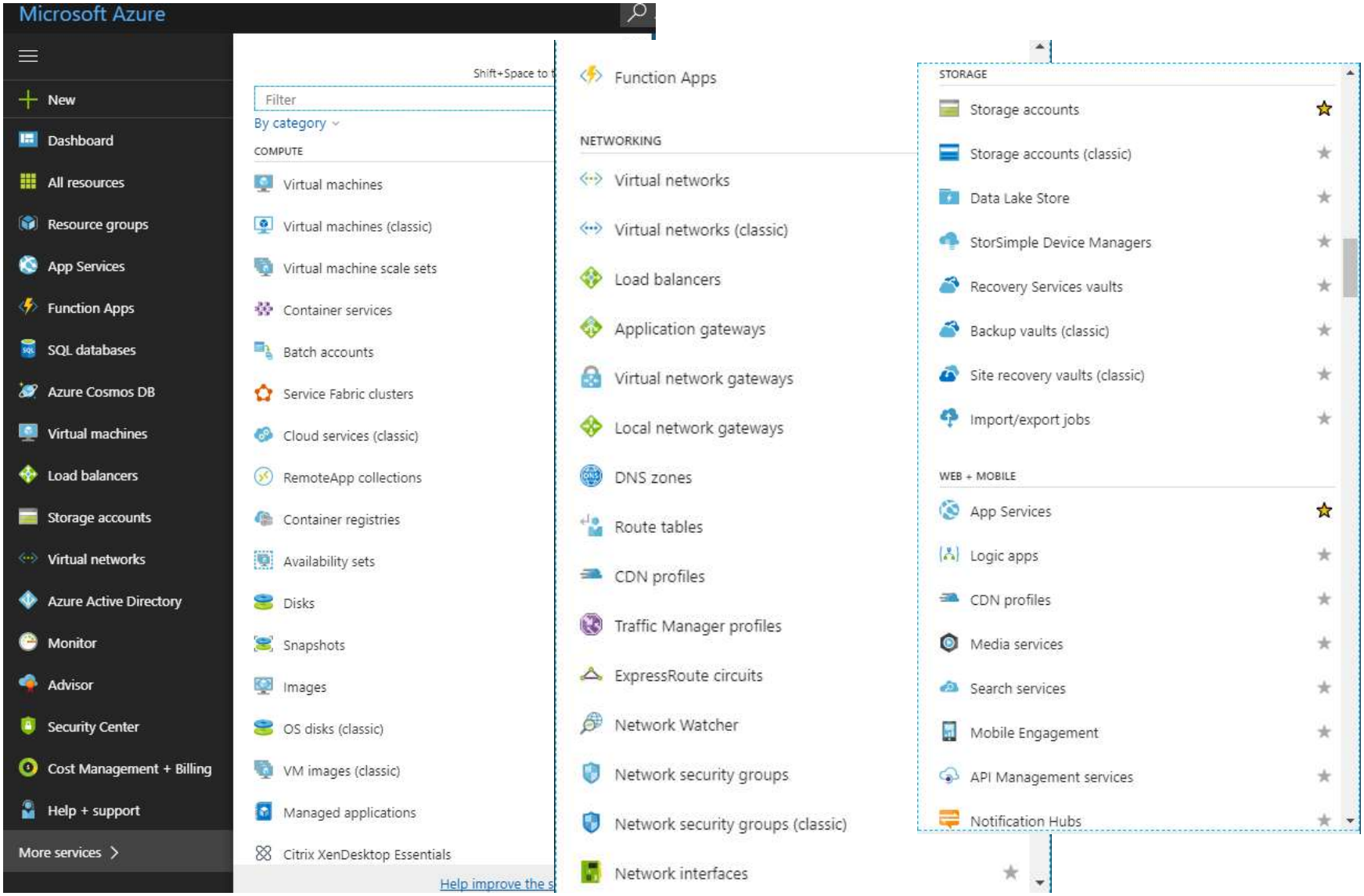
- Once you create an account, go to Portal directly.
- *(Management) Portal* is a Web interface that allows administrators to access and manage most, but not all Azure features.
- Microsoft typically releases the newer UI portal in beta before retiring an older one.



What is MS Azure Portal

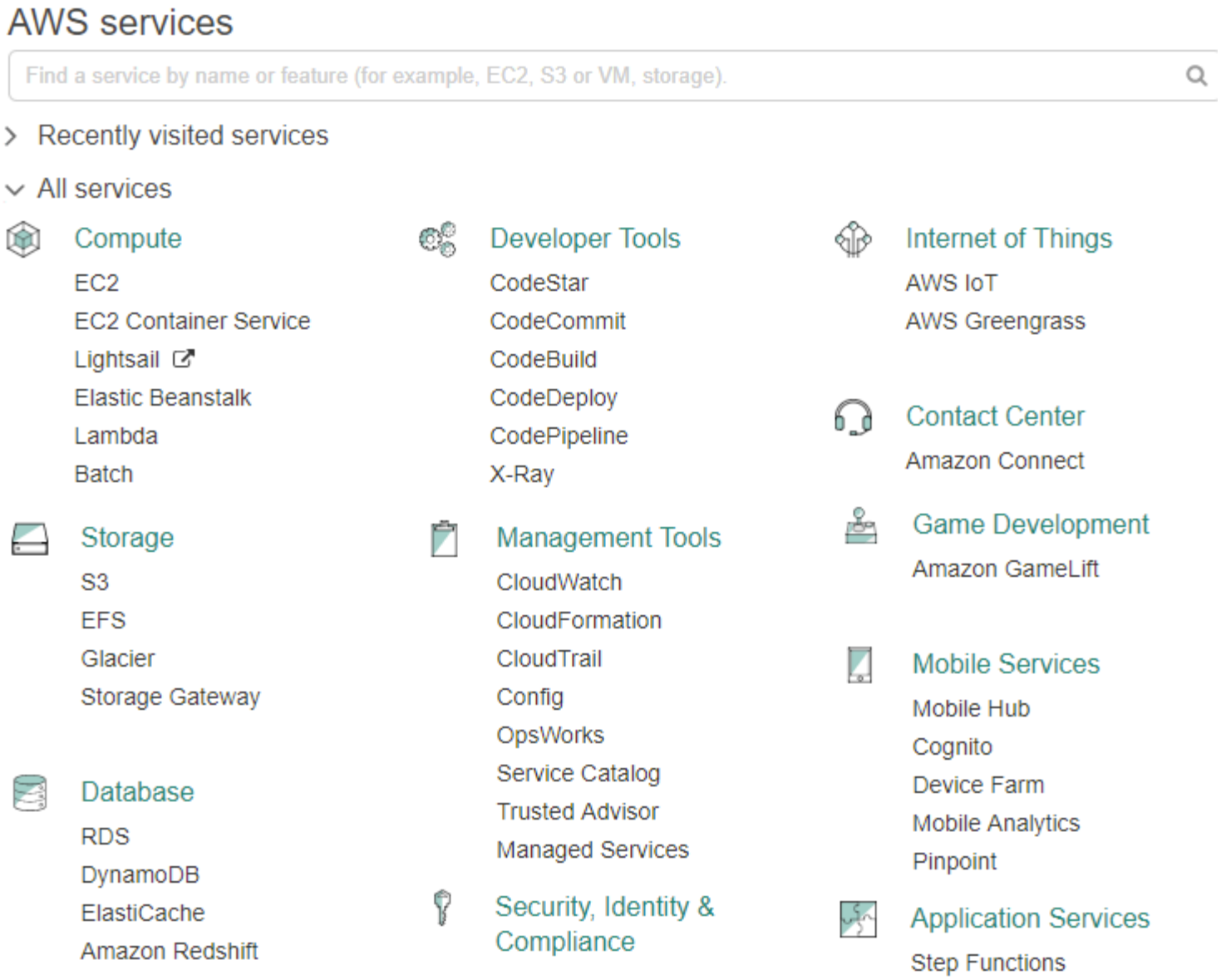
- The Microsoft Azure portal is a central place where you can provision and manage your Azure resources.
- Azure Portal is:
  - A **comprehensive marketplace** that lets you browse through thousands of items from Microsoft and other vendors that can be purchased and/or provisioned.
  - A **unified and scalable browse experience** that makes it easy to find the resources you care about and perform various management operations.
  - **Consistent management pages** (or blades) that let you manage Azure's wide variety of services through a consistent way of exposing settings, actions, billing information, health monitoring and usage data, and much more.
  - A **personal experience** that lets you create a customized start screen that shows the information that you want to see whenever you log in. You can also customize any of the management blades that contain tiles.

Many, Many Services



Why So Many Azure Services

- You might need them.
- Also, AWS might have more:



AWS Service, . . .

Networking & Content Delivery

VPC
CloudFront
Direct Connect
Route 53

Migration

AWS Migration Hub
Application Discovery Service
Database Migration Service
Server Migration Service
Snowball

IAM
Inspector
Certificate Manager
Directory Service
WAF & Shield
Artifact
Amazon Macie
CloudHSM

Analytics

Athena
EMR
CloudSearch
Elasticsearch Service
Kinesis
Data Pipeline
QuickSight
AWS Glue

Artificial Intelligence

Lex
Amazon Polly
Rekognition
Machine Learning

SWF
API Gateway
Elastic Transcoder

Messaging

Simple Queue Service
Simple Notification Service
Simple Email Service

Business Productivity

WorkDocs
WorkMail
Amazon Chime

Desktop & App Streaming

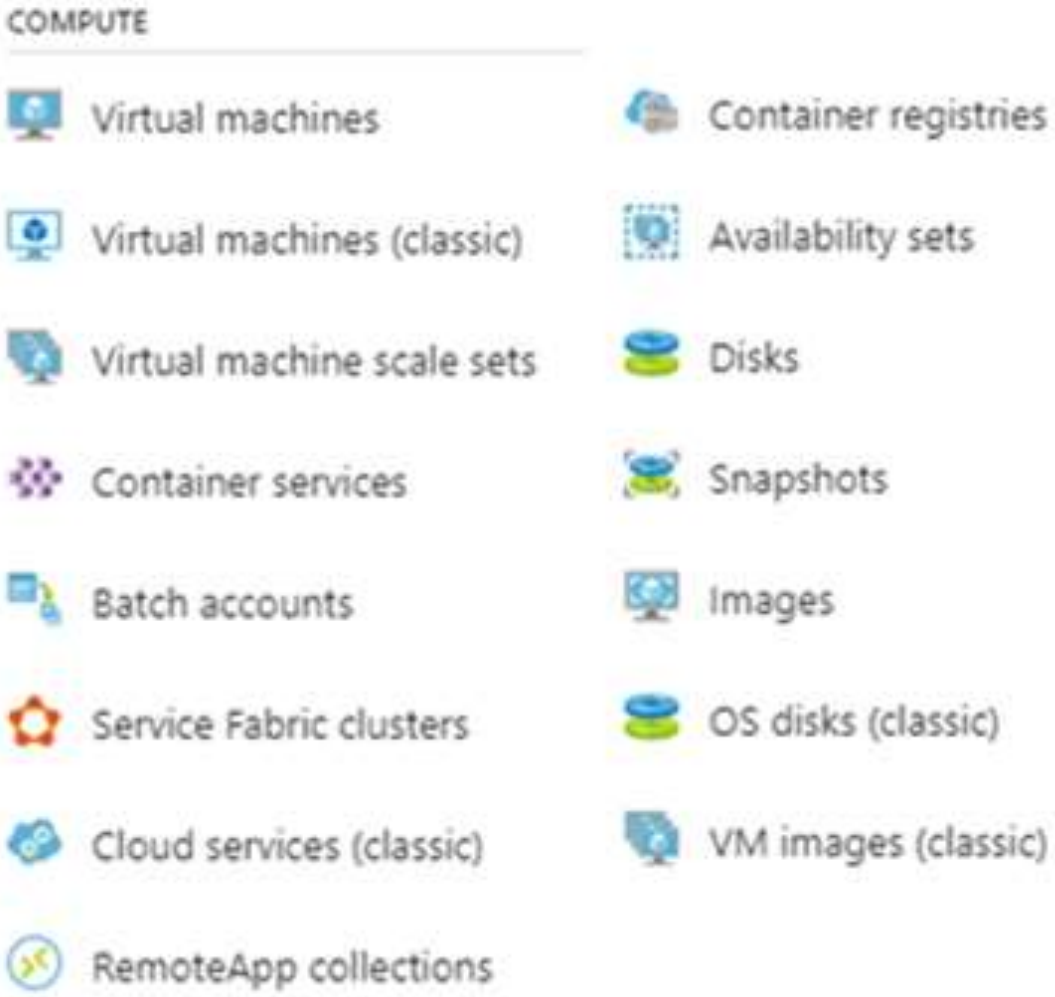
WorkSpaces
AppStream 2.0

Components of Azure

- Azure groups services into categories in the Management Portal and on various visual aids.
- These are many main groups of services.
- We cannot review them all.
- We will become familiar with some of those categories and services as we practice with them.
- Many more services you will discover only when a specific problem forces you to use them.
- In what follow we will give a brief description of a few “main” categories of services

Compute Services

- The most basic function of a Cloud platform is to executes applications.
- Cloud computes. Azure has many compute models and each has its own role.

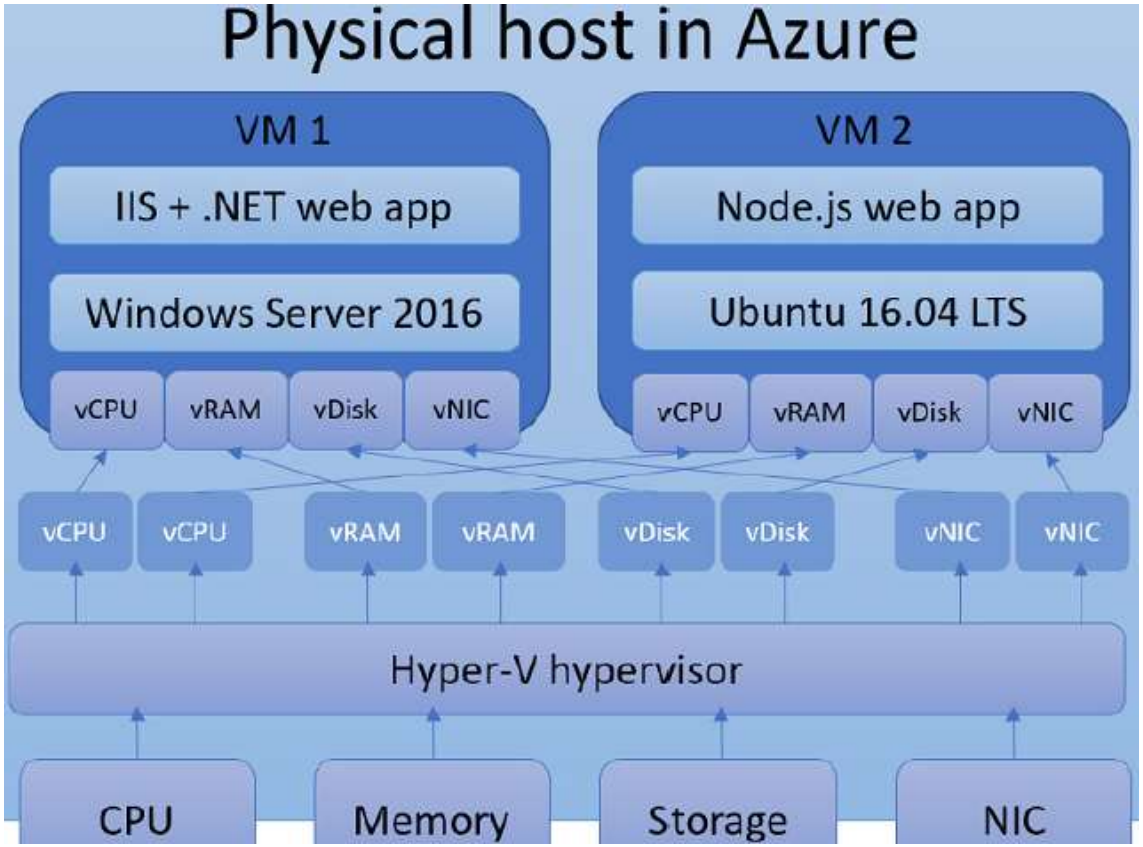


Azure Virtual Machines

- The ability to create a virtual machine on demand, whether from a standard image or from one you supply, is perhaps the most essential function of a Cloud service.
- Images of VMs are called VHDs (Virtual Hard Drives) . To create a VM, you specify which VHD to use and the VM's size and other properties and Cloud provider instantiates the Virtual Machine on your behalf.
- You pay for the time that the VM is running. With Azure you pay by the minute and only while VM is running, though there is a minimal storage charge for keeping the VHD available. Some other providers will charge you for hour of usage even if you used the VM only a few minutes.
- Azure offers a gallery of stock VHDs (called "images") that contain a bootable operating system to start from. These include Microsoft and partner VMs, such as Windows Server and Linux, SQL Server, Oracle and many others.
- We can create VHDs and images, and then upload them to the Cloud ourselves. We can even upload VHDs that contain only data and then access data from other running VMs.

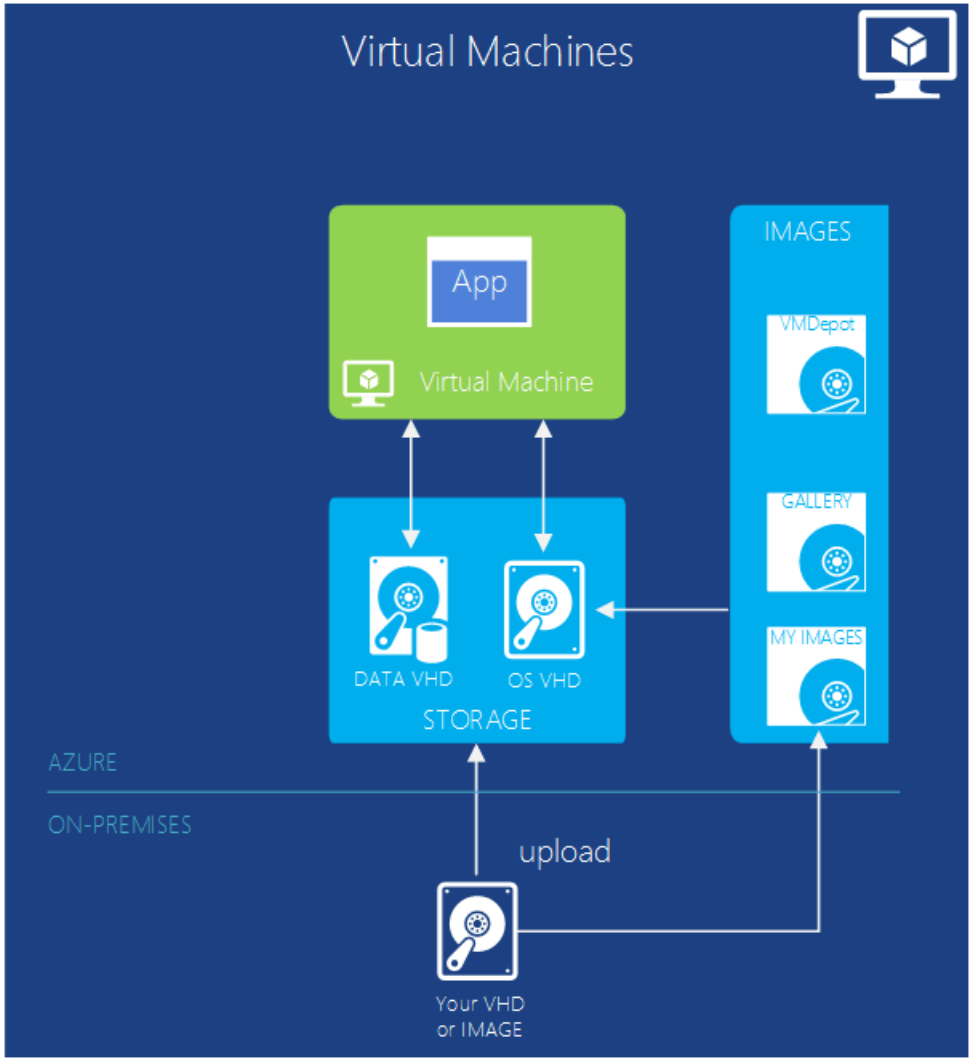
Virtualization in Azure

- Virtualization is the real magic behind Azure and the Cloud technology.
- Virtualization logically divides physical resources of a server into virtual resources that can be securely accessed by individual workloads.
- A virtual machine (VM) contains a virtual CPU (vCPU), memory (vRAM), storage (vDisk), and network connectivity (vNIC) as show in figure bellow



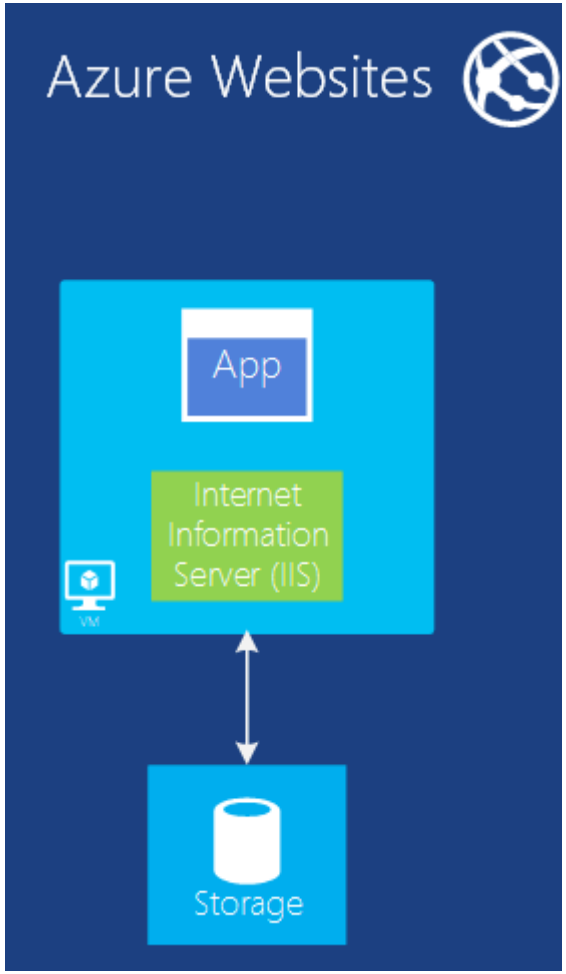
Azure Virtual Machines

- The figure shows how a Virtual Machine (VM) is created from a Virtual Hard Drive (VHD).
- Wherever the VHD comes from, you can persistently store any changes made while a VM is running.
- The next time you create a VM from that VHD, things pick up where you left off. The VHDs that back the Virtual Machines are stored in Azure Storage blobs.



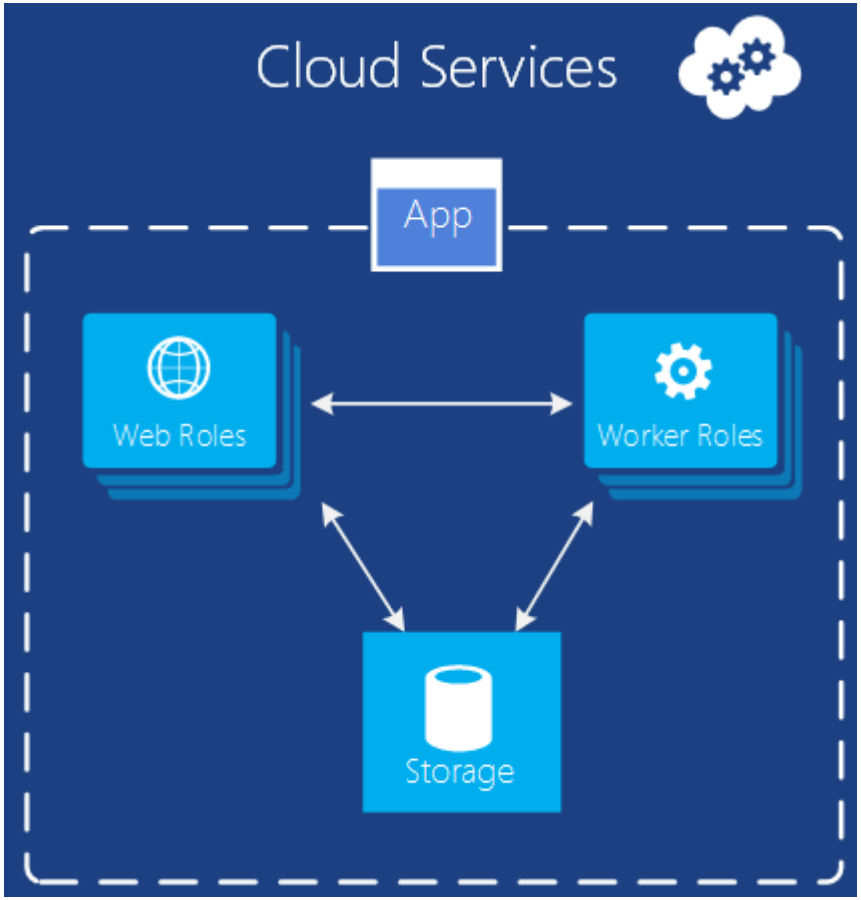
App Services

- App Services allow you to create, build, deploy, and manage powerful web, mobile, and API apps using a single back-end.
- In Azure we build standards-based web apps and APIs using .NET, Java, Node.js, PHP, and Python.
- This compute model offers a managed web environment using the Azure Management portal as well as APIs.
- We can move an existing website application into Web Apps unchanged, or you can create a new one directly in the cloud.
- Once a website is running, you can add or remove instances dynamically, relying on Azure Web Apps to load balance requests across them.



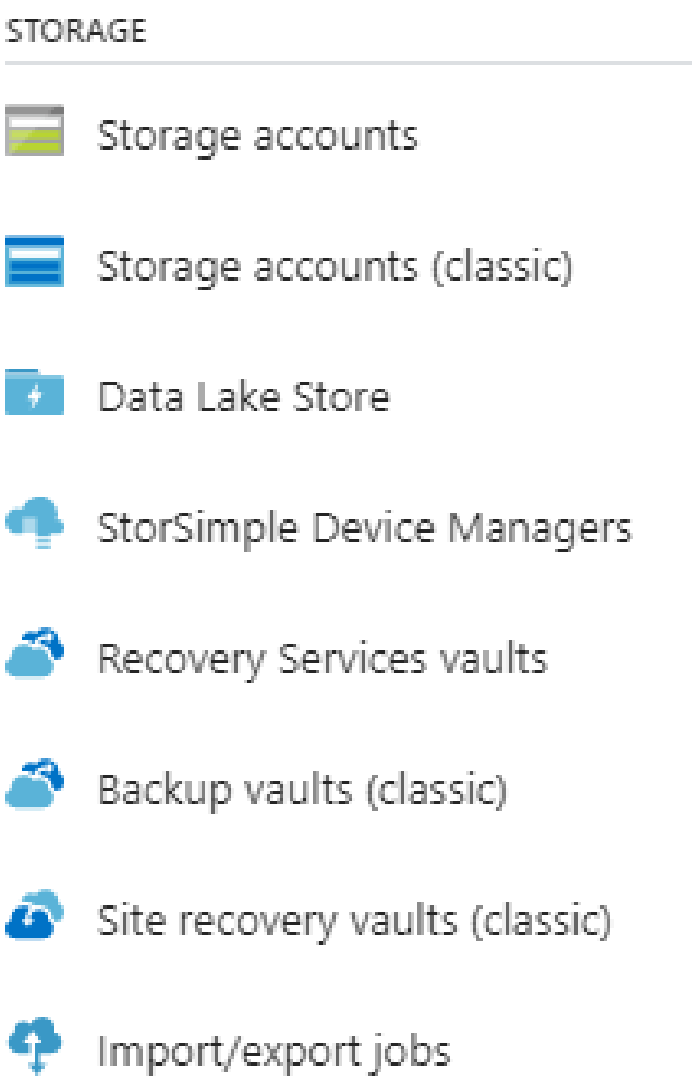
Cloud Services

- Azure Cloud Services provides a place to run highly scalable custom code on a Platform as a Service (PaaS) environment.
- If you want to build a cloud application that can support lots of simultaneous users, doesn't require much administration, and never goes down use Azure Cloud Services.
- To use it, you create an application using the technology you choose, such as C#, Java, PHP, Python, Node.js, or something else. Your code then executes in virtual machines (referred to as instances) running a version of Windows Server.
- These VMs are distinct from the ones you create with Azure Virtual Machines. For one thing, Azure itself manages them, doing things like installing operating system patches and automatically rolling out new patched images. This implies that your application shouldn't maintain state in web or worker role instances.
- Worker role does not run an IIS.



Storage Management

- Applications need data, and different kinds of applications need different kinds of data. Because of this, Azure provides several different ways to store and manage data.
- Azure provides many storage options.
- All are designed for very durable storage.
- With any of these options, there are always 3 copies of your data kept in sync across an Azure datacenter -- 6 if you allow Azure to use geo-redundancy to back up to another datacenter at least 300 miles away.



Storage Accounts

- A storage account can store up to 500TB of data in the cloud.
- Use a general-purpose storage account to store object data, use a NoSQL data store, define and use queues for message processing, and set up file shares in the cloud.
- Use the Blob storage account and the hot or cool access tiers to optimize your costs based on how frequently your object data is accessed.

Storage Types

File

- Simple, distributed, cross-platform file system
- Lift and shift migration
- Simple and inexpensive
- Move data to cloud with no coding

Disk

- Premium storage for I/O-intensive applications
- Low latency, high throughput
- Automatic triple replication
- Enterprise-grade durability

Blob

- Massively-scalable object storage for unstructured data
- Cost-effective for massive volume
- Tiered storage options
- Single infrastructure with global reach

Queue

- Durable queues for large-volume cloud services
- Simple, cost-effective messaging
- Decoupled component flexibility
- Resilient scaling and buffering

Table

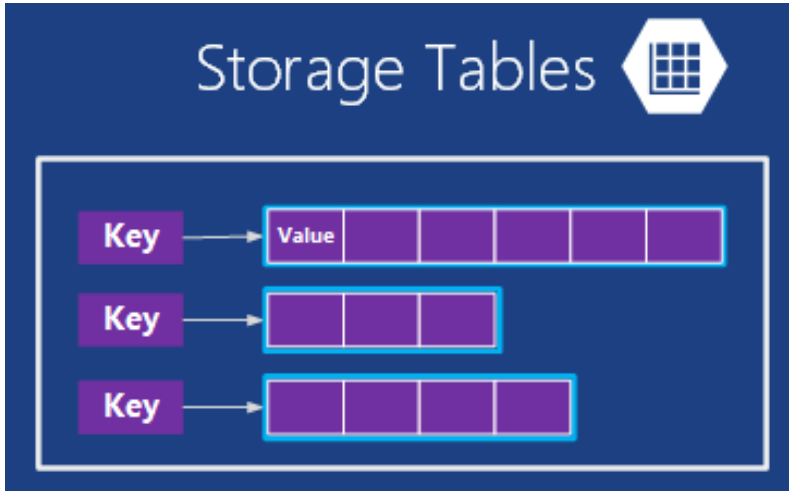
- Flexible NoSQL database
- Key-value table storage
- Structured or unstructured data
- Low latency at Internet scale

Blobs

- Azure Blobs (again "Blob Storage" and just "Storage Blobs" are the same thing) is designed to store unstructured binary data. Like Tables, Blobs provides inexpensive storage, and a single blob can be as large as 1TB (one terabyte). Azure applications can also use Azure drives, which let blobs provide persistent storage for a Windows file system mounted in an Azure instance. The application sees ordinary Windows files, but the contents are actually stored in a blob.+
- Blob storage is used by many other Azure features (including Virtual Machines), so it can certainly handle your workloads too.
- **Scenarios for Blobs**
- An application that stores video, massive files, or other binary information can use blobs for simple, cheap storage. Blobs are also commonly used in conjunction with other services like Content Delivery Network, which we will talk about later.

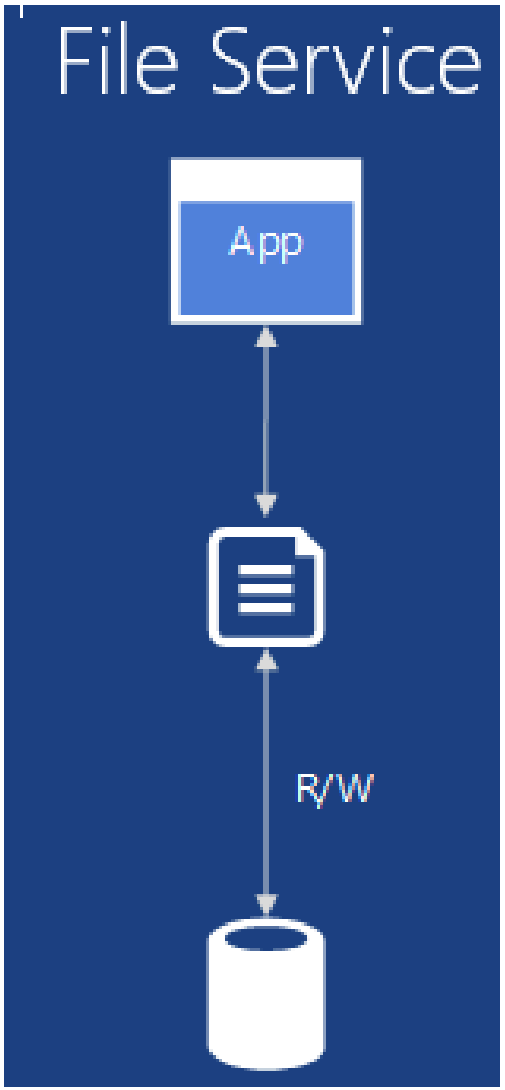
Tables

- *Figure: Azure Tables provides a flat NoSQL way to store data.*
- Azure Tables do not provide relational storage. In fact, it's an example of a NoSQL approach called a key/value store. Azure Tables let an application store properties of various types, such as strings, integers, and dates. An application can then retrieve a group of properties by providing a unique key for that group. While complex operations like joins aren't supported, tables offer fast access to typed data. They're also very scalable, with a single table able to hold as much as a terabyte of data. And matching their simplicity, tables are usually less expensive to use than SQL Database's relational storage.+



File Service

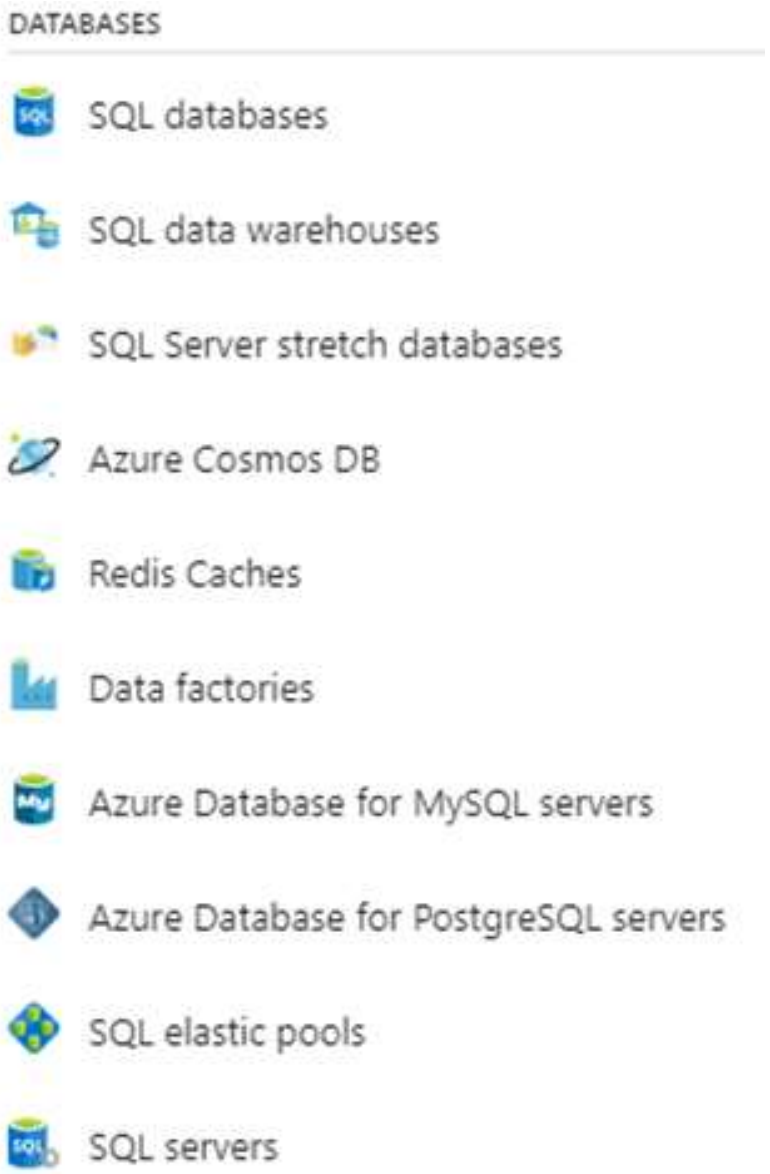
- On-premise, it's common to have large amounts of file storage accessible through the Server Message Block (SMB) protocol using a \\Server\share format.
- Azure now has a service that allows you to use this protocol in the cloud. Applications running in Azure can use it to share files between VMs using familiar file system APIs like ReadFile and WriteFile and a REST interface.
- Azure Files is built on top of the blob service, so it inherits the same availability, durability, scalability, and geo-redundancy built into Azure Storage.



\\myaccount.file.core.windows.net\MyShare

Database Management

- If you're creating an Azure application (using any of the compute models) that needs relational storage, SQL Database can be a good option. Applications running outside the cloud can also use this service, though, so there are plenty of other scenarios. For instance, data stored in SQL Database can be accessed from different client systems, including desktops, laptops, tablets, and phones. And because it provides built-in high availability through replication, using SQL Database can help minimize downtime.

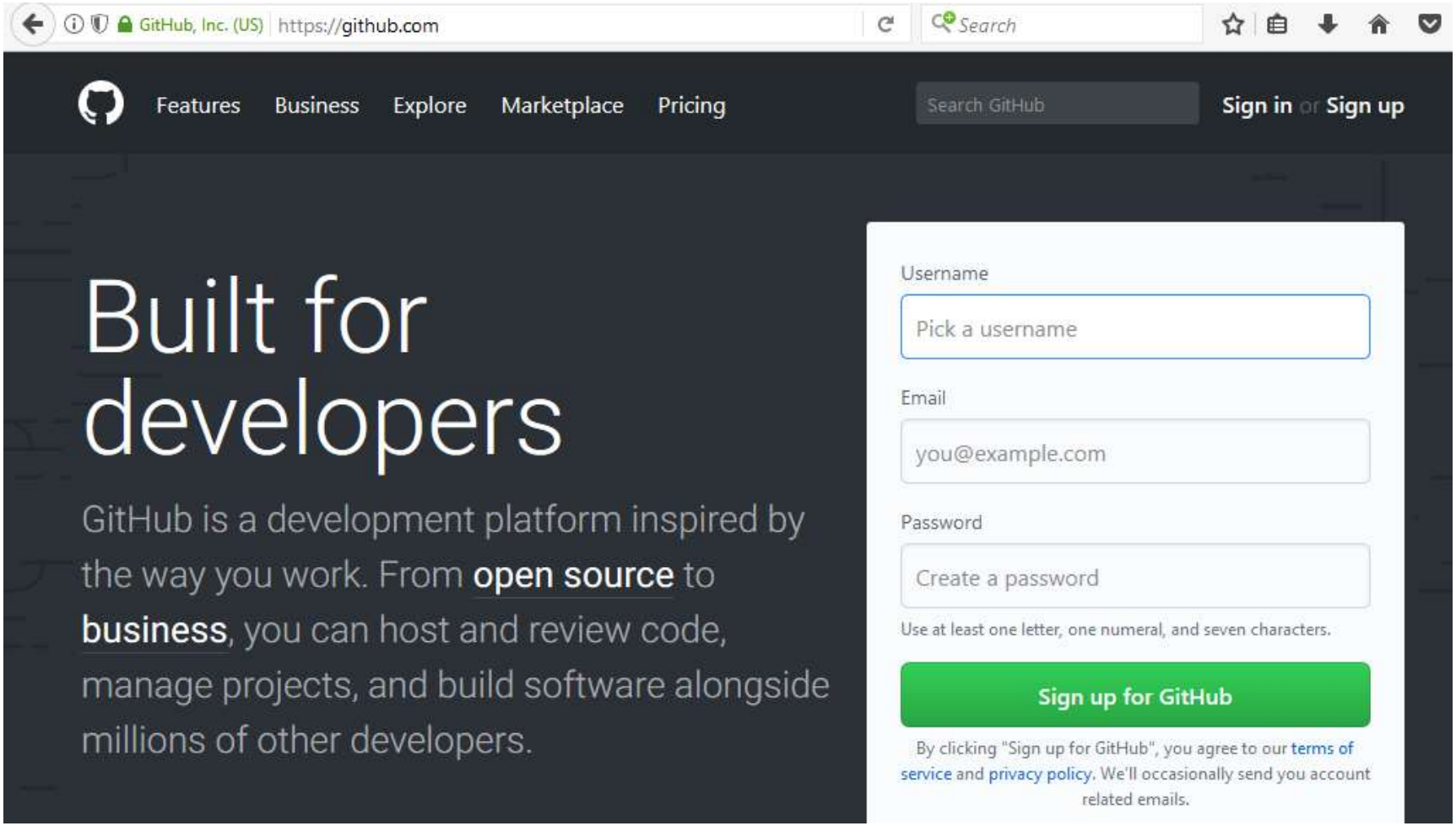


Azure Resources, GitHub Account

- GitHub is a free web service that many organizations and individuals use to manage projects, code, templates, and documentation.
- Azure has hundreds of free templates and script examples that you can use, and contribute to.
- Creating a GitHub account is optional, but a highly recommended part of building your lab environment:

1. Open your web browser to https://www.github.com and provide a `username, e-mail address,` and `password` to create a free GitHub account.
2. After you receive a validation e-mail from GitHub, select the link in the e-mail to activate your account.
3. Check out some of the Azure repositories that provide sample resources such as:
   a) Azure Resource Manager templates - https://github.com/Azure/azure-quickstarttemplates
   b) Azure CLI 2.0 - https://github.com/Azure/azure-cli
   c) Azure DevOps Utilities - https://github.com/Azure/azure-devops-utils

GitHub Sign up Page



Extra Help

- Cloud Computing and Azure moves quickly, and new services and features are always being released.
- As you start to explore Azure and want to learn about additional services, the most excellent site is:

  https://docs.microsoft.com/azure
- Every Azure service is documented with quick start examples, tutorials, code samples, developer reference, and architecture guides.
- You can also access both free and paid support options if you really need some help along the way.

Creating Azure Linux Virtual Machine

As the simplest illustration of the Power of Azure, let us create a Linux VM.

Before You Begin, Cygwin or Mac OS or Linux

- To connect to Linux boxes (VMs) in Azure from your local Windows machine, you need to install Cygwin, first. Cygwin is a Linux emulator. You get it from: https://cygwin.com/install.html
- During the installation, make sure you select `Net` group of packages and then check box `OpenSSH` package. That will install `OpenSSH` Linux package with Cygwin. There are many Linux packages and Cygwin would get bloated (many GBs) if you would install all of them.
- `OpenSSH` lets you run commands like `ssh` (secure shell) or `scp` (secure copy).
- Your Mac OS or Linux box have those (Unix) packages already installed.
- To update all of your Linux (Ubuntu) packages to the latest version, you might type on the command prompt:

```
$ sudo apt-get –y update
```

- There are many Linux. On a Red Hat (CentOS), a similar command reads

```
$ sudo yum –y update.
```

- We will learn about both apt-get and yum utilities in due course.

SSH Key Pair

- One can login into a Linux machine using username and password. Passwords are not particularly secure and we need a stronger protection.
- A much better protection is provided by SSH key pairs. An SSH key pair is made of a public key which in our case will be transferred to the remote Linux VM and a private key which will be kept as a secrete on our local machine.
- If you have an existing SSH key pair, you may use it. You do not have to create a new pair.
- We will see later than SSH key pairs also protect our data in transit and are used to encrypt our communication with remote machines.
- From the Cygwin prompt, i.e. Bash shell, run

```
$ ssh-keygen -t rsa -b 2048
```

- The command output includes the file name of the public key file.
- On the following screen is the output of this command. Notice that we accepted that the system (Cygwin) sends generated key pair (2 files) to a default location: `/home/073621/.ssh` . Your directory will have a different name. `.ssh` starting with a dot (.) is name of a standard directory

Generation of SSH Key Pair

```
$ ssh-keygen -t rsa -b 2048
Generating public/private rsa key pair.
Enter file in which to save the key (/home/073621/.ssh/id_rsa):
/home/073621/.ssh/id_rsa already exists.
Overwrite (y/n)? y
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/073621/.ssh/id_rsa.
Your public key has been saved in /home/073621/.ssh/id_rsa.pub.
The key fingerprint is:
SHA256:AEsQOkcqKMmFFzlc5Rkh0jThp1U+NtiBG6QyOH8Ph5A
073621@USMASCSQ607244
The key's randomart image is:
+---[RSA 2048]----+
|  **O*+=oo       |
|o*o*++=oB .      |
|O+oEoo.*o*       |
|ooo + =o. o      |
|   . = .S        |
|    . +          |
|       .         |
+----[SHA256]-----+
```

- We generated 2 files: the private key file named: `id_rsa` and the public key file named: `id_rsa.pub`

Content of the private key file `id_rsa`

- The private key file `id_rsa` reads like:

```
-----BEGIN RSA PRIVATE KEY-----
MIIEpAIBAAKCAQEAxWtdo1180xFYMoKOqE3k9SQBdEMxa//EvE08eveipldNKqJe
jbUzMZPMc17znQmKCGfAV8/VILGfS2+44GgC+POT8+Kmp5OQ0Tfd9gcm5qZNfRoQ
0UQG5pFkx4phd13yfAa/BfFKqvB6mNlCn2qlJ2cmCHPXc5F/hdbDgq59vdu4KYdp
6Htukv784vC/SensucZ3DJQVHu4gEtdJYXOEmwXVnlBZYo75RWnxQbV35mh02d3r
duYikcjEKBppifBFzuyUbnNXEfHAHJIKU8C4sUM5qUmsxA6ZJ7XSaaMkrg7Dk4Ov
EHnvG3PM6fI3nCCEAT9KaMJ0oCt/Ddq/5VE4YQIDAQABAoIBAEnSw1pCrFnVQ5Dn
4h2htuffNwoycreZiqOMA8DLcGZG0R1bingkaQUCgYAuhYrpZhu4kLJaSMWaGK/0
. . . . . .
Vkpp8PfI2ks0t9tRdIpA+tWW0P8n+wThuoPfaiTi5uN0oiy7UnAX9qMcZa/0kZoC
LcQv3FyMnFJTcmEqVi4CrHZyyUcaMG1gXnB11CSOPEgRrlavmp+jd8MyeObS/q4M
9udR1NJHLgT6A0BIqRHq+QKBgQCliqAcf0s0IRdbqAjW8o925faki1Bq7/JueMWD
NLFxnHFSxfDoyeAW17rFXxobt7Kb+ZnzDqIb9/paARZOKDyUWxy5D8BjfIwduTaW
U+AYUb6kWYMonuaABetYTuicvHIga7cb6tzf4SxHSeipG9A9l9ZkdUl3yytazDSN
+ngf0QKBgQCm+fpbYqFucLIVYfg+2FbYJT6iFuQpChoTqedwJvMPTaWjFfPLh7w4
8tUAVQz4ZXmhbTbUMjZcXTYIwW+5QU+oHWv3zqSUPFRslgm3GFWQeHOlg03MX5cU
PCYPOdR4GpOEWswPNB/4ueoTkKJDnyrx/QPGVKO5CVRHIkJ52g6OXw==
-----END RSA PRIVATE KEY-----
```

Content of the public key file `id_rsa.pub`

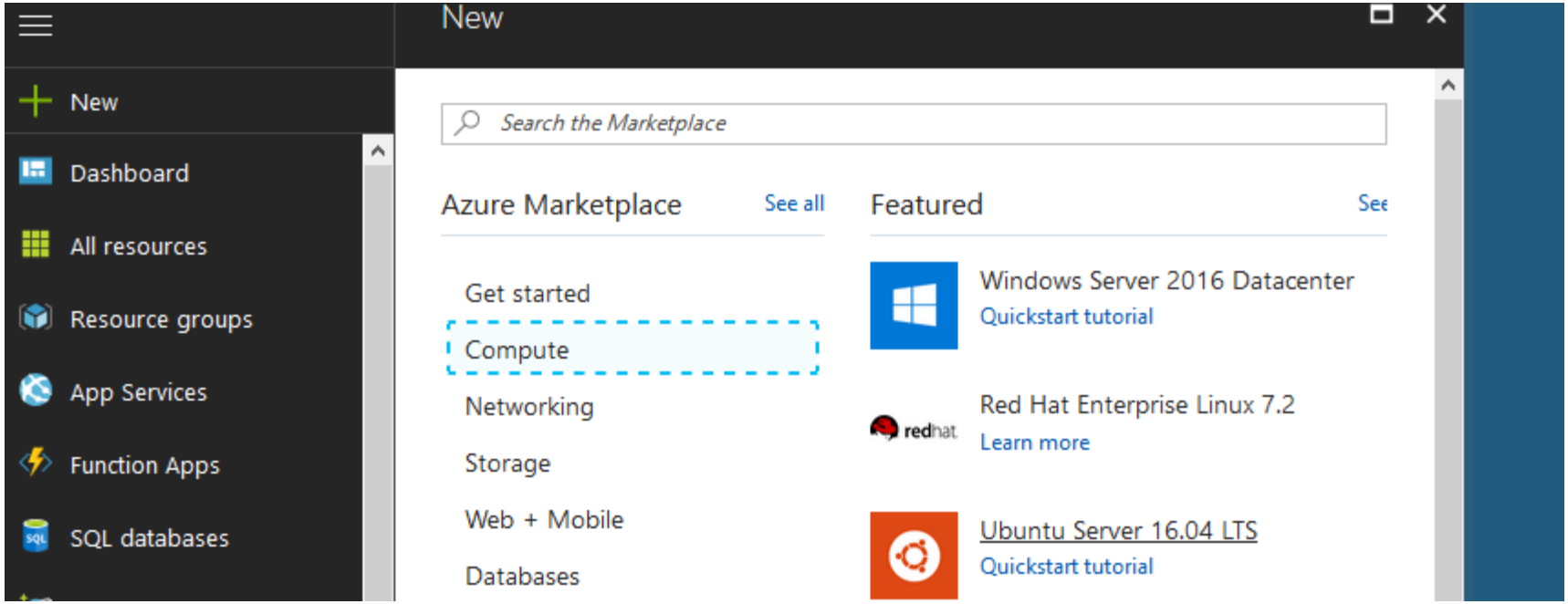
- Just generated public key file `id_rsa.pub` reads exactly like this:

```
ssh-rsa
AAAAB3NzaC1yc2EAAAADAQABAAABAQDFa12jXXzTEVgygo6oTeT1JAF0QzFr/8
S8TTx696KmV00qol6NtTMxk8xzXvOdCYoIZ8BXz9UgsZ9Lb7jgaAL485Pz4qan
k5DRN932Bybmpk19GhDRRAbmkWTHimF3XfJ8Br8F8Uqq8HqY2UKfaqUnZyYIc9
dzkX+F1sOCrn2927gph2noe26S/vzi8L9J6ey5xncMlBUe7iAS10lhc4SbBdWe
UFlijvlFafFBtXfmaHTZ3et25iKRyMQoGmmJ8EXO7JRuc1cR8cAckgpTwLixQz
mpSazEDpkntdJpoySuDsOTg68Qee8bc8zp8jecIIQBP0pownSgK38N2r/lUThh
073621@USMASCSQ607244
```

- We will need to copy that content, i.e. the public key, and transfer it to Azure or remote Linux machine. In doing that we must carefully copy the initial `ssh-rsa` string and stop at the very end, in our case `…244`. No extra white spaces are allowed.

Create Linux Machine on Portal

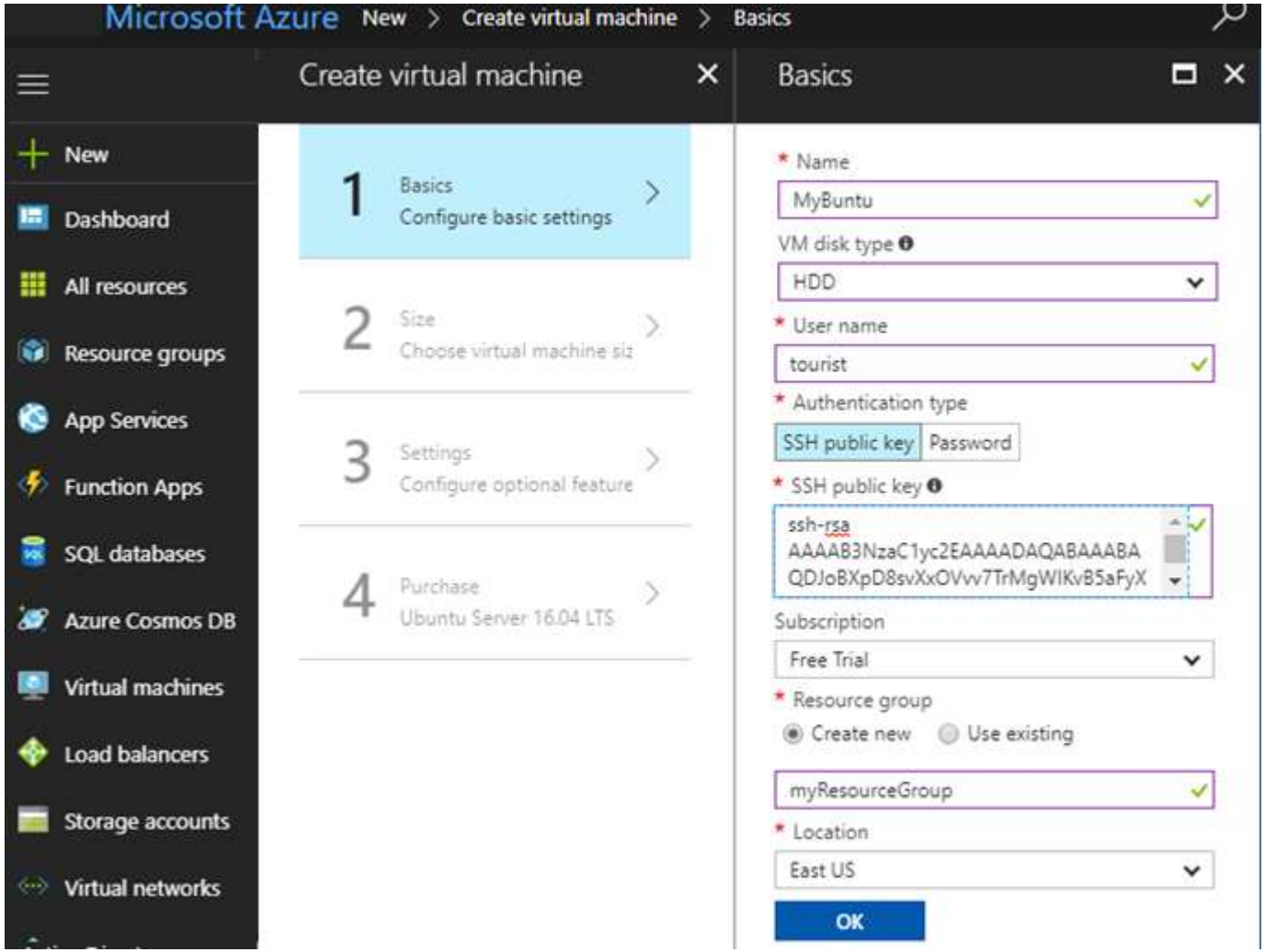
- In the top right corner of azure.microsoft.com page, hit Portal.
- Once in Azure Portal, Hit `+ New`
- On the panel that appears select `Compute` and then on the right side: `Ubuntu Server 16.04 LTS`



- `Create Virtual Machine` panel will pop up. Several choices must be made.

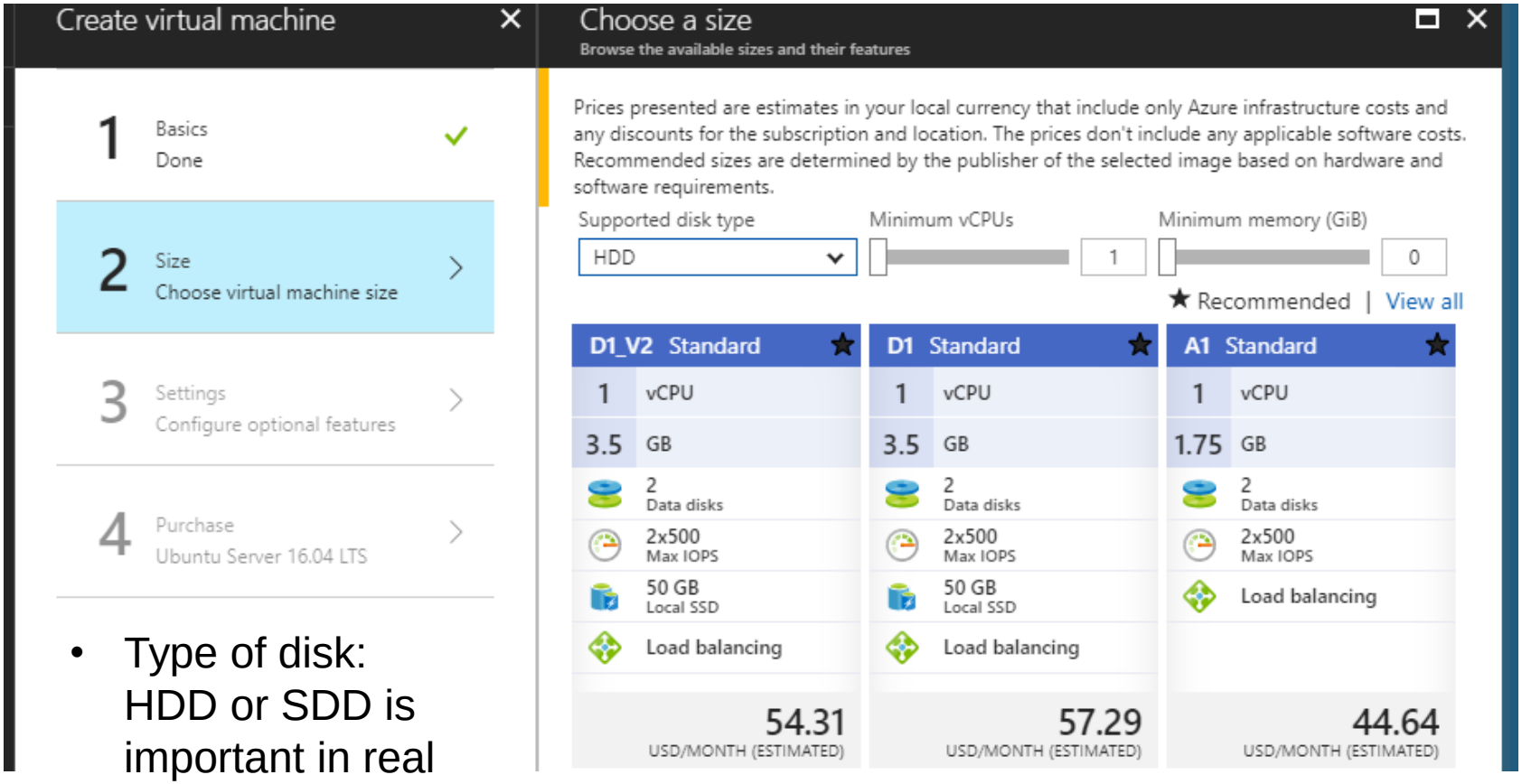
Populate Basic Parameters

- Insert VM Name
- VM disk type
- User name
- Authentication type. Select SSH public key.
- Copy and past the content of file id_rsa.pub from your local machine into provided space. No spaces after the end of the text, please.
- Name resourceGroup
- Select Location near you
- Hit OK



Choose VM Size

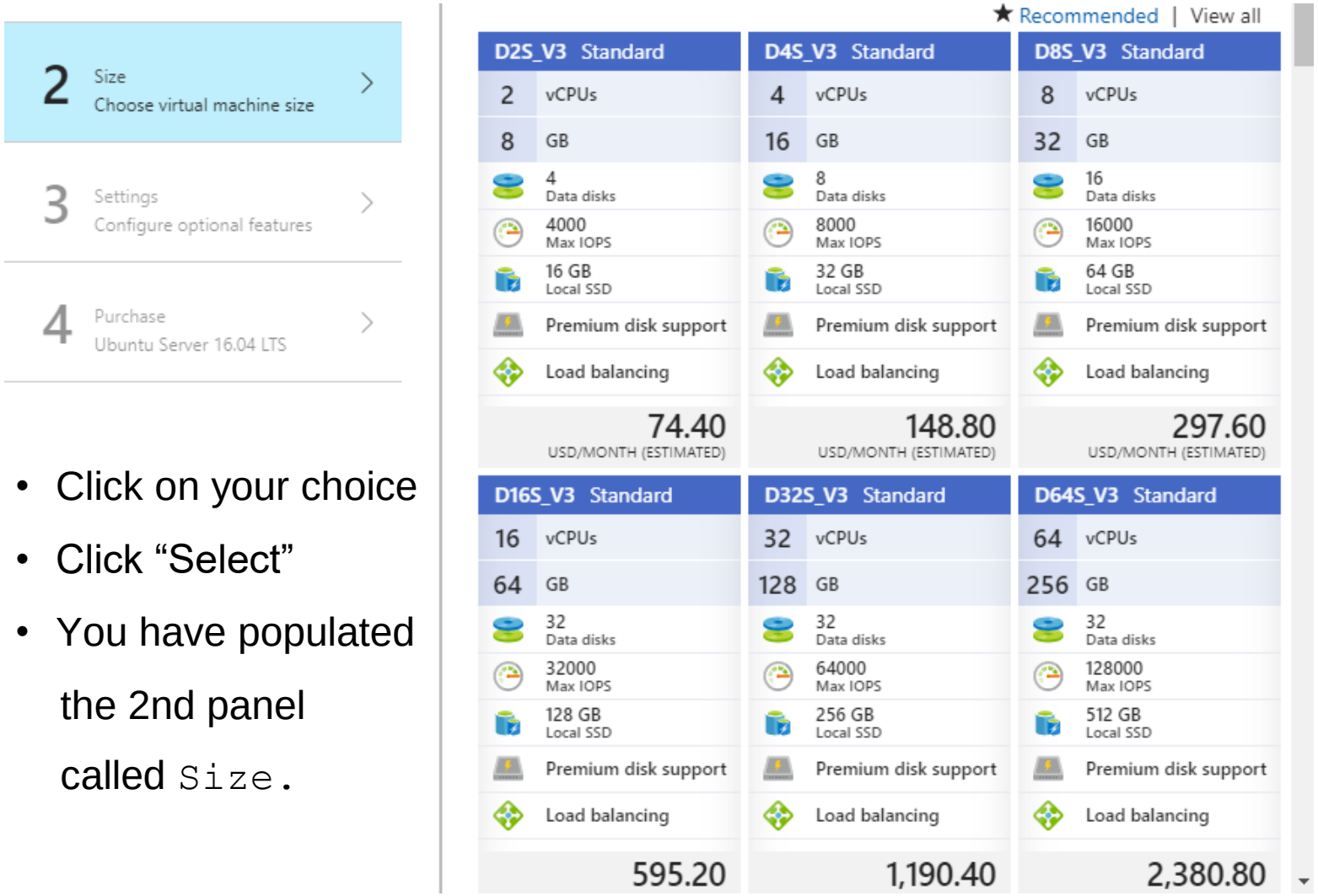
- Next select the size of VM appropriate for your task. We will chooses the cheapest machine.
- Your tasks might require one of very powerful machines. Choose wisely.



- Type of disk: HDD or SDD is important in real deployments.

Satisfy Curiosity, Select `View all`

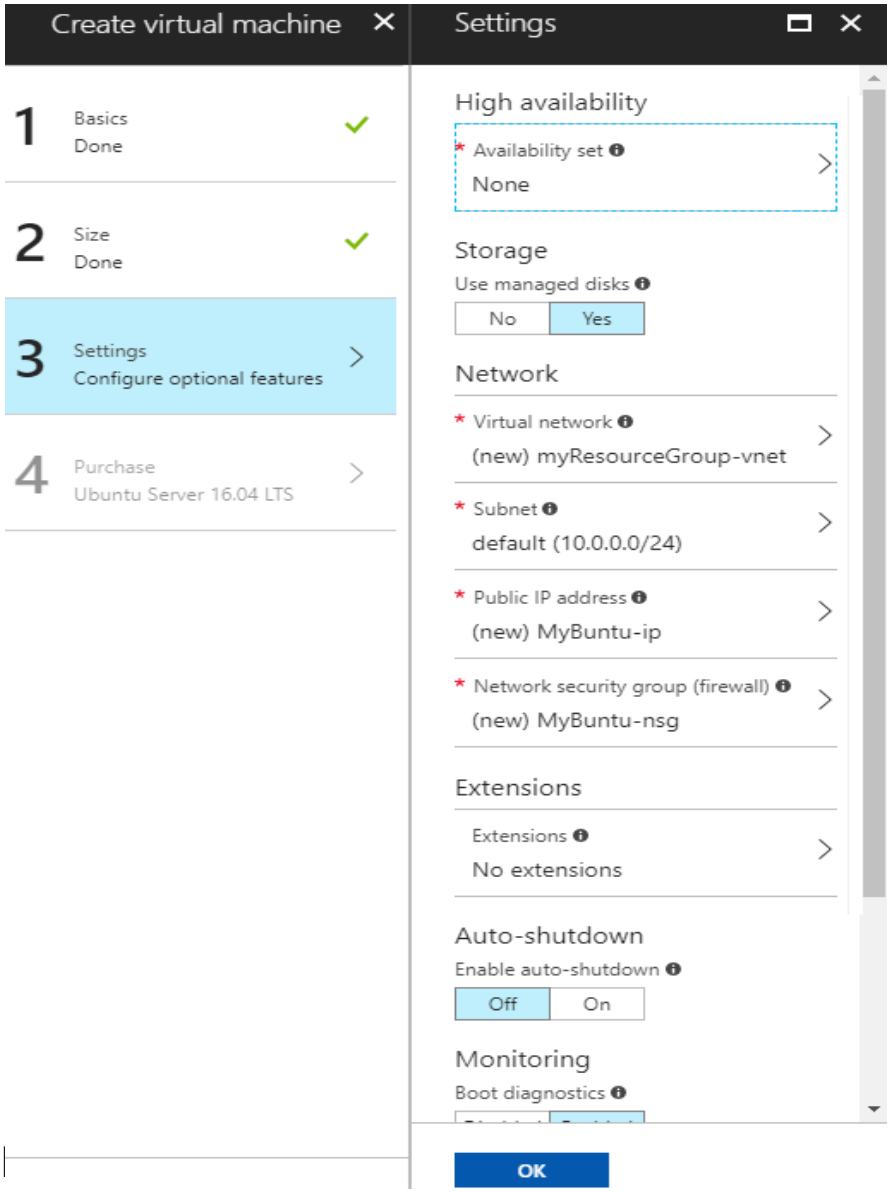
- You will have a clear view of a great variety of machines



- Click on your choice
- Click “Select”
- You have populated the 2nd panel called `Size`.

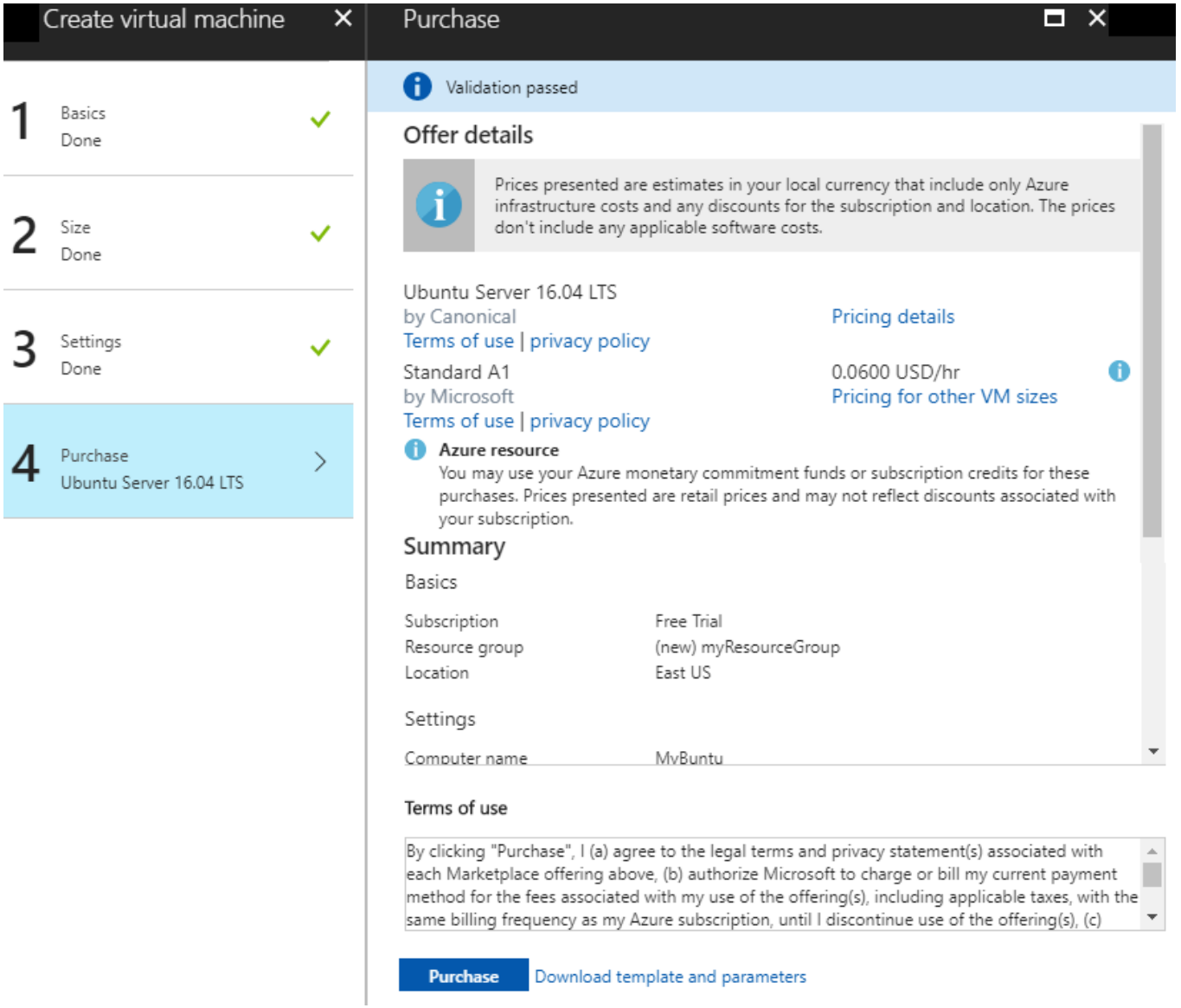
Settings, Optional Features

- Under **Settings**, keep the defaults or make specific selections and click **OK**.
- On the summary page, click **Ok** to start the virtual machine deployment.
- The VM will be pinned to the Azure portal dashboard. Once the deployment has completed, the VM summary automatically opens.

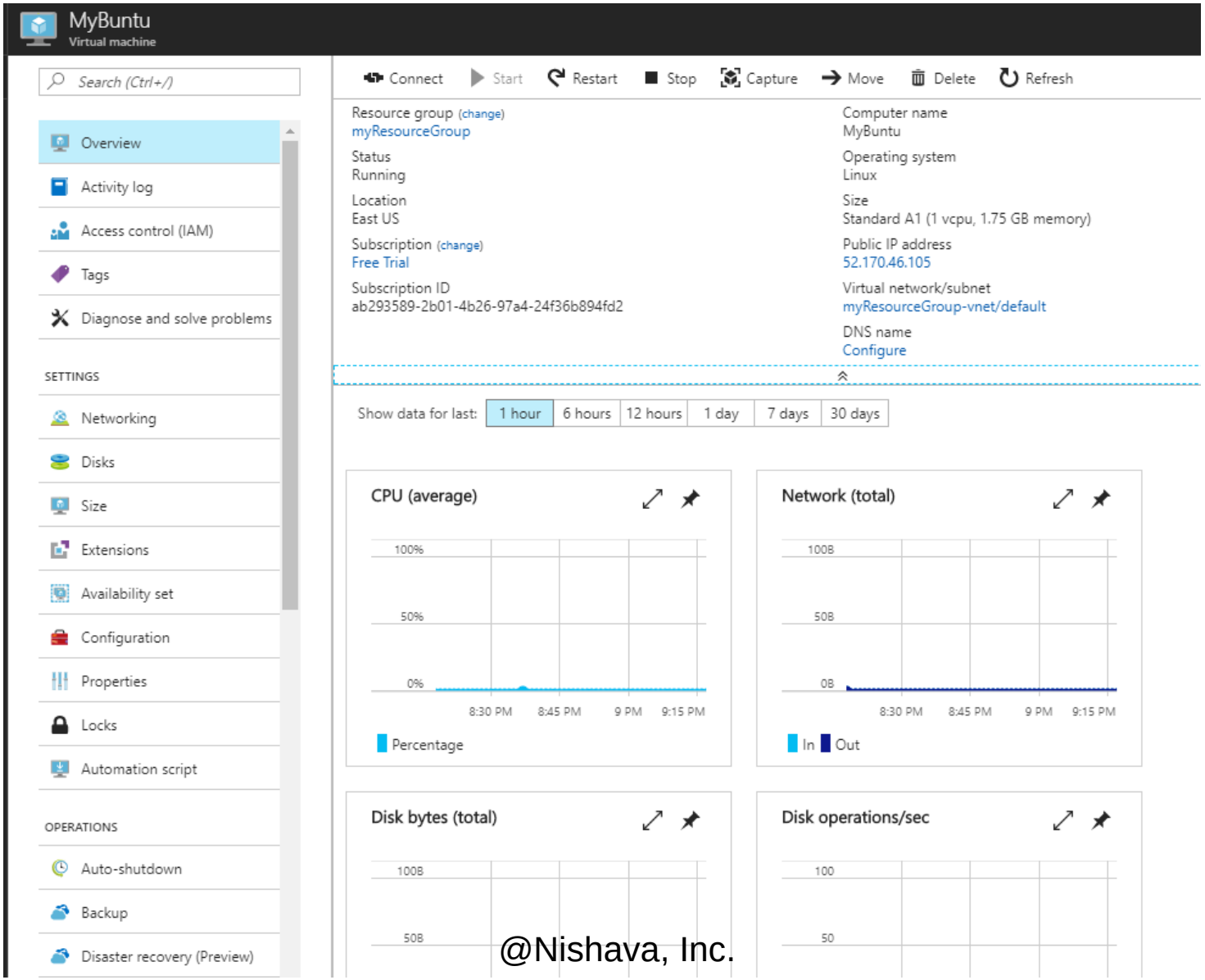


Purchase

- Click “Purchase”
- After you hit Purchase, Azure starts the process of creation of the machine you requested.
- Deployment sometimes takes several minutes.



VM is Provisioned and Deployed

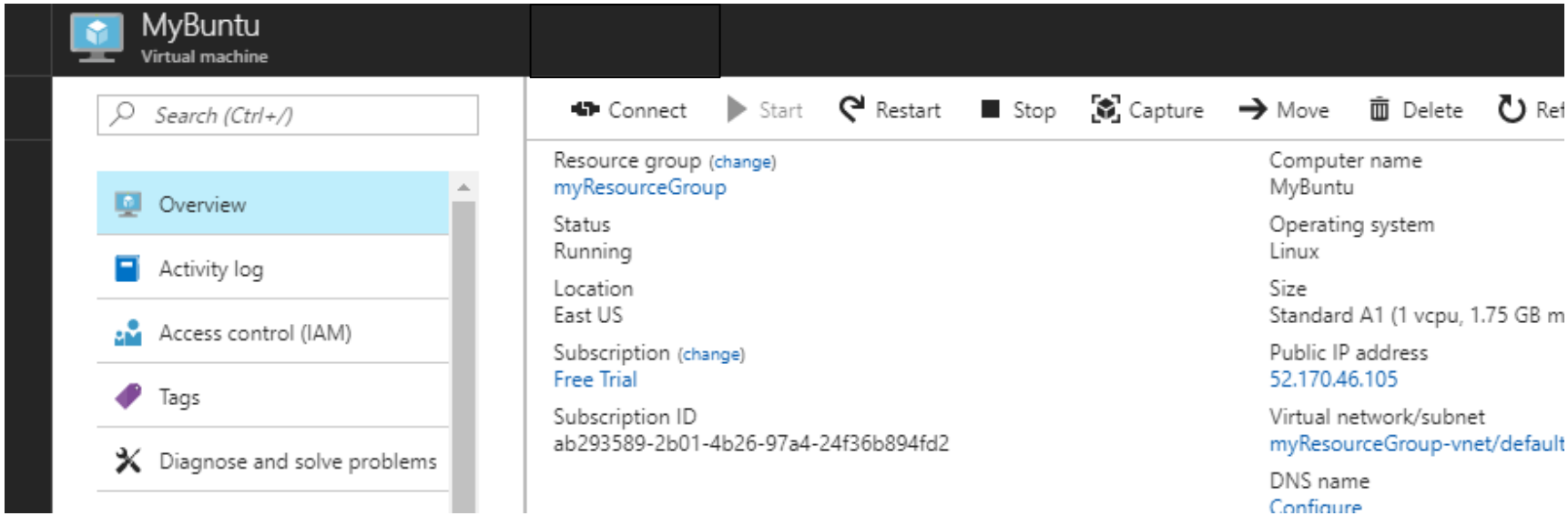


Connect

- Click the **Connect** button on the virtual machine properties. The connect button displays an SSH connection string that can be used to connect to the virtual machine.

```
ssh tourist@52.170.46.105
```

- Copy the command to your Cygwin or Mac OS prompt



- `52.170.46.105` is the public IP address of your machine

You are in

```
$ ssh tourist@52.170.46.105
The authenticity of host '52.170.46.105 (52.170.46.105)' can't be established.
ECDSA key fingerprint is SHA256:OojIGVyXwspB/OezZIGnipbfDgynJaEDUvBd309tqOc.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '52.170.46.105' (ECDSA) to the list of known hosts.
Welcome to Ubuntu 16.04.3 LTS (GNU/Linux 4.11.0-1011-azure x86_64)
 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage
  Get cloud support with Ubuntu Advantage Cloud Guest:
    http://www.ubuntu.com/business/services/cloud
0 updates are security updates.
Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.
To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.
tourist@MyBuntu:~$ pwd
/home/tourist
tourist@MyBuntu:~$
```

Install Apache

- If we want to see something colorful, we could install Apache on our Linux VM in Azure.
- On remote prompt of your Ubuntu Linux machine, just type:

```
$ sudo apt-get –y ––fix-missing install apache2
```

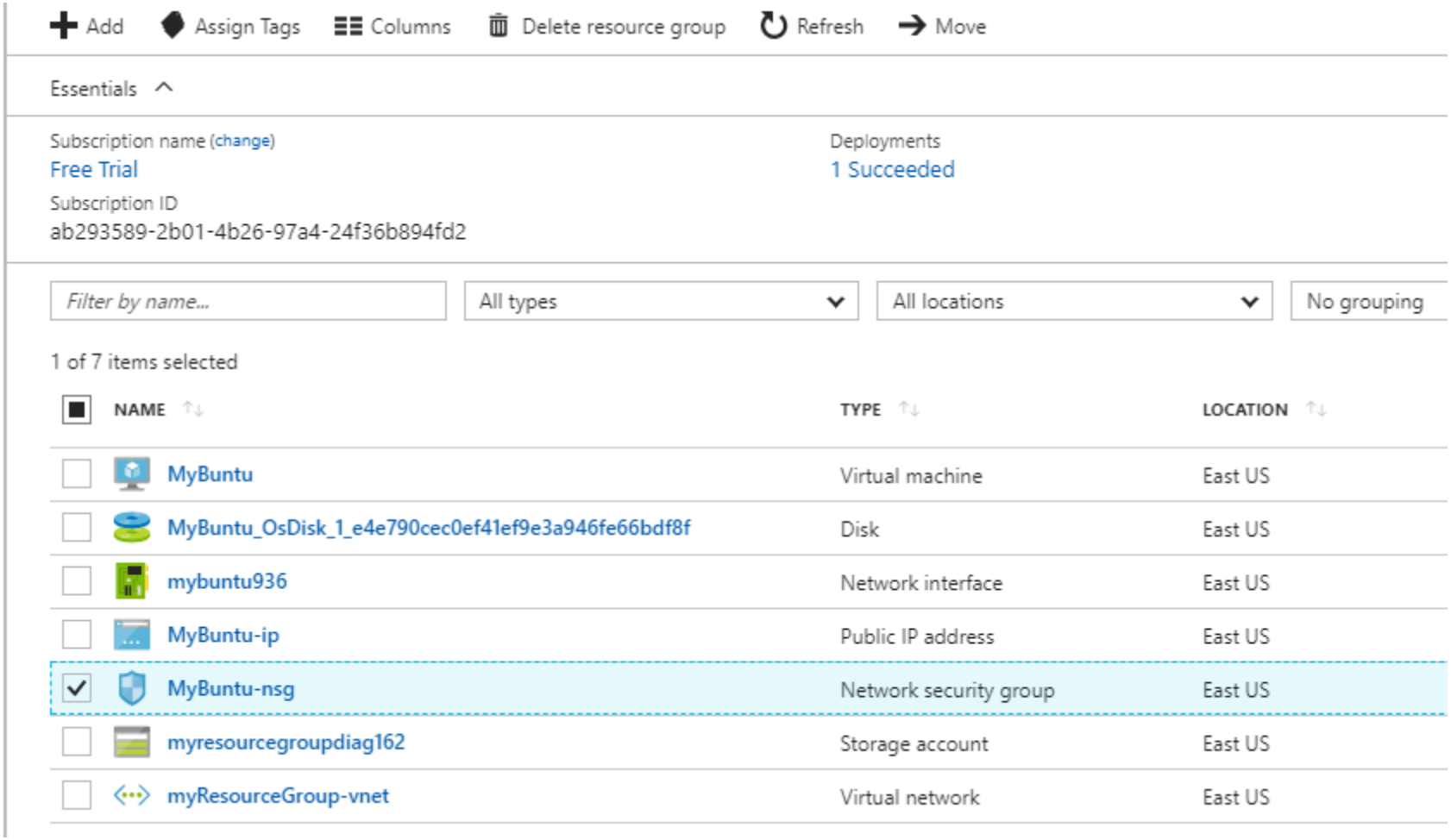
Start Apache, Open Port 80

- On the command prompt type:

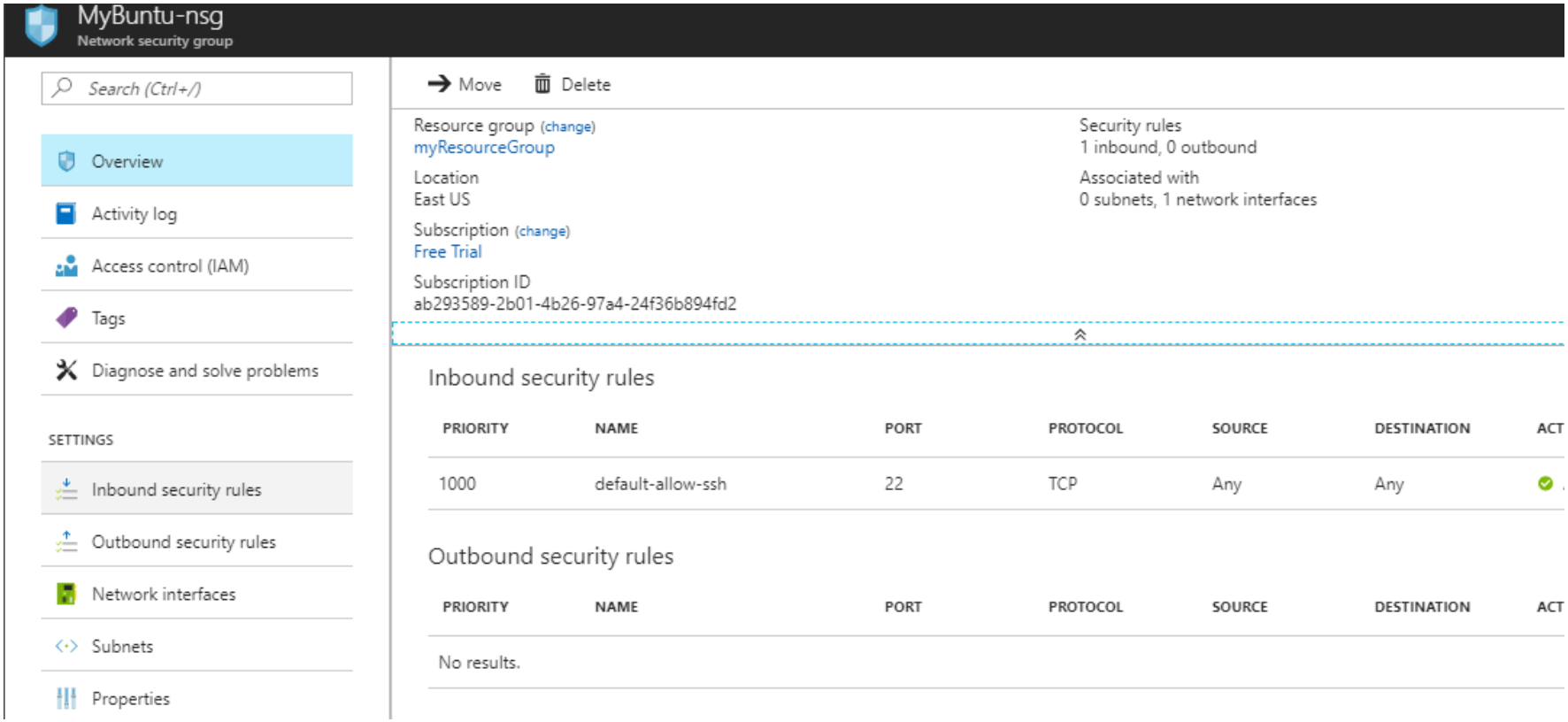
```
$ sudo /etc/init.d/apache2 start
```

- A Network security group (NSG) secures inbound and outbound traffic. When a VM is created from the Azure portal, an inbound rule is created on port 22 for SSH connections. Because this VM hosts a webserver, an NSG rule needs to be created for port 80.
- On the virtual machine, click the name of the **Resource group**.
- Select the **network security group**. The NSG can be identified using the **Type** column.
- On the left-hand menu, under settings, click **Inbound security rules**.
- Click on **Add**.
- In **Name**, type **http**. Make sure **Port range** is set to 80 and **Action** is set to **Allow**.
- Click **OK**.

Network Security Group

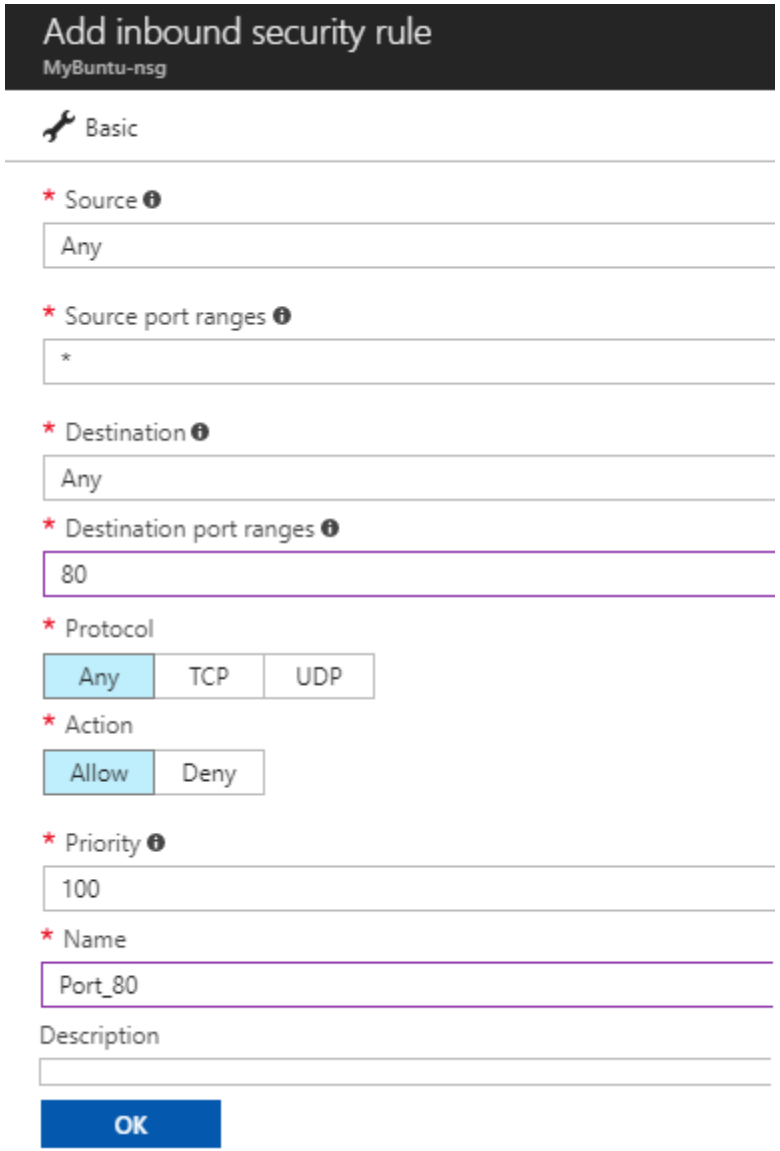


Inbound Security Rules



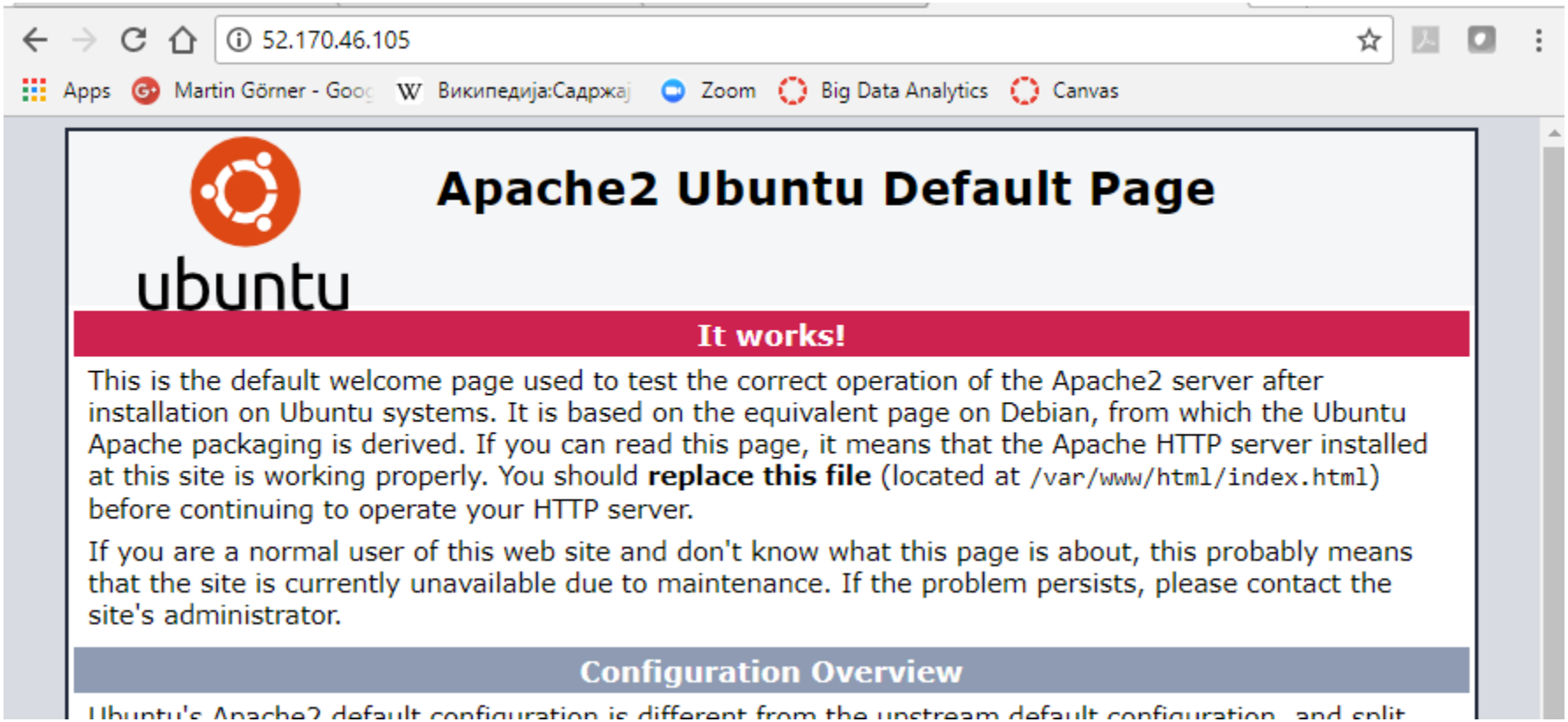
Set Port 80 for Inbound Traffic

- Change
  - Port name,
  - Destination port
  - Action to Allow
- Hit OK



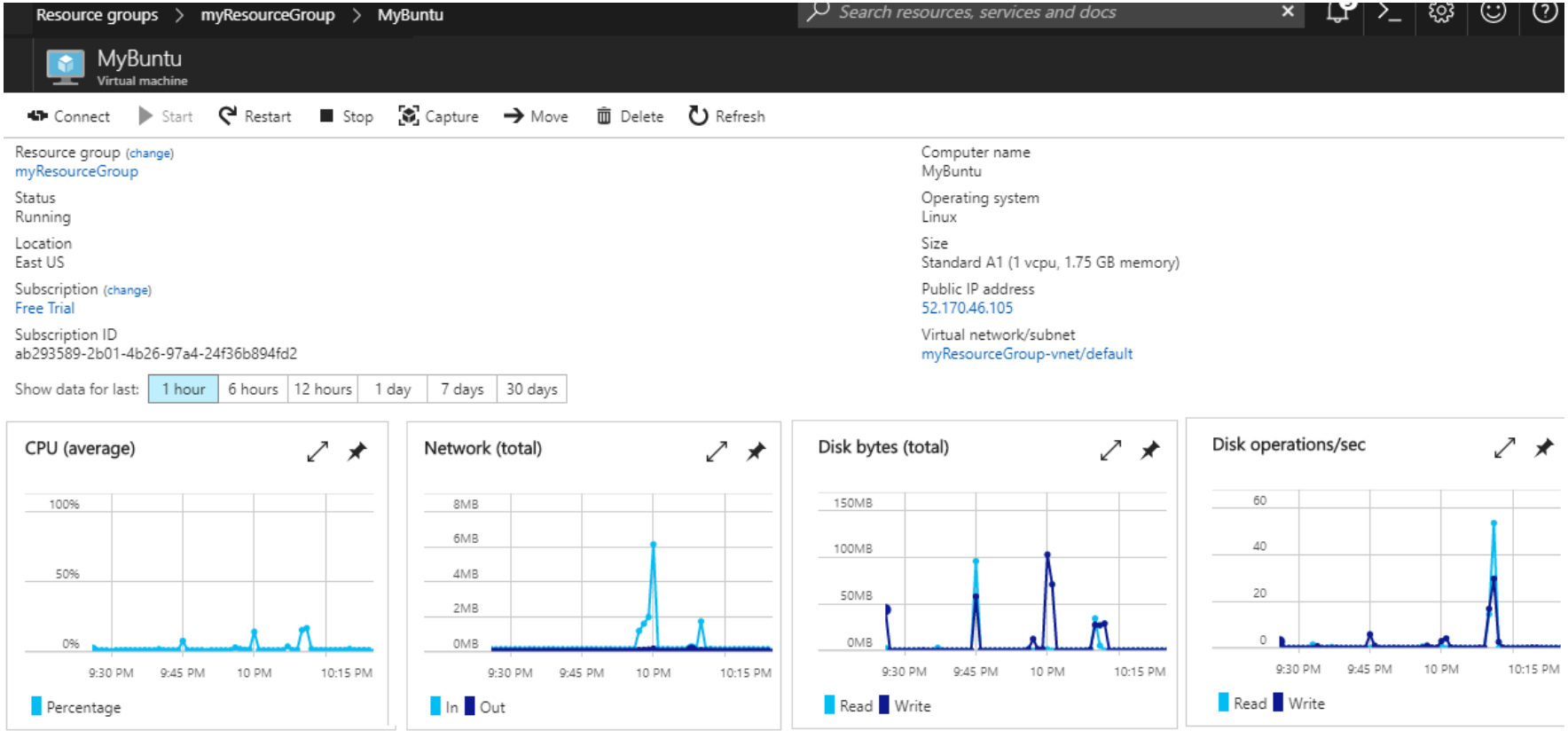
Visit your Machine on the Web

- With Apache installed, and port 80 open to your VM, the webserver can now be accessed from the internet.
- Open a web browser, and enter the public IP address of the VM. The public IP address can be found on the VM properties in the Azure portal.



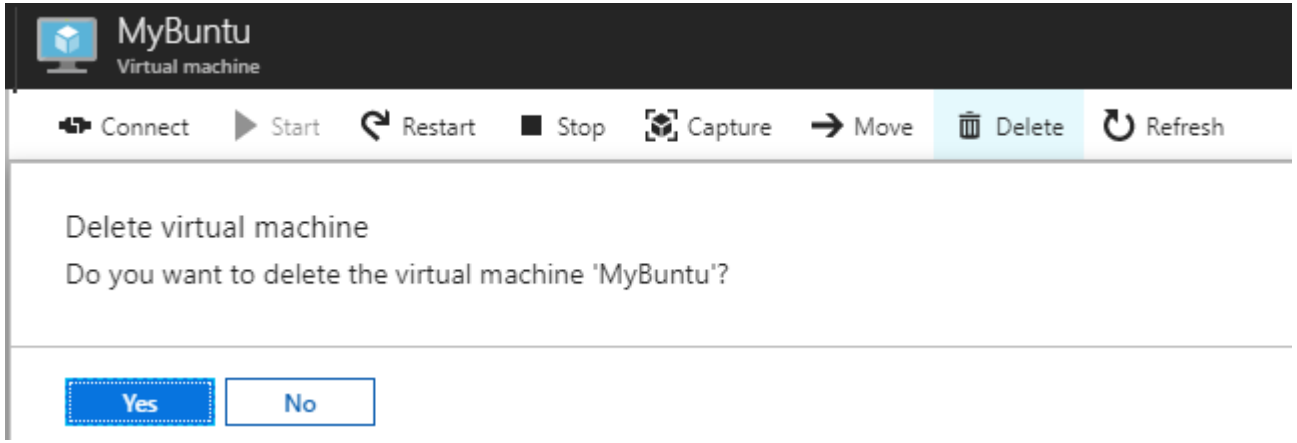
Go back to Portal

- Select Resource groups > myRessourceGroup > MyBuntu
- And you will see information on recent behavior of your machine and all of its parameters:



Delete resources

- Resource that are not needed should be removed.
- Select your VM and then Delete:



- Select your Resource group and Delete