What is the cloud?

The term 'cloud' is simply a marketing term companies use to make their online products and services sound cool.

Think of all the things you can't do when the Internet goes down:

- You can't watch Netflix
- You can't post to Instagram
- You can't listen to Spotify
- You can't access GMail
- You can't play Fortnite
- You can't chat on Discord

All of these apps, features or services are either entirely cloud based, or at the very least, they require some type of network connectivity to work. You will often hear these products referred to as cloud based services:

- Netflix is a cloud-based movie streaming services
- Facebook is a cloud-based social media platform
- Spotify is a cloud-based music streaming service

With a cloud based application, most of the important logic, storage and data processing functions happen on computers and server your device connects to through the Internet. The data storage and processing does not happen locally on your phone, tablet or computer.

The Opposite of the Cloud

Turn off your computer's Internet connection. What programs work?

- You can probably play the built in Solitaire and Minesweeper games.
- If your computer has Microsoft Office installed, you can probably open up Word and PowerPoint.
- You can play any mp3 files you downloaded to your computer before the Internet went downloaded
- You can view any photos that you previously downloaded off your phone
- You can edit your videos using software like MovieMaker if you have it installed on your machine

None of these examples require the services of externally located computers. All of the data, software and processing power required to play a song or edit a video happens on the tablet you're holding in your hand or on the desktop located in your home.

On-Premise vs the Cloud

When all of your computing needs are fulfilled by a computer you own, that resided in your house, and it can run without the need to connect to a server located somewhere on the internet, it is referred to as an on-premise system.

Running software programs locally, on an on-premise computer in your home or office without the need for a network connection is the polar opposite of a cloud-based system.

What is Cloud Computing?

What does a typical, on-premise desktop or laptop computer do?

- It stores files such as images, videos and music
- It runs programs like PhotoShop, Movie Maker or VirtualDJ Pro

Any time you use a cloud based computer to perform a function that would traditionally be done on a home computer of your own, that's considered cloud-computing.

In its simplest form, storing images, music, videos and other files in Dropbox or in Apple's iCloud can be considered cloud-computing.

When you upload your images and videos Apple's iCloud, instead of downloading them all to your local desktop, you have transferred the responsibility of storing data from your personal device to the cloud.

And when you sort your images by date, or organize your videos by filesize, all of the computer processing required to perform those tasks will be done by iCloud servers, not your phone or your desktop. Not only will your computer have more hard drive space, because all of the data is stored in the cloud, but your computer will likely perform faster because it isn't bogged down by as it tries to manage, index and organize a bloated hard drive.

When you use the cloud to do something a computer would normally do, especially in terms of file storage or data processing, that is what we call cloud-computing.

DJ Scrumtuous' Data Dilemma

DJ Scrumtuous is an up and coming rapper who rhymes about DevOps, Scrum and Agile virtues.

She is doing daily video podcasts, recording several new beats a day and taking lots of photographs to document her journey. Unfortunately, she has shot so much video and recorded so many beats, she has no more storage space on her laptop.

DJ Scrumtuous needs 2TB of storage space right now. She also predicts that in six months to a year she will need about 30TB of storage.

She priced out a network storage device (NAS) on Canada Computers and found the cheapest one was $459.

[Sunset] | *https://ccimg.canadacomputers.com/Products/600x600/1268/131559/52473.jpg*

For 30 TB of data, she would need two 16 TB hard drives which are $599 each.

To guard against losing all of her work from a single hard drive failure, she would need an additional two hard drives to 'mirror' the primary hard drives.

DevOps rap is a cutthroat game, so there is a good chance someone will try to steal the hard drives with all of her beats on them. So DJ Scrumtuous also wants to maintain an offsite copy of her data at her Mom's place just in case her apartment gets robbed. So in total, she'd need six 16 TB hard drives.

Oh, and there's one other problem, DJ Scrumtuous knows all about the Thug Life, but she knows nothing about the Nerd Life. She has no idea how to set up a NAS system, so she'd have to hire someone technical to set the whole thing up for her.

Table 1. Table Storage Costs

Quantity	Product	Price
1	NAS System	$459
6	16TB Hard Drives	$599
1	Installation	$268
	Total	$4,321

Amazon S3 Storage

Alternatively, DJ Scrumtuous has learned that 2TB of object storage on Amazon S3 is $47 a month, it's pay-as-you go, and she can increase her storage capacity way beyond 30TB if the need arises.

Furthermore, all S3 data is failover protected, there is 99.95% up-time promise and eleven nines of durability, which means none of her files will ever be lost.

Furthermore, S3 is a fully managed system, so DJ Scrumtuous doesn't have to install anything, manage any software or perform any future upgrades or updates.

Which option do you think DJ Scrumtuous should chose? The $4,321 on-premise solution, or the pay-as-you-go solution that takes advantage of cloud computing

How is over-provisioning or under-provisioning a danger with the on-premise option?

DJ Scrumtuous' Processing Problem

Every night DJ Scrumtuous processes the raw, 4K video she shoots on her daily, long-form podcast. However, her laptop simply isn't powerful enough.

It usually takes 4 hours to process one hour of video on her laptop, so a 3 hour video has to process overnight. Furthermore, sometimes her laptop runs out of memory and when she wakes up in the morning, the process has failed to complete.

Other times she has three separate video files that need to process. That means she sometimes has to get up in the middle of the night to start a second or third file to process in order to make her videos available to her fans the next day.

To reduce the processing time and eliminate system crashes, DJ Scrumtuous has priced out a system with 64 gigs of memory and an i9-11900K processor for $6,099 plus tax. The up and coming DJ doesn't have that much money on hand, but has been offered financing with a 22% interest rate. Her monthly payments will be $270 for 3 years.

Optionally, DJ Scrumtuous have found out that she can install her video editing software on a virtual Windows machine that runs on Amazon's Elastic Cloud Computing (EC2) service.

The EC2 cloud service allows the video processing to run on extremely powerful servers that will compress an hour of video in about 45 minutes. Furthermore, if there are multiple videos to process, three separate virtual machines can be run in parallel, allowing all three files to be processed at the same time - something that wouldn't be possible on the on-premise machine she is thinking of purchasing.

Each hour of video processed on Amazon EC2 instances would cost $2. DJ Scrumptuous expects to process about 150 hours of video a month, so her monthly cost would be $300.

Which option do you think would be the best for DJ Scrumtuous, the $6,099 on-premise solution, or the solution that takes advantage of virtual machines and cloud computing?

A Perspective on Data Sizes

Here's a comparison of the different data size categorizations from a bit, right up to a terrabyte.

- A bit is a piece of data that can be represented by a 1 or a 0.
- A byte is 8 bits of data. Each letter in a text file is a byte of data.
- A kilobyte (KB) is 1000 bytes of data. That's like a text file with 250 words in it.
- A megabyte (MB) is 1000 kilobytes. A 1 minute mp3 is about a mega-byte in size.
- A gigabyte (GB) is 1000 megabytes, or about 17 hours of mp3 music.
- A terrabyte (TB) is 1000 gigabytes, or about 2 years of mp3 music, is a terra-byte (TB)
- A petabyte (PB) is 1000 terabytes. A 4K movie shot in the uncompressed format Hollywood studios use consumes 18.2GB per minute, or just over a single TB per hour. A single movie shoots about 250 hours of footage before editing, all of which can easily approach a petabyte in size.

To personalize these numbers a bit, modern desktop computers sold at big box stores are usually equipped with one or two terrabytes of hard drive space and 8 to 16 gigabytes of memory.

Top Cloud Computing Companies

We are all familiar with popular cloud-based apps and offerings such as Spotify, Zoom, Uber and WhatsApp. We commonly refer to these single-purpose, cloud-based apps as Software as a Service

(SaaS) offerings, because they typically focus on delivering a single service or software offering.

When we talk about cloud computing, we're not really concerned with SaaS. What we're really concerned with is companies that provide platforms where we can deploy application, or even just cloud based infrastructure.

Amazon is arguable the biggest and the best known provider of Platform as a Service (PaaS) and Infrastructure as a Service (IaaS) offerings, but they certainly aren't the only vendor in the market. The other big cloud computing vendors who offer a similar set of services to Amazon include:

- The Google Cloud Platform (GCP) which has $20 billion in annual sales

- Microsoft's Azure Platform which has about $70 billion in annual sales

- China's Alibaba cloud which has just under $10 billion in annual sales

- The IBM Cloud with its various Watson offerings

- The Oracle Cloud

All of these companies try to differentiate themselves on price, products and customer service, but the fact is, they all provide the same core set of services, many of which are completely interchangeable, at similar prices.

One of the key differences between a cloud computing vendor and other companies that have cloud based offerings, is that the services provided by the cloud computing vendors are intended to be used by other companies to build their SaaS offerings.

The various Amazon services are like jigsaw puzzle pieces other companies can use to build their own products. It should come as a suprise to nobody to find out that when Amazon Web Services go down, so do SaaS based offerings that use them.

From Dropbox to Spotify, there are many cloud based services in the world. But there's obviously a difference between apps like Netflix and Instagram and the big cloud vendors like Amazon and Google.

Cloud based offerings typically get categorized into three separate categories:

- SaaS - software as a service

- PaaS - platform as a services

- IaaS - infrastructure as a services

Basic, single-purpose applications you install on your phone or access through your browser are typically referred to as software as a service offerings. Dropbox is a great example of a cloud based, SaaS offering. Microsoft's Office365, where all of the office apps are accessed through a browser, or at the very least require a network connection to work, is another example of a cloud-based SaaS offering. GMail is a SaaS based offering too, providing email software as a cloud based service. Zoom, WhatsApp and Uber are all common examples of SaaS.

PaaS is a platform as a service. PaaS offerings provide a deployment environment for applications. All of the underlying infrastructure is managed by the cloud provider, so a developer need only worry about deploying a working application to the PaaS offering, and the PaaS provider will take

care of difficult tasks such as fail-over, workload management and high-availability.

Any company that allows you to upload HTML files to their servers so they can host your website would be considered PaaS. They are providing a hosting platform for you web application.

Y