The Disruptive and Democratizing Credentials of Cloud Computing

Prof. Nabil Sultan

Professor of Innovation Management and Leadership

University Campus Suffolk

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- Disruptive Innovations and the Disruptive (and Servitized) Attributes of the Cloud
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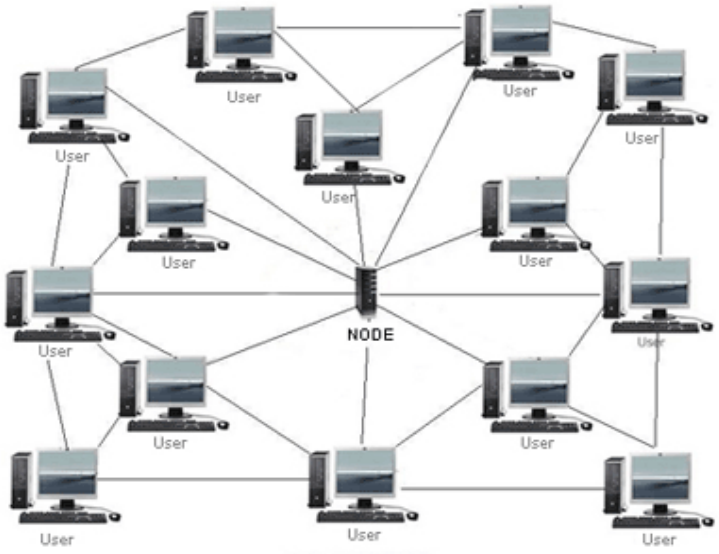
What is cloud computing?

- An IT service model that relies on the Web and technologies such as grid computing and virtualization to deliver a range of IT services – through a data centre - on a pay-per-use (or pay-as-you-go) cost structure.

Grid computing

- The provision of compute power through linking computers together –in a grid- and then “pooling” their CPU resources to achieve high performance compute/processing power.



GRID COMPUTING

Virtualization

- The technology that enables single physical resources (e.g., a server, an operating system, an application, or storage device) appear as multiple logical resources.

- The technology that masks the physical characteristics of computing resources (e.g., a PC, a Server) in order to simplify the way in which other systems, applications, or end users interact with them. For example, a PC that is running Windows (the host operating system) and using virtualization software can also run Linux (as a guest operating system).

Where did the word "cloud" come from?

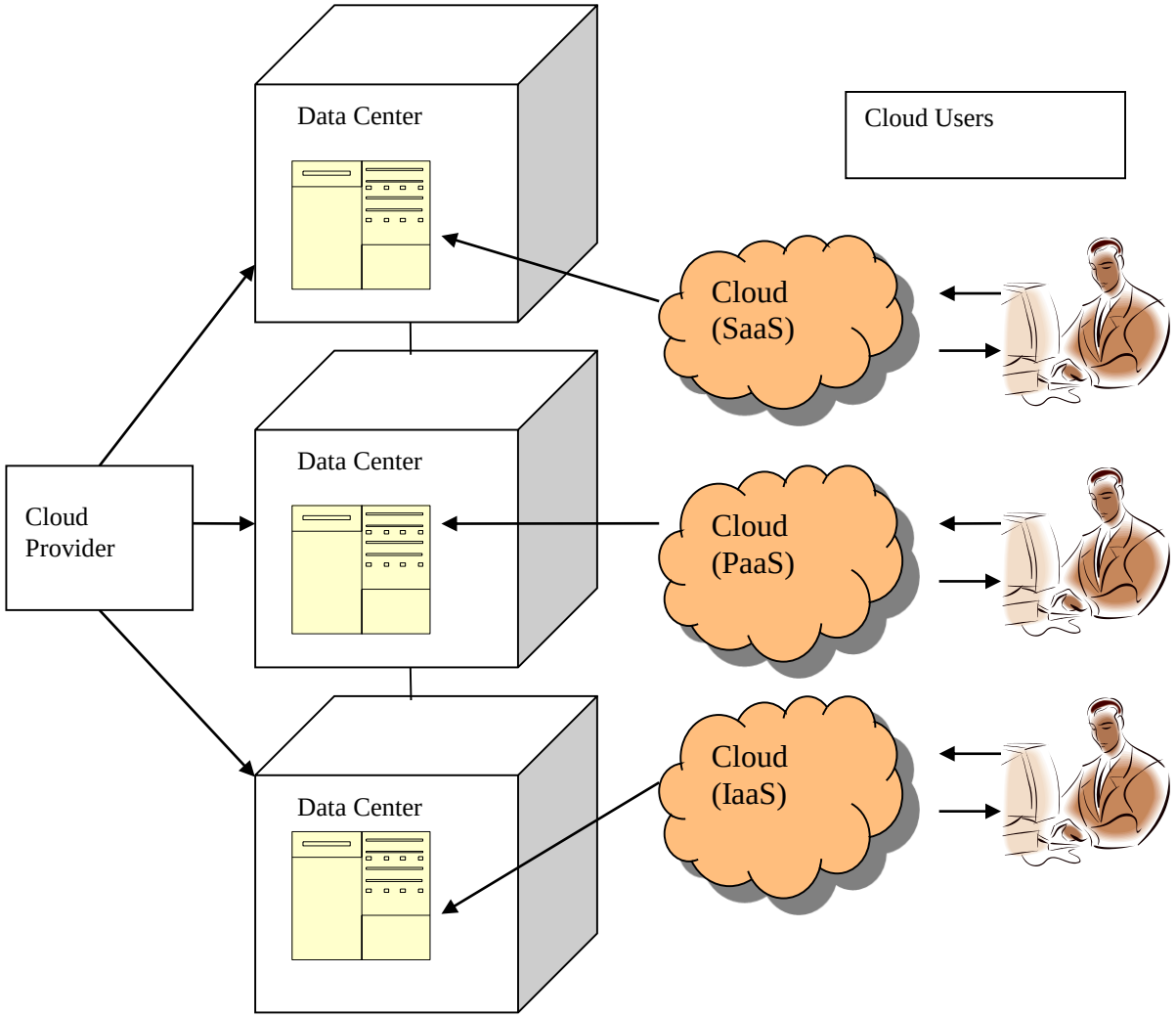
- In 2006 **Eric Schmidt** (Executive Chairman of **Google)** described Google's Software as "cloud computing" at a search engine conference.

- The term cloud is a metaphor for the Internet, possibly inspired by cloud images in computing text books.

Cloud computing's service structure

- There are broadly three types of IT services delivered by cloud computing (Sultan, 2011):
- **Software as a Service** (SaaS): it involves the remote access of software applications (e.g., productivity (Office) suites, business applications, e.g., CRM, KMS);
- **Infrastructure as a Service** (IaaS): it involves the remote access of IT infrastructure (e.g., virtual computers, processing capabilities, storage);
- **Platform as a Service** (PaaS): it involves the remote access of development software, testing and hosting of the developed software. Example: Access to development software to create Web applications and then to test them and host them on a desired platform (e.g., Apache web server running on a UNIX or Linux operating system, Internet Information Server (IIS) running on Window NT/2000 operating system.

Cloud Use Communication



Four implementations of the cloud model

- **Public cloud**
  - You rely on cloud providers (Amazon, Microsoft, Saleforce.com) to serve you from their own data centres.

- **Private Cloud**
  - Your become your own cloud provider by having your in-house data centre (by installing private cloud software).

- **Hybrid-cloud**
  - You rely on a combination of both public and private clouds

- **Community Cloud**
  - Provided (often by one organization) and consumed by groups of organizations in businesses or professions similar to that of the providing organization. Examples: the UK's G-Cloud and SITA's Air transport Industry (ATI) cloud.

But there are cloud concerns !

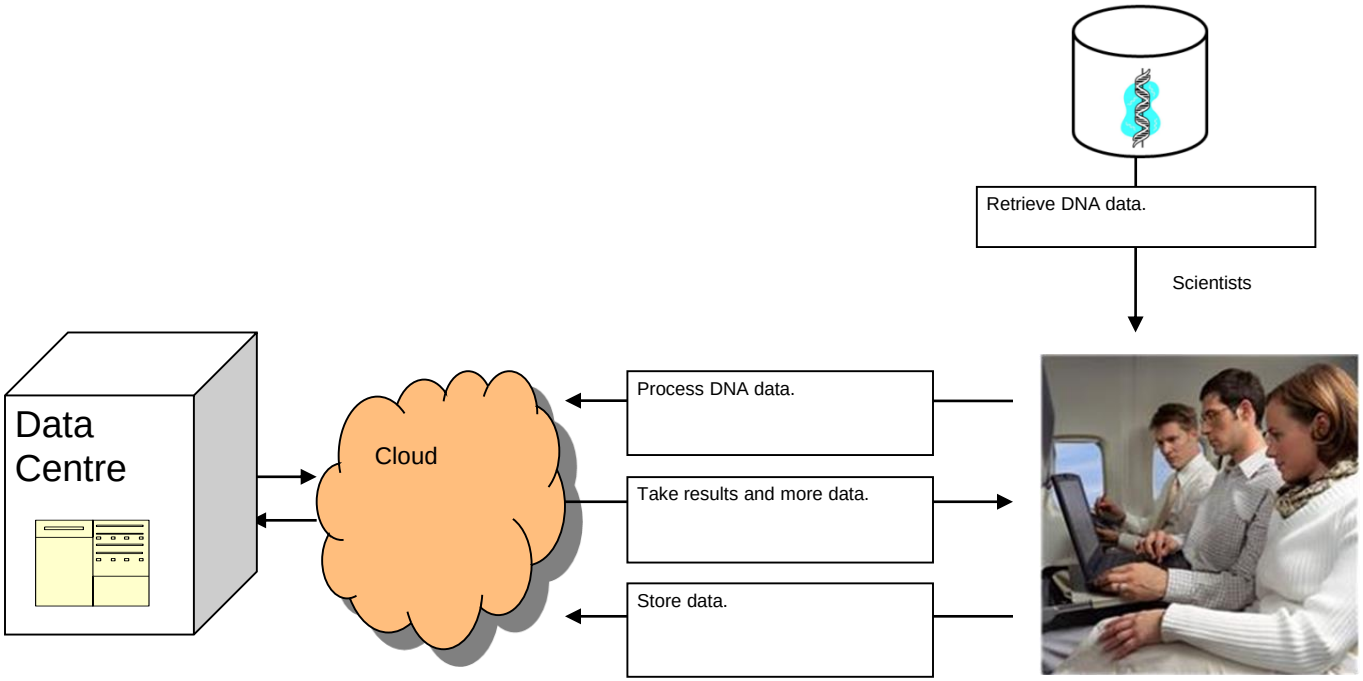
- There are still many concerns about cloud computing:
  - Security
  - Data Protection
  - Outages (disruption of services)
  - Going "bust"!
  - Interoperability (lack of open standards). You cannot change cloud suppliers like changing your electricity suppliers!

Is providing IT as a service a new concept?

- **Not really!**
  - In the 1930s (before computers) companies (such as IBM) specialized in producing **electric accounting machines** based on punch-cards and were able to offer data processing services (e.g., payrolls) to organizations in return for a fee.
  - This practice continued in the 1960s and 1970s (this time using mainframe computers and teletypes). This process was called "Timesharing" then.
  - This is why some people call cloud computing "Timesharing 2.0" (Campbell, 2009).

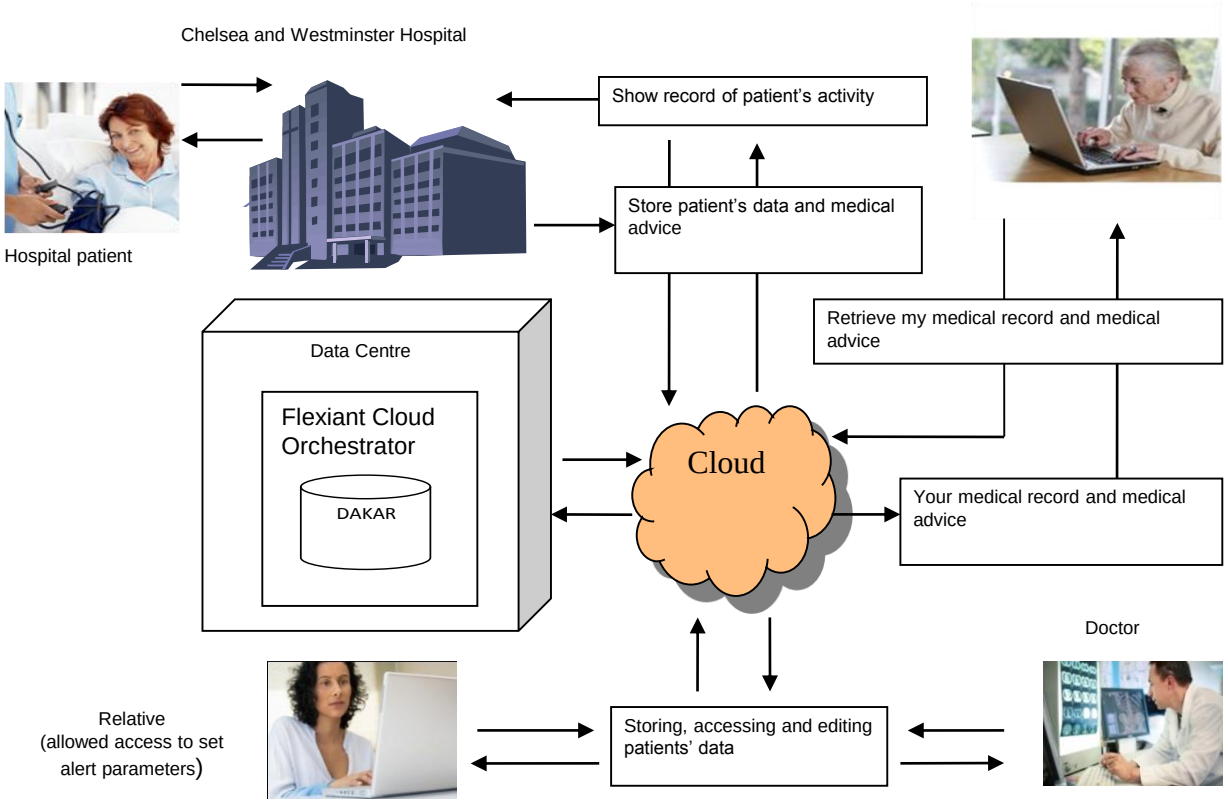
Managing data in the age of the cloud (Life Science Research)

- Sultan (2014a)



Managing data in the age of the cloud (Healthcare Provision)

- Sultan (2014b)



Managing data in the age of the cloud (Big Data)

- **Big Data** is a term used to describe the collection (and processing) of large amounts of different and complex types of data (thanks to the Web and advances in technology) that it becomes difficult to process by using ordinary database management tools (e.g., relational databases) or traditional data processing applications.

- **Google** processes more than 24 petabytes per day, a volume that is thousands of time the quantity of all printed material in the US Library of Congress (Meyer-Schonberger & Cukier, 2013).

Galactic Information!

- University of California (UC) report : **“How Much Information? 2010 Report on Enterprise Server Information”** estimated :

- the annual global processing of data in 2008 by the world’s enterprise servers at 9.57 zettabytes (1 zettabyte = 10^{21}) . If one is to imagine this information as a stack of books (assuming each book is 4.8 centimetres thick and contains 2.5 megabytes of information) it would extend for 5.6 billion miles, enough to stretch from Earth to Neptune 20 times over.

- The study estimated that enterprise server workloads are doubling about every two years. This means that by 2024 the world’s enterprise servers will annually process the digital equivalent of a stack of books extending more than 4.37 light-years to Alpha Centauri, our closest neighbouring star system in the Milky Way Galaxy

Break with the past

- The cloud computing model represents a significant break with the past:
  - You no longer need to buy too much of your hardware and software needs (you can rent them!).
  - No need to maintain (or update) them.
  - No need to hire staff to look after them.
  - You pay for what you need as you go (pay-as-you-go). There is scalability.
  - You could save power (and money).
  - You might even save the environment!
  - It has all attributes of a disruptive innovation!

Disruptive innovations

- According to Clayton Christenson and his colleagues (Christensen, 1997; Christensen and Raynor, 2003; Christensen , Anthony and Roth, 2004) there are two types of disruptive innovations: There are two types of disruptive innovation:

- **New market disruption** (affects established businesses and creates new market opportunities). Think of the PC!
- **Low-end disruption** (affects the low end of the original business by attracting customers who are served by this level of the business). Example: Korean automakers' entry into the US market. The Korean automakers did not create a new market; they simply attracted the "least attractive" customers of the targeted businesses.

New market disruptive innovations

- Such disruptions are described as "new market" disruptions because they destabilize existing markets and create new ones.

- They occur when characteristics (e.g., high cost, inconvenience, complexity) of existing products prevent many people (i.e., non-consumers) from obtaining them.

- Think of mainframe computers and minicomputers (difficult and expensive products) and the PC (a disruptive innovation).

- Disruptive innovations have performance issues (initially)!

The disruptive qualities of cloud computing

- Cost
- Complexity
- Convenience
- Serves non-consumers
- Performance issues
- New market (remote as opposed to on-premise consumption of IT services

The cloud as a new IT servitization model

- Early literature on servitization introduces on the concept as a "value-added" activity (Vandermerwe and Rada, 1988).

- A strategy of creating value by adding services to products (Baines et al., 2009).

- More contemporary research on serzitization sees "service(s)" as the intangible value-creating product of exchange that is more superior (but not an alternative) to the tangible product (Vargo and Lusch, 2008).
- However, what we see in cloud computing is that the **main product** (i.e., software and hardware) **turning (or morphing) into a service** (Sultan, 2014c)!

Democratizing IT !

- Good IT resources are no longer the privilege of well-resourced organisations.
- Small to medium enterprise (SMEs) are likely to be among the main beneficiaries of this computing service model.
- If democracy means empowering the weak by providing equal access to resources then cloud computing is a democratizing force.

Democratising IT !

- Ben Kepes (2011) thinks that cloud computing has unleashed a democratization process similar to that brought about by the word processor.

- Businesses in developing countries now have the option (thanks to cloud computing) to use business software (e.g., CRM applications) that is prohibitively expensive in the traditional software world.

- According to Kepes, the economics and speed of provisioning cloud computing resources is enabling an entire generation of businesses to be founded.

Internet penetration in Developing Countries

- Internet penetration in many parts of the Third World is increasing rapidly (Source: Internet World Stats, 2012)

Internet Users and Population Statistics for Selective African Countries - 2012 Q2				
Selective African Countries	Population (2012 Est.)	Internet Users Dec/2000	Internet Users 30-June-2012	Penetration (% Population)
Cape Verde	523,568	8,000	167,542	32.0
Egypt	83,688,164	450,000	29,809,724	35.6
Kenya	43,013,341	200,000	12,043,735	28.0
Libya	5,613,380	10,000	954,275	17.0
Mauritius	1,313,095	87,000	458,927	35.0
Morocco	32,309,239	100,000	16,477,712	51.0
Nigeria	170,123,740	200,000	48,366,179	28.4
Reunion (FR)	843,459	130,000	300,000	35.6
Saint Helena (UK)	3,687	n/a	1,217	33.0
Sao Tome & Principe	183,176	6,500	36,928	20.2
Senegal	12,969,606	40,000	2,269,681	17.5
Seychelles	90,024	6,000	38,854	43.2
South Africa	48,810,427	2,400,000	8,500,000	17.4
Sudan	34,206,710	30,000	6,499,275	19.0
Swaziland	1,386,914	10,000	251,448	18.1
Tunisia	10,732,900	100,000	4,196,564	39.1
Uganda	33,640,833	40,000	4,376,672	13.0
Zimbabwe	12,619,600	50,000	1,981,277	15.7

Mobile Technology in Developing Countries

- Inadequate communication infrastructures in many developing countries have resulted in a huge rise in mobile and smart phone ownerships.

- The difficulties of rolling out fixed-line networks across Africa's vast land mass explains why in mid-2010 mobile users constituted around 90 percent of all African telephone subscribers (Internet World Stats, 2012).

Mobile Technology in Developing countries?

- If there is any real future for a massive uptake of cloud computing in the developing world it is likely to be through **mobile broadband**.

- Providing SaaS through mobile broadband can give businesses in the developing world a (potentially) low cost alternative to traditional desktop-based business applications.

- By moving their data to the cloud, these businesses are not held hostage to frequent power failures and broadband disruptions that are common in many developing countries (Goundar, 2010).

Mobile Technology in Developing Countries

- Such scenario will no doubt have an impact on the world's ability to access IT resources.
- The democratising force of cloud computing provides an opportunity for individuals and businesses in developing countries to compete with those in advanced nations on an equal footing.
- And could (consequently) bridge the digital divide that currently exists between the developed and the developing countries or north and south, thus making cloud computing a force for good in a world marred by historic inequality and financial greed.

Thank you..

Questions?

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Data Centre

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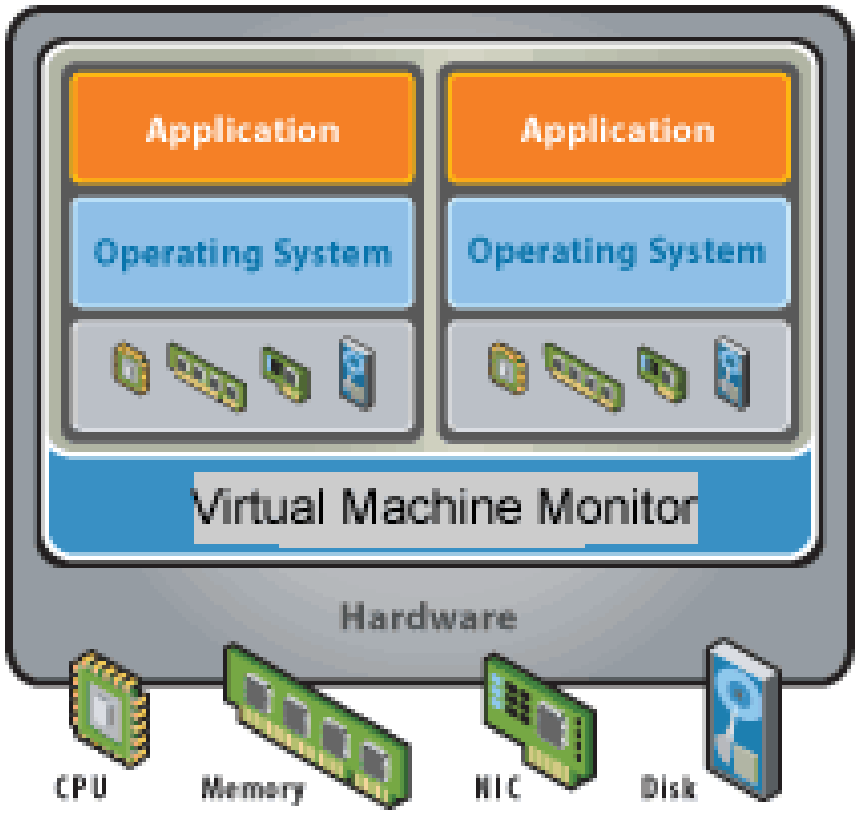
Virtualization

Server (Full) Virtualization



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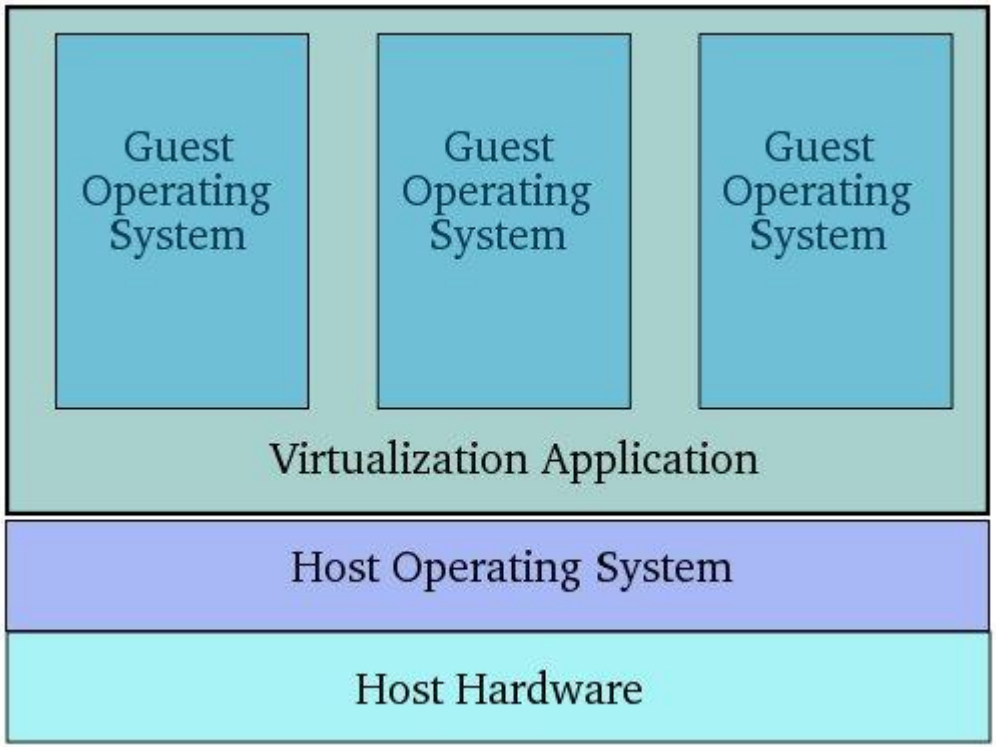
Virtualization

Hosted Virtualization



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