閱讀摘錄與筆記

A View of Cloud Computing (2010)

前作：Above the Clouds: A Berkeley View of Cloud Computing (2009)

> **Computing as a utility**, has the potential to transform a large part of the IT industry, making software even more attractive as a service and shaping the way IT hardware is designed and purchased.

1000 台機器運行 1 小時提供的運算量相等於 1 台機器運行 1000 小時。如果可以這樣去衡量的話，當時間與規模的代價在比較利益下互有優劣時，運算中心的誘人之處就凸顯出來了。

Computing as utility（功能），「功能化」的運算會再度改變電腦的使用習慣。近代個人電腦作為 universal computing machine 在未來會有可能式微也說不定？

Definition of Cloud computing：Cloud computing refers to both the applications delivered as services over the Internet and the hardware and systems software in the data centers that provide those services.

文中提及 IaaS 與 PaaS 僅是 SaaS 在移往 lower/higher 等級的服務的不同而已。避免混淆，文章中僅承認 SaaS。(Saas: application delivered over the Internet)

Definition of Cloud: HW/SW of data center

- Public cloud: opened to the general public, selling **utility computing**
- Private cloud: internal data center

Cloud computing is the sum of SaaS and utility computing.

一個組織在架設服務的時候都需要考慮硬體如何配置（伺服器要買多好、機櫃空間、買 Router/Switch）。這樣的長遠規劃稱為 hardware provisioning。而 data center （cloud computing）在這方面帶來了改變：

- 動態的配置（儲存/計算）資源，使用者不需要做長遠規劃的必要。（想要更多就跟 data center 要）
- 動態的配置同時也可以讓短期使用的 trade-off 更小，這時保守策略下的 cost down 變得更划算
- 不需要購買一些基本設施來測試 data storage/computing

> Omitting private clouds from cloud computing has led to considerable debate in the blogosphere. We believe the confusion and skepticism illustrated by Larry Ellison's quote occurs when the advantages of public clouds are also claimed for medium-sized data centers.
>
> The statistical multiplexing necessary to achieve elasticity and the appearance of infinite capacity available on demand re- quires automatic allocation and management. In practice, this is done with

經過 Virtualization ， Hypervisor (VMM) 接受上層各式 VM 的要求，OS 排成進行 muliplexing 。（automatic allocation and management 交給 OS 來處理）
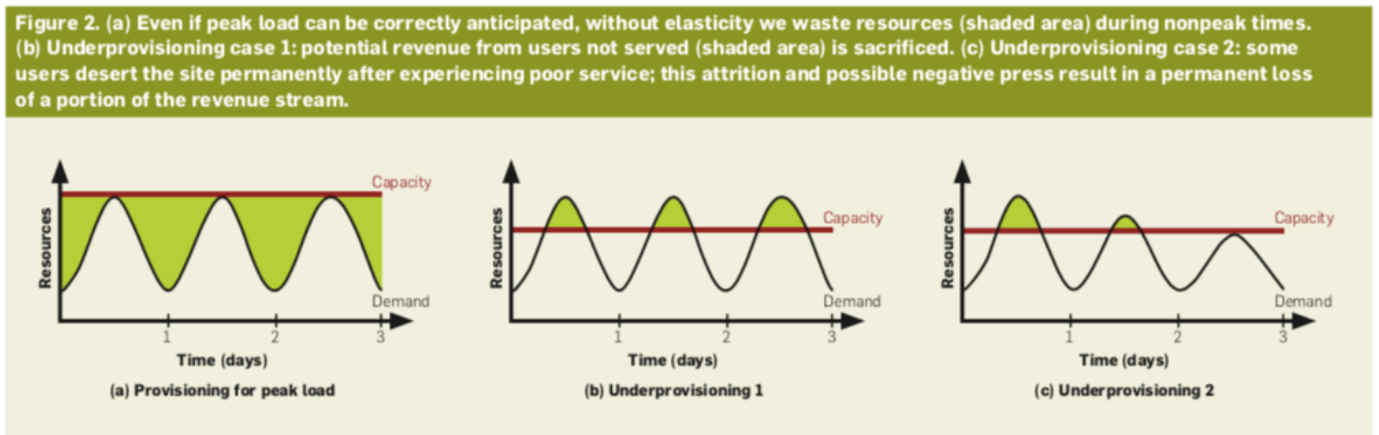
影響 utility（功能）的建置有兩個層面：抽象化的層次，以及待管理資源的層次。舉例兩極端：

- Amazon EC2 提供**近似一台伺真實服器**的環境，硬體以上的所有東西都可以由使用者設定與架設。
- Google AppsEngine 提供**無伺服器的應用程式平台**，免去架設伺服器及網路設定。（可以在上面架一個 django app 之類的）
- [Azure] 為上面兩極端的混合。

Utility computing vs. Conventional hosting （功能化的運算/儲存 vs. 自身為 host 的運算/儲存）在經濟利益之下進行比較：（忽略安全性考量）

- demand for a service varies with time
- demand is unknown

Cloud computing 帶來的正是 economic benefit of elasticity。（見下圖）

Figure 2. (a) Even if peak load can be correctly anticipated, without elasticity we waste resources (shaded area) during nonpeak times. (b) Underprovisioning case 1: potential revenue from users not served (shaded area) is sacrificed. (c) Underprovisioning case 2: some users desert the site permanently after experiencing poor service; this attrition and possible negative press result in a permanent loss of a portion of the revenue stream.

Cloud computing 發展關鍵與問題： （這些 criteria 可以拿來衡量 openstack ，open source cloud technologies）

Problems
availability：使用者對雲端中心能否穩定提供服務質疑
data lock-in：擔心資料在雲端中心之間的互通性
data confidentiality
data transfer bottleneck: 輪船運送一個 10TB 的硬碟橫跨太平洋 vs. 兩台終端機之間 end2end 傳送 10TB 的資料（我讀到這 topic 的第一個念頭也是想到這個問題XD）
performance unpredictability：problem of I/O interference between virtual machines, flash memory will decrease I/O interference
scalable storage: 資料放哪裡
bugs in large-scale distributed system
legislation issues: issue between cloud provider & users, software licensing

其實這些問題在現在 (2019) 的技術來說，是已經不太需要擔心的事情。