



淺談雲端運算趨勢與虛擬化技術發展

The trend of Cloud Computing and Virtualization Technology

Jazz Wang
Yao-Tsung Wang
jazz@nchc.org.tw



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淺談雲端運算的新趨勢

Part 1 : Overview the trend of Cloud Computing

Jazz Wang
Yao-Tsung Wang
jazz@nchc.org.tw



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什麼是雲端運算啊？可以個簡單的定義嗎？

What is Cloud Computing ?

雲端運算怎麼聽起來要買一些新硬體、新軟體啊？

Is it about buying NEW Hardware and Software?



雲端運算可能只是拿來振興經濟的幌子吧？

Is it a trap to another bubble economy ?

我聽你們在那裡講五四三.....

Cloud Computing is as simple as 5..4..3..2..1...



National Definition of Cloud Computing 美國國家標準局 **NIST** 給雲端運算所下的定義

5 Characteristics

五大基礎特徵

4 Deployment Models

四個佈署模型

3 Service Models

三個服務模式

On-demand self-service.

隨需自助服務

Broad network access

隨時隨地用任何網路裝置存取

Resource pooling

多人共享資源池

Rapid elasticity

快速重新佈署靈活度

Measured Service

可被監控與量測的服務

4 Deployment Models of Cloud Computing

雲端運算的四種佈署模型

Public Cloud

公用雲端



Target Market

is **S.M.B.**

主要客戶為

中小企業

**Dynamic Resource Provisioning
between public and private cloud**

私有雲端動態根據計算需求

調用公用雲端的資源

*Hybrid
Cloud*

以**大型企業**
為主要客戶
**Enterprise is
key market**

Community Cloud

社群雲端

Academia 學術為主



私有雲端

Private Cloud

3 Service Models of Cloud Computing

雲端運算的三種服務模式

IaaS

Infrastructure as a Service

架構即服務

PaaS

Platform as a Service

平台即服務

SaaS

Software as a Service

軟體即服務



2 R&D directions : Cloud or Device

兩大研究方向：你該選「雲」還是「端」？



One key spirit of Cloud Computing

用一句話說明雲端運算！服務才是王道！

Anytime 隨時

Anywhere 隨地

With Any Devices 使用任何裝置

Accessing Services 存取各種服務

Cloud Computing =~ ***Network Computing***

雲端運算 =~ 網路運算

Key spirit of Cloud ~

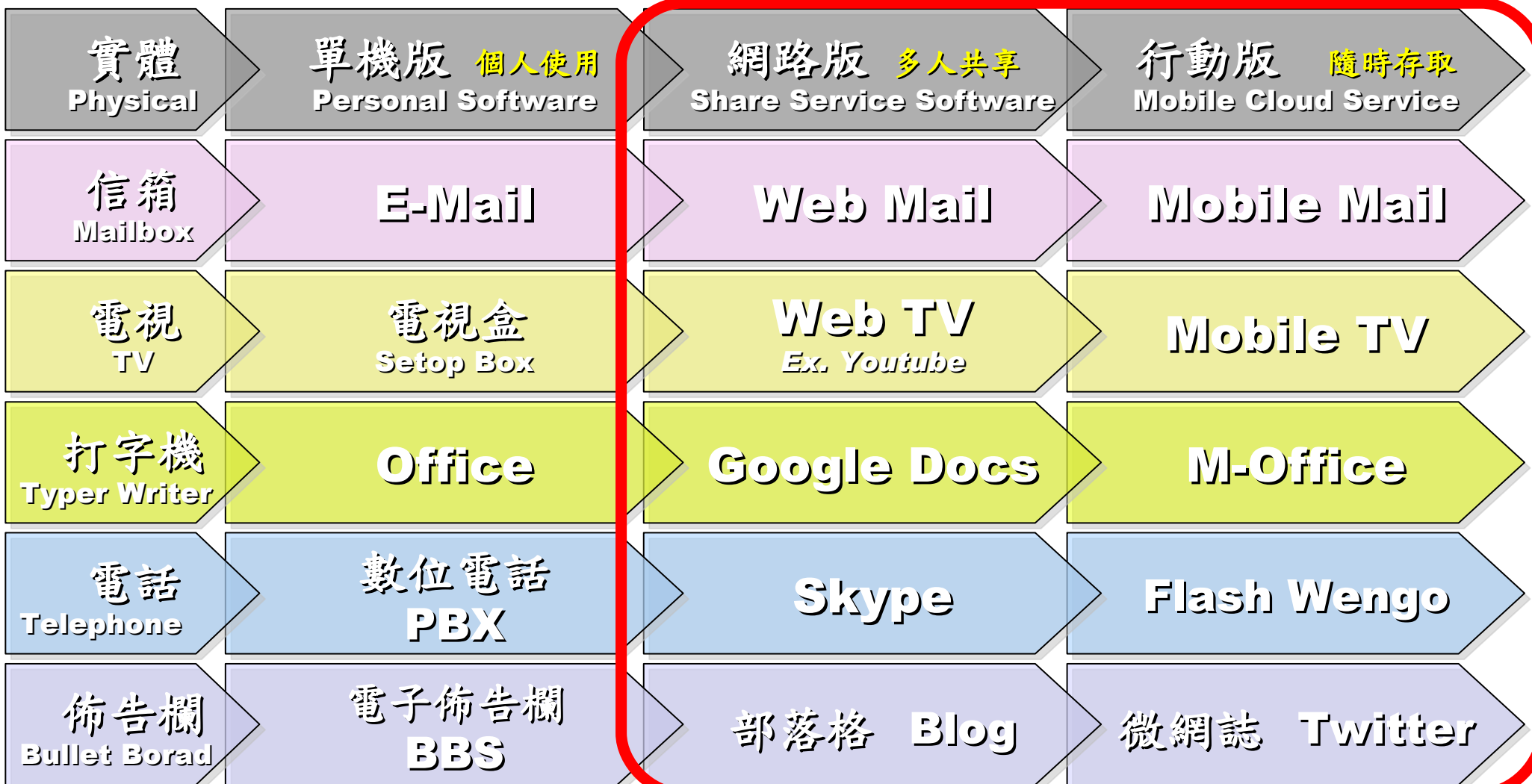
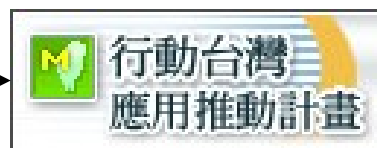
形成服務才是重點！！

Everything as a Service !!

Evolution of Cloud Services

雲端服務只是軟體演化史的必然趨勢

數位化



Rome wasn't built in a day !

羅馬不是一天造成的！



圖片來源：<http://www.mjfq.com/pic/20070822/20070822234234402.jpg>

When did the Cloud come ?!

這朵雲幾時飄過來的？！

Brief History of Computing (1/5)



Source: <http://pinedakrch.files.wordpress.com/2007/07/>

**Mainframe
Super
Computer**

1960 PDP-1

*·
·
·*

1965 PDP-7

*·
·
·*

1969 1st Unix

1977 Apple II



1981 IBM 1st PC 5150



Back to Year 1970s ...

Brief History of Computing (2/5)



Source: <http://www.nhc.org.tw>

Mainframe
Super
Computer

PC | Linux
Cluster
Parallel

**1990 World Wide Web
by CERN**

...

...

**1993 Web Browser
Mosaic by NCSA**



1991 CORBA

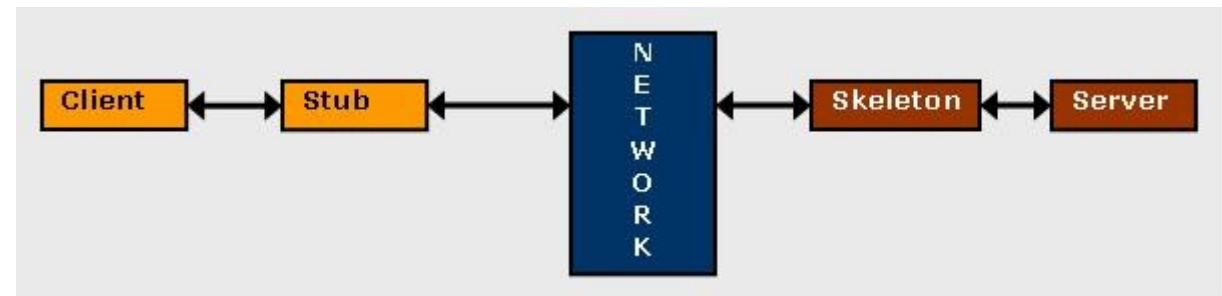
...

Java RMI

Microsoft DCOM

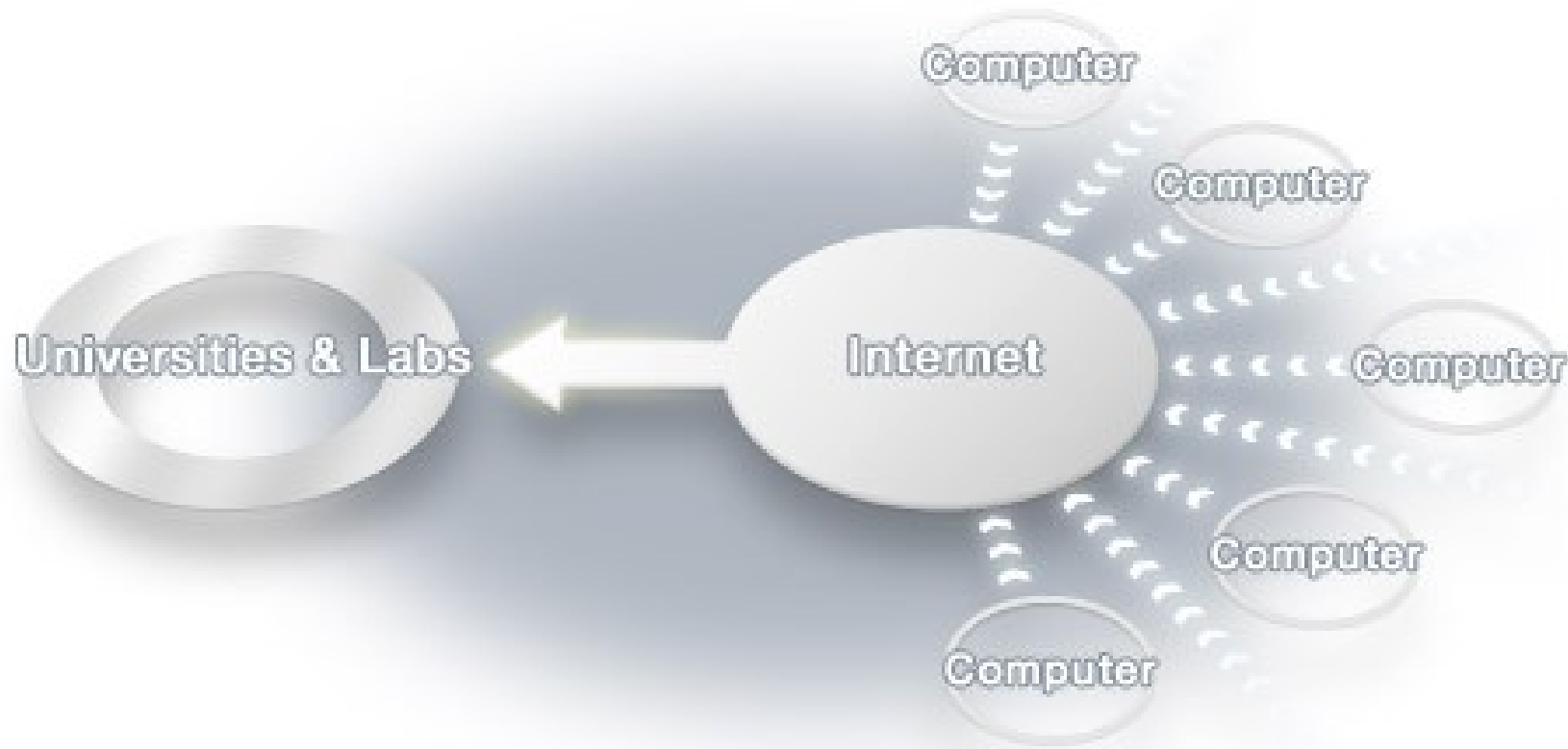
...

Distributed Objects



Back to Year 1990s ...

Brief History of Computing (3/5)



Source: <http://www.scei.co.jp/folding/en/dc.html>

Mainframe
*Super
Computer*

PC | Linux
*Cluster
Parallel*

Internet
*Distributed
Computing*

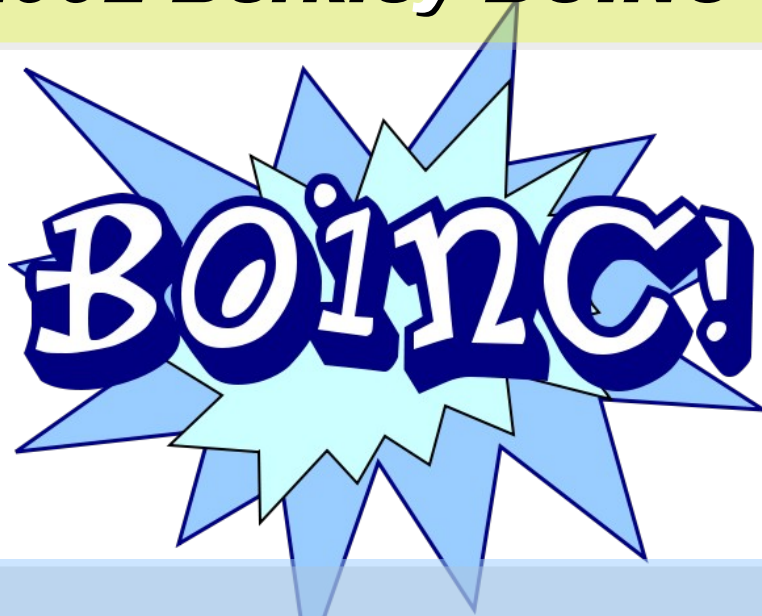
1997 Volunteer Computing
1999 SETI@HOME



2003 Globus Toolkit 2



2002 Berkley BOINC



2004 EGEE gLite



Back to Year 2000s ...

Brief History of Computing (4/5)



Source: <http://gridcafe.web.cern.ch/gridcafe/whatisgrid/whatis.html>

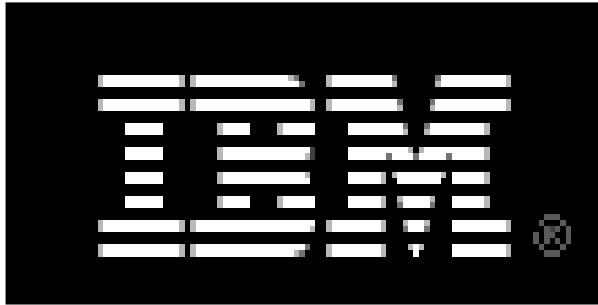
Mainframe
*Super
Computer*

PC | Linux
*Cluster
Parallel*

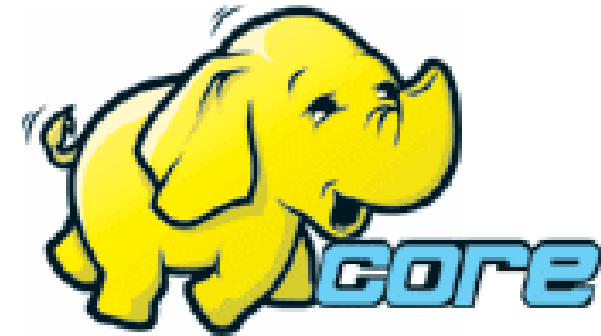
Internet
*Distributed
Computing*

Virtual Org.
*Grid
Computing*

2001 Autonomic Computing
IBM



2006 Apache Hadoop



2005 Utility Computing
Amazon EC2 | S3

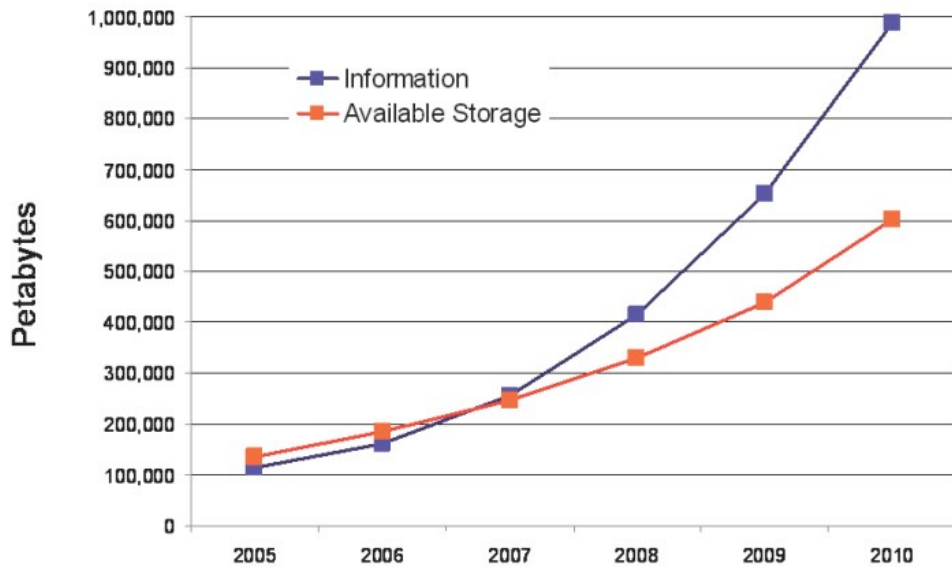


2007 Cloud Computing
Google + IBM



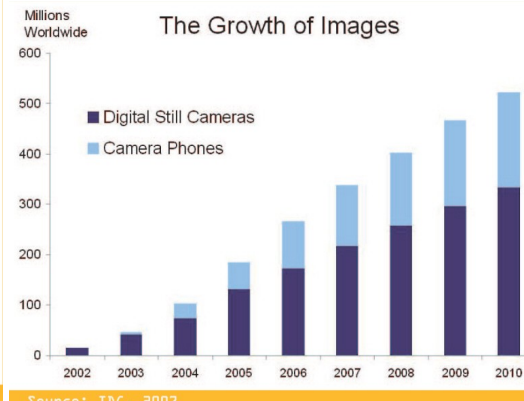
Back to Year 2007 ...

Information Versus Available Storage



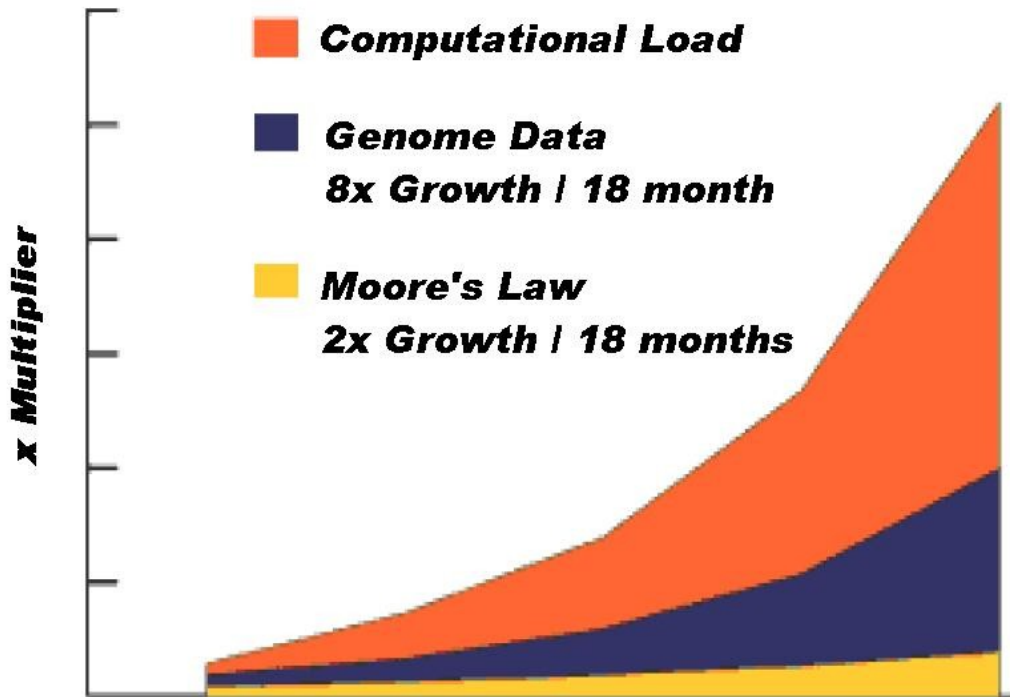
2007 Data Explore

Top 1 : Human Genomics – 7000 PB / Year
Top 2 : Digital Photos – 1000 PB+ / Year
Top 3 : E-mail (no Spam) – 300 PB+ / Year



Source: <http://www.emc.com/collateral/analyst-reports/expanding-digital-idc-white-paper.pdf>
 Source: IDC, 2007

Source: IDC, 2007

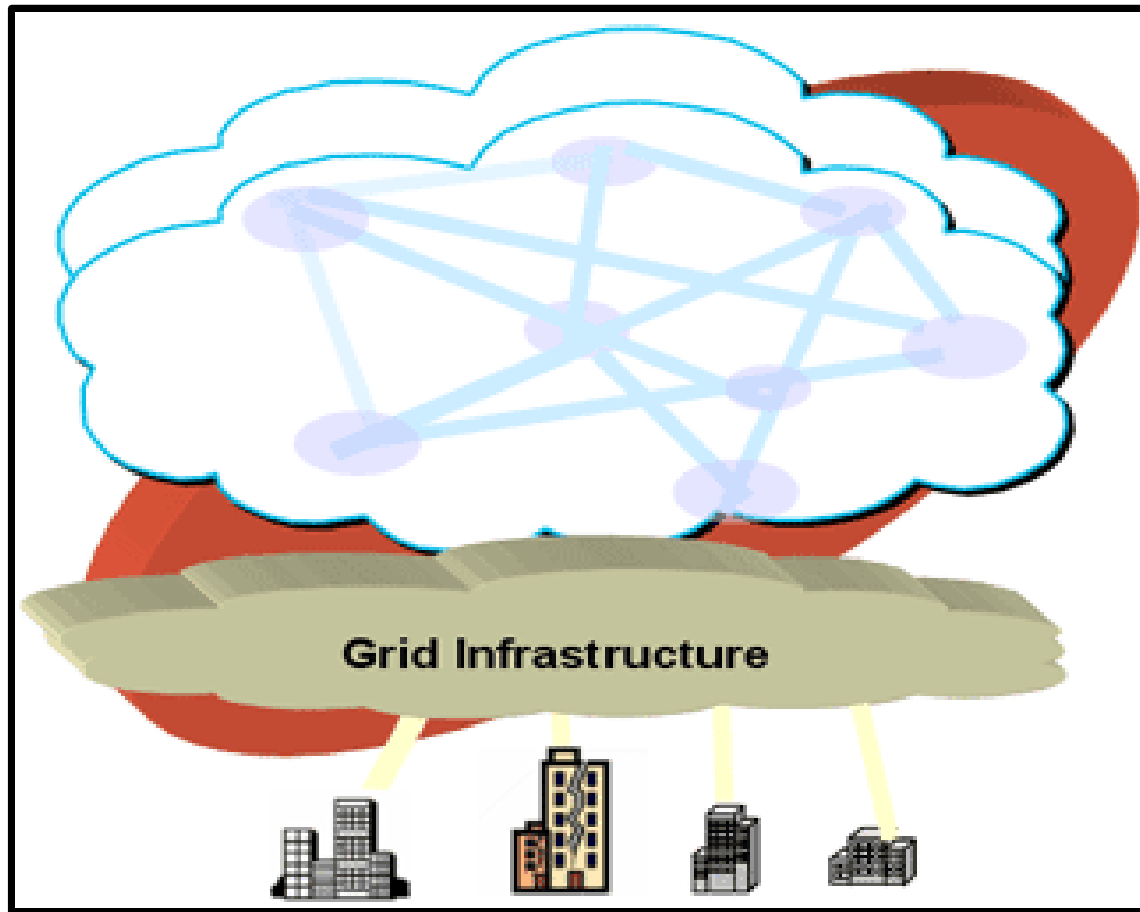


Particle Physics Large Hadron Collider (15PB)	Human Genomics (7000PB) 1GB / person 200PB+ captured 200% CAGR	World Wide Web (~1PB)	Wikipedia (10GB) 100% CAGR
Annual Email Traffic, no spam (300PB+)	Internet Archive (1PB+)	Estimated On-line RAM in Google (8PB)	Personal Digital Photos (1000PB+) 100% CAGR
200 of London's Traffic Cams (8TB/day)	2004 Walmart Transaction DB (500TB)	Typical Oil Company (350TB+)	Merck Bio Research DB (1.5TB/qtr)
UPMC Hospitals Imaging Data (500TB/yr)	MIT Babytalk Speech Experiment (1.4PB)	Terashake Earthquake Model of LA Basin (1PB)	One Day of Instant Messaging in 2002 (750GB)
Total digital data to be created this year 270,000PB (IDC)			

Source: http://lib.stanford.edu/files/see_pasig_dic.pdf

Phillip B. Gibbons, Data-Intensive Computing Symposium

Brief History of Computing (5/5)



Source: <http://mmdays.com/2008/02/14/cloud-computing/>

mainframe
super
computer

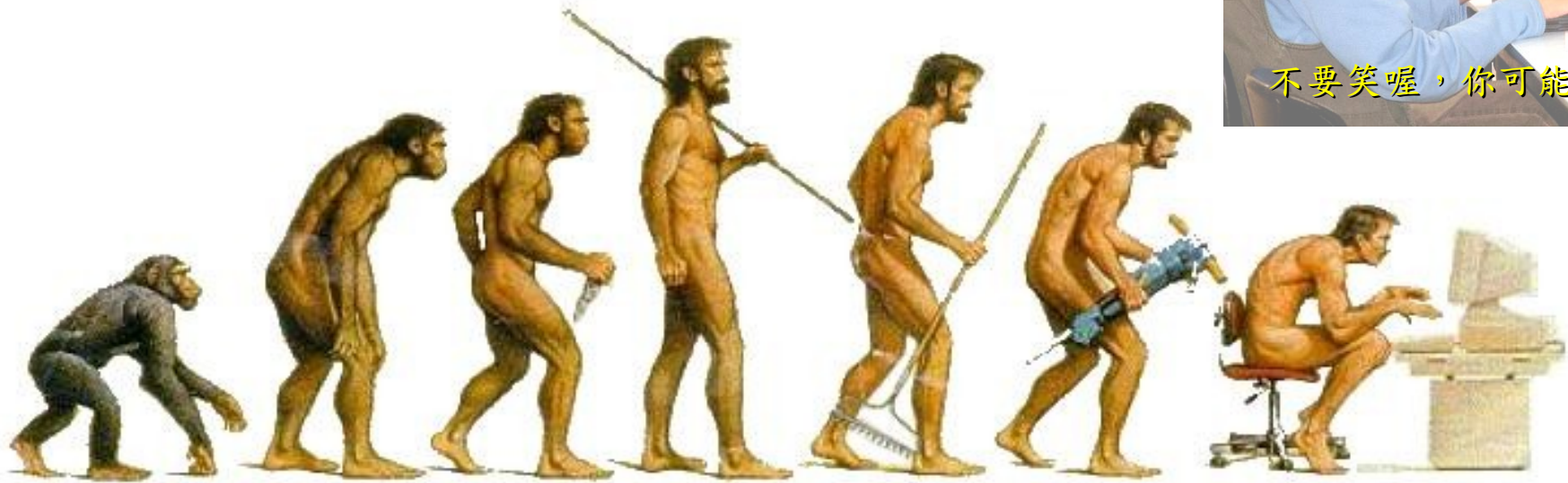
PC | Linux
Cluster
Parallel

Internet
Distributed
Computing

Virtual Org.
Grid
Computing

Data Explode
Cloud
Computing

Evolution



(OR is it?)

What can we learn from the past ?!

在這漫長的演化中，我們到底學到些什麼?!

Lesson #1: One cluster can't fit all !

教訓一：叢集的單一設定無法滿足所有需求！

Answer #1: Virtual Cluster 新服務：虛擬化叢集

Lesson #2: Grid for Heterogeneous Enterprise !

教訓二：格網運算該用在異業結盟的資源共享！

Answer #2: Peak Usage Time 尖峰用量發生時間點

Lesson #3: Extra cost to move data to Grid !

教訓三：資料搬運的網路與時間成本！

Answer #3: Total Cost of Ownership 總擁有成本

This is why Cloud Computing matters ?!

這就是為什麼雲端運算變得熱門?!

What are the trend of next 10 years ?

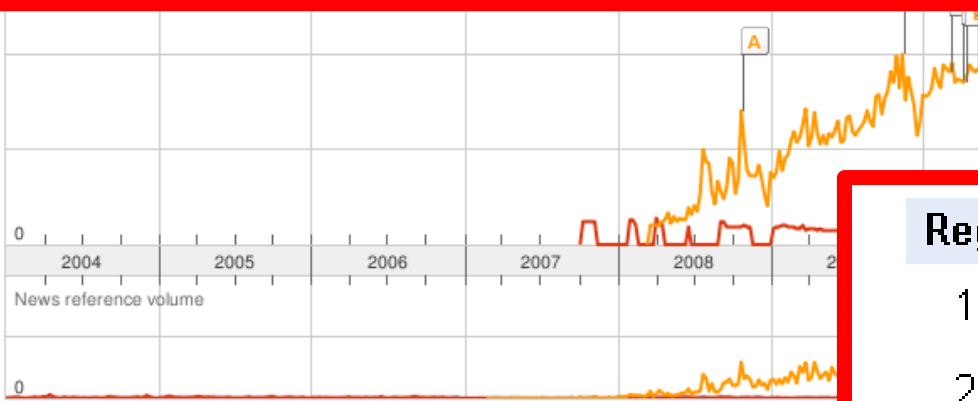
什麼是下個十年的熱門技能？

● distributed computin... ● grid computing ● cloud computing

[Sign in](#) to see and export additional Tren

All regions All years

Search Volume index



- B [Microsoft's cloud computing system is growing up](#)
Philadelphia Inquirer - Nov 17 2009
- C [Google looks to be 'cloud-computing' rainmaker for other online business services](#)
Winnipeg Free Press - Mar 10 2010

Regions

- [India](#)
- [Singapore](#)
- [South Korea](#)
- [Hong Kong](#)
- [Taiwan](#)
- [Ireland](#)

Regions

- [India](#)
- [Singapore](#)
- [South Korea](#)
- [Hong Kong](#)
- [Taiwan](#)
- [Ireland](#)

Cities

- Bangalo
- Mahape
- Mumbai
- Chennai
- San Jos
- Delhi, In

似乎亞洲國家特別熱愛雲端?! *Too Hot in Asia?!*

Trend #1: Data are moving to the Cloud

趨勢一：資料開始回歸集中管理

Access data anywhere anytime 為了隨時存取

Reduce the risk of data lost 降低資料遺失風險

Reduce data transfer cost 減少資料傳輸成本

Enhance team collaboration 促進團隊協同合作

How to store huge data ?!

如何儲存大量資料呢?!

Trend #2: Web become default Platform!

趨勢二：網頁變成預設開發平台

Open Standard 網頁是開放標準

Open Implementation 實作不受壟斷

Cross Platform 瀏覽器成為跨平台載具

Web Application 網頁程式設計成為顯學

Browser difference become entry barrier ?!

瀏覽器的差異造成新的技術門檻?!

Trend #3: HPC become a new industry

趨勢三：高速計算已悄悄變成新興產業

Parallel Computing 平行運算的技能

Distributed Computing 分散運算的技能

Multi-Core Programming 多核心程式設計

Processing Big Data 處理大資料的技能

Education and Training are needed !!

為了讓這些技能與產業接軌，亟需教育訓練！！

Let's Talk about Public Cloud

讓我們先來談談公用雲端服務

Public Cloud

公用雲端



Microsoft

Google

Target Market

is **S.M.B.**

主要客戶為

中小企業

*Hybrid
Cloud*

以**大型企業**
為主要客戶
Enterprise is
key market

Community Cloud

社群雲端

Academia **學術**為主

IBM

私有雲端

Private Cloud



- Amazon Web Service (AWS)
- 虛擬伺服器：**Amazon EC2**
 - Small (Default) \$0.085 per hour(L) - \$0.12 per hour(W)
 - All Data Transfer \$0.15 per GB
- 儲存服務：**Amazon S3**
 - \$0.15 per GB – first 50 TB / month of storage used
 - \$0.15 per GB – all data transfer in
 - \$0.01 per 1,000 PUT, COPY, POST, or LIST requests
- 觀念：**Paying for What You Use**

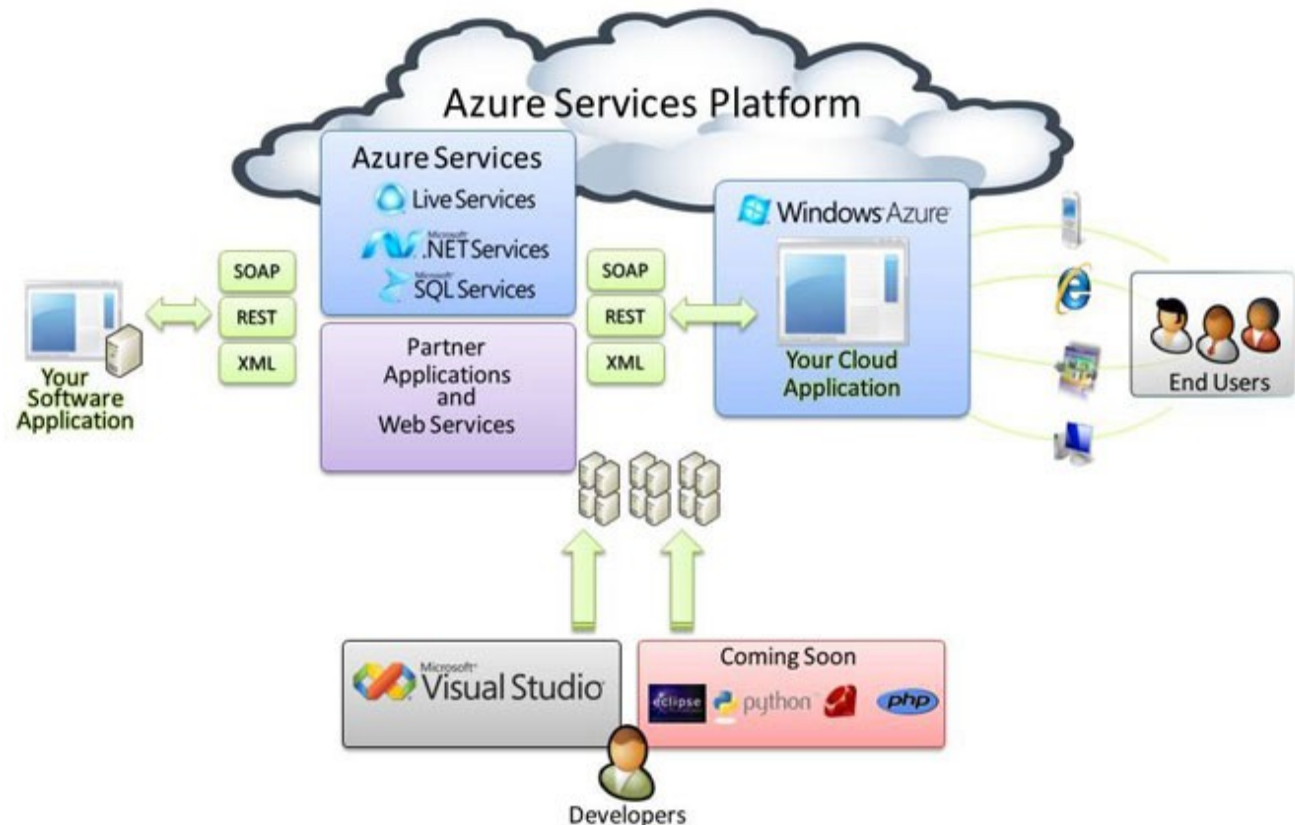
參考來源：<http://eblog.cisnet.org.tw/post/Cloud-Computing.aspx>
<http://aws.amazon.com/ec2/pricing/>
<http://aws.typepad.com/aws/2010/02/aws-data-transfer-prices-reduced.html>
<http://aws.amazon.com/s3/#pricing>

- Google App Engine (GAE)
- 讓開發者可自行建立網路應用程式於 Google 平台之上。
- 提供：
 - 500MB of storage
 - up to 5 million page views a month
 - 10 applications per developer account
- 限制：
 - 程式設計語言只能用 Python 或 Java
- 計費標準：
 - 連出頻寬 \$0.12 美元/GB, 連入頻寬 \$0.10 美元/GB
 - CPU 時間 \$0.10 美元/時
 - 儲存的資料 \$0.15 美元/GB-每月
 - 電子郵件收件者 \$0.0001 美元/每個收件者



Public Cloud #3: *Microsoft* 微軟

- Microsoft Azure 是一套雲端服務作業系統。
- 作為 Azure 服務平台的開發、服務代管及服務管理環境。
- 服務種類：
 - .Net services
 - SQL services
 - Live services



Microsoft Cloud Computing 全貌

Private

Public

Microsoft SharePoint Server
 Microsoft Exchange
 Microsoft Dynamics

Software as a Service (SaaS)

Microsoft Online Services

Microsoft SharePoint Services
 Microsoft Office Live

Microsoft SQL Server
 Microsoft .NET

Platform as a Service (PaaS)

Windows Azure
 SQL Services
 Windows Azure platform
 AppFabric

Microsoft System Center
 Windows Server

Infrastructure as a Service (IaaS)

Windows Azure
 Microsoft System Center
 Windows Server

Microsoft | Dynamic Data Center Toolkit For Enterprises

Microsoft | Dynamic Data Center Toolkit For Hosters

IT as a Service

Dallas
→ DaaS

Azure
AppFabric
→ PaaS
(類似 GAE)

SQL Azure
→ PaaS
(雲端 SQL)

Window Azure
→ PaaS
(類似 EC2)

Hyper-V
→ IaaS
(虛擬化)

Public Cloud Comparison:

公用雲端的比較

	On-Premises Apps	Small-to-Medium Web Apps	Large Web Apps	Parallel Processing Apps	Web Apps with Back-end Processing	Store Blob Data
GoGrid, Flexiscale, Others	X	X				
Amazon Web Services	X	X	X	X	X	X
Windows Azure 2009 July CTP		X	X	X	X	X
Google AppEngine			X			
Salesforce.com Force Platform			X			

25

How can we build our Private Cloud ??

那我們如何打造私有雲端呢??

Public Cloud

公用雲端



Microsoft

Google

Target Market

is **S.M.B.**

主要客戶為

中小企業

**Hybrid
Cloud**

以**大型企業**
為主要客戶
Enterprise is
key market

Community Cloud

社群雲端

Academia **學術**為主



私有雲端

Private Cloud

Reference Cloud Architecture

雲端運算的參考架構

應用

Social Computing, Enterprise, ISV, ...

程式語言

Web 2.0 介面, Mashups, Workflows, ...

控制

Qos Negotiation, Admission Control, Pricing, SLA Management, Metering...

虛擬化

VM, VM management and Deployment

硬體設施

Infrastructure: Computer, Storage, Network

User-Level

User-Level
Middleware

Core
Middleware

System Level

IaaS
PaaS
SaaS

Open Source for Private Cloud

建構私有雲端運算架構的自由軟體

應用

Social Computing, Enterprise, ISV, ...

eyeOS, Nutch, ICAS,
X-RIME, ...

程式語言

Web 2.0 介面, Mashups, Workflows, ...

Hadoop (MapReduce),
Sector/Sphere, AppScale

控制

Qos Negotiation, Admission Control,
Pricing, SLA Management, Metering...

OpenNebula, Enomaly,
Eucalyptus, OpenQRM, ...

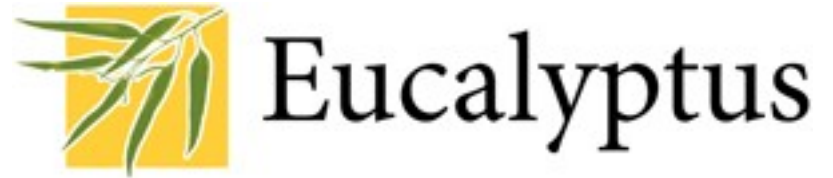
虛擬化

VM, VM management and Deployment

Xen, KVM, VirtualBox,
QEMU, OpenVZ, ...

硬體設施

Infrastructure: Computer, Storage,
Network

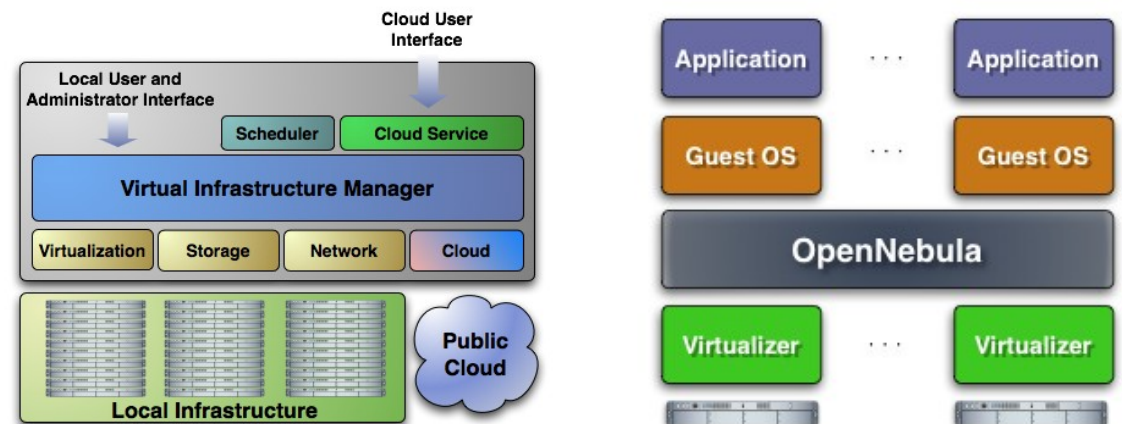


- <http://open.eucalyptus.com/>
- 原是加州大學聖塔芭芭拉分校(UCSB)的研究專案
- 目前已轉由Eucalyptus System這間公司負責維護
- 創立目的是讓使用者可以**打造自己的EC2**
- 特色是相容於 Amazon EC2 既有的用戶端介面
- 優勢是Ubuntu 9.04 已經收錄 Eucalyptus 的套件
- [Ubuntu Enterprise Cloud powered by Eucalyptus in 9.04](#)
- 目前有提供 Eucalyptus 的官方測試平台供註冊帳號
- 缺點：目前仍有部分操作需透過指令模式

- <http://www.opennebula.org>
- 由歐洲研究學會(European Union FP7)贊助
- 將實體叢集轉換成具管理彈性的虛擬基礎設備
- 可管理**虛擬叢集**的**狀態、排程、遷徙(migration)**
- 優勢是Ubuntu 9.04 已經收錄 OpenNebula 的套件
- 缺點：需下指令來進行虛擬機器的遷徙(migration)。



關於 OpenNebula 的更多資訊，請參考
<http://trac.nchc.org.tw/grid/wiki/OpenNEbula>





虛擬化技術的過去、現在與未來

Part 2 : Virtualization - PAST, NOW and FUTURE

Jazz Wang
Yao-Tsung Wang
jazz@nchc.org.tw



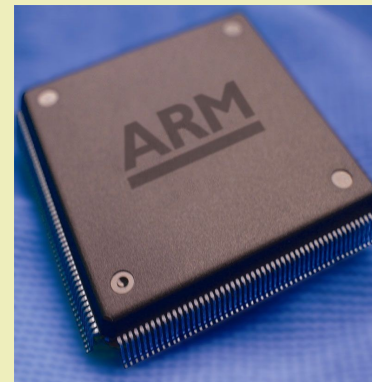
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Virtualization ?? Emulator ??

模擬器，最早的虛擬化技術??

Virtual Hardware / OS

模擬硬體 / 作業系統



mame4iphone

Latest Version:

MAME 0.138 15 May 10

— DOWNLOAD NOW —

[Download source updates to MAME 0.138](#)

Mac4Lin

QEMU



Physical Hardware / OS

實際硬體 / 作業系統

What is Virtualization ??

虛擬化技術有哪些呢??

Application Virtualization 應用程式虛擬化

Desktop Virtualization
Client Virtualization 桌面虛擬化

Presentation Virtualization 顯示虛擬化

OS-level Virtualization 作業系統虛擬化

Network Virtualization 網路虛擬化

Storage Virtualization 儲存虛擬化

資料

庫資料
資料
虛擬化

Database Virtualization

Data Virtualization

Open Source for Virtualization

自由軟體虛擬化技術

Application Virtualization 應用程式虛擬化

Desktop Virtualization
Client Virtualization 桌面虛擬化

Presentation Virtualization 顯示虛擬化

OS-level Virtualization 作業系統虛擬化

Network Virtualization 網路虛擬化

Storage Virtualization 儲存虛擬化

??

VNC, FreeNX

Xen, VirtualBox,
KVM, OpenVZ

Open vSwitch

ZFS, Lustre,
Ceph

CIO 2010 : Virtualization, Cloud and Web 2.0

虛擬化技術是 2010 年 CIO 資訊長認為最重要的資訊投資

CIO strategic technologies reflect increased interest in “lighter-weight” solutions

CIO technologies

Ranking of technologies CIOs selected as one of their top 5 priorities in 2010

Ranking	2010		2009	2008	2007
Virtualization	1	↑	3	3	5
Cloud computing	2	↑	16	*	*
Web 2.0	3	↑	15	15	*
Networking, voice and data communications	4	↑	6	7	4
Business intelligence (BI)	5	↓	1	1	1
Mobile technologies	6	↑	12	12	11
Data/document management and storage	7	↑	10	9	9
Service-oriented applications and architecture	8	↑	9	10	7
Security technologies	9	↓	8	5	6
IT management	10		*	*	*
Enterprise applications	11	↓	2	2	2

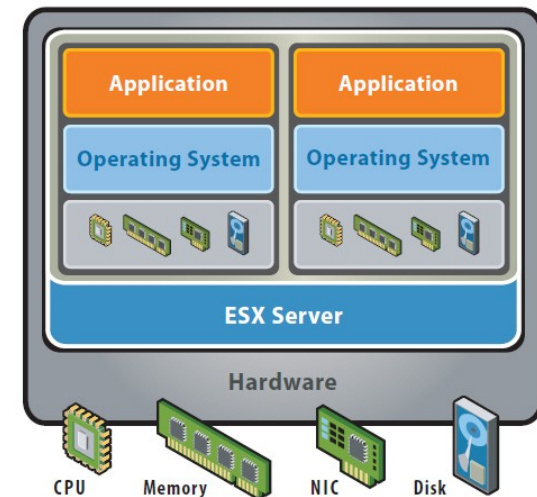
* New question for that year

Source: Gartner Executive Programs : “ Leading in Times of Transition: The 2010 CIO Agenda ”

Why do we need Virtualization ?

企業為何採用虛擬化技術？

- 導入虛擬化的效益高於雲端運算
- 導入評量指標：
 - 總硬體使用率 (100% CPU 使用 ?)
 - 總電源開銷、空調、管理人力
- 商業解決方案：
 - **VMWare** ESXi / vSphere
 - **Microsoft** Hyper-V
 - **Citrix** XenServer
- 預期效益：
 - 減少伺服器採購成本與營運成本 (Server Consolidation)
 - 增加管理彈性與災害復原機制 (Ex. 異常斷電造成的服務修復)



VMware ESX Server virtualizes server storage and networking, allowing multiple applications to run in virtual machines on the same physical server.



Windows Server® 2008
Hyper-V™



Presentation Virtualization

顯示虛擬化：用 **Terminal** + 無碟架構

用綠色自由軟體

GREEN OSS

打造綠色工廠

GREEN FACTORY

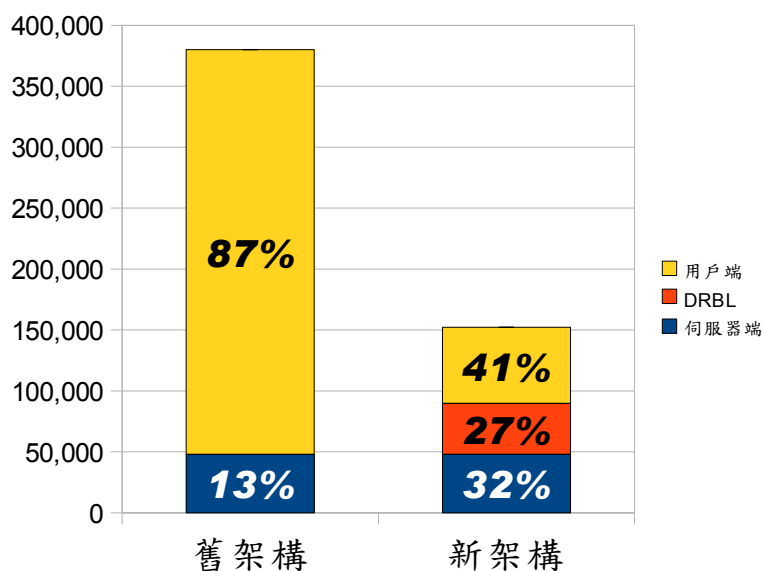
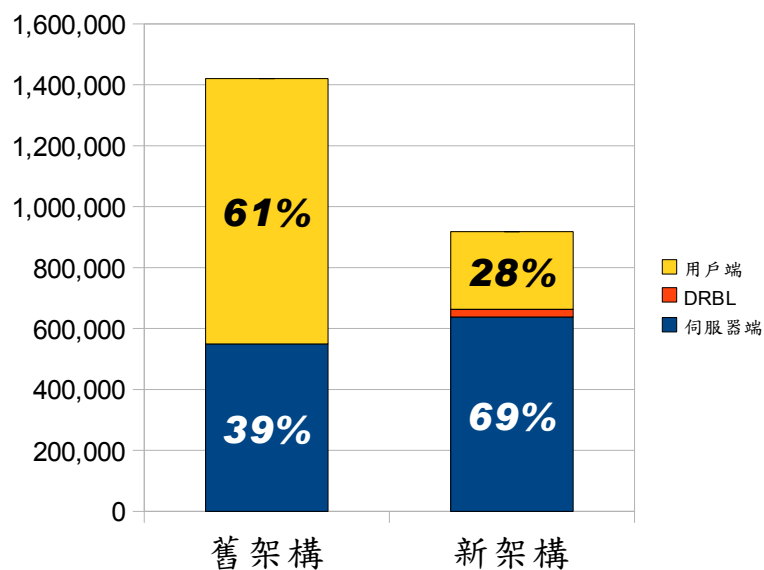
關於企鵝龍 (DRBL) 在金屬加工業的節能案例分享，請參考

http://trac.nhc.org.tw/cloud/attachment/wiki/jazz/09-10-14/TSMC/08-08-17_DRBL_Green_Computing_v2.pdf

修改理念 = 減少不必要的開支與能源消耗

- 降低硬體建置開支
 - 不用 **200W** 的桌上型電腦（有風扇→易故障）
 - 改用 **20W** 的精簡型電腦（無風扇→耐油氣）
 - **不裝硬碟**（少一個零件也可減少用電）
- 降低軟體授權開支
 - 購買 **Windows** 作業系統與 **Office** 授權只為了相當簡單的報工作業並不划算
 - 改用 **Terminal 遠端桌面連線** 模式
- 降低 **MIS** 系統管理人員負擔
 - 故障時直接拿備品精簡電腦替換→**免安裝設定**

新舊架構成本比較 (總建置成本 / 年度營運成本)



舊架構	
伺服器端	550,000
一般用戶端	870,000
新架構	
伺服器端	638,000
DRBL	25,000
一般用戶端	255,000
合計金額	
舊架構	1,420,000
新架構	918,000
節省金額	
	502,000

舊架構	
伺服器端	48,198
一般用戶端	331,920
新架構	
伺服器端	48,198
DRBL	41,628
一般用戶端	62,442
合計金額	
舊架構	380,118
新架構	152,268
節省金額	
	227,850

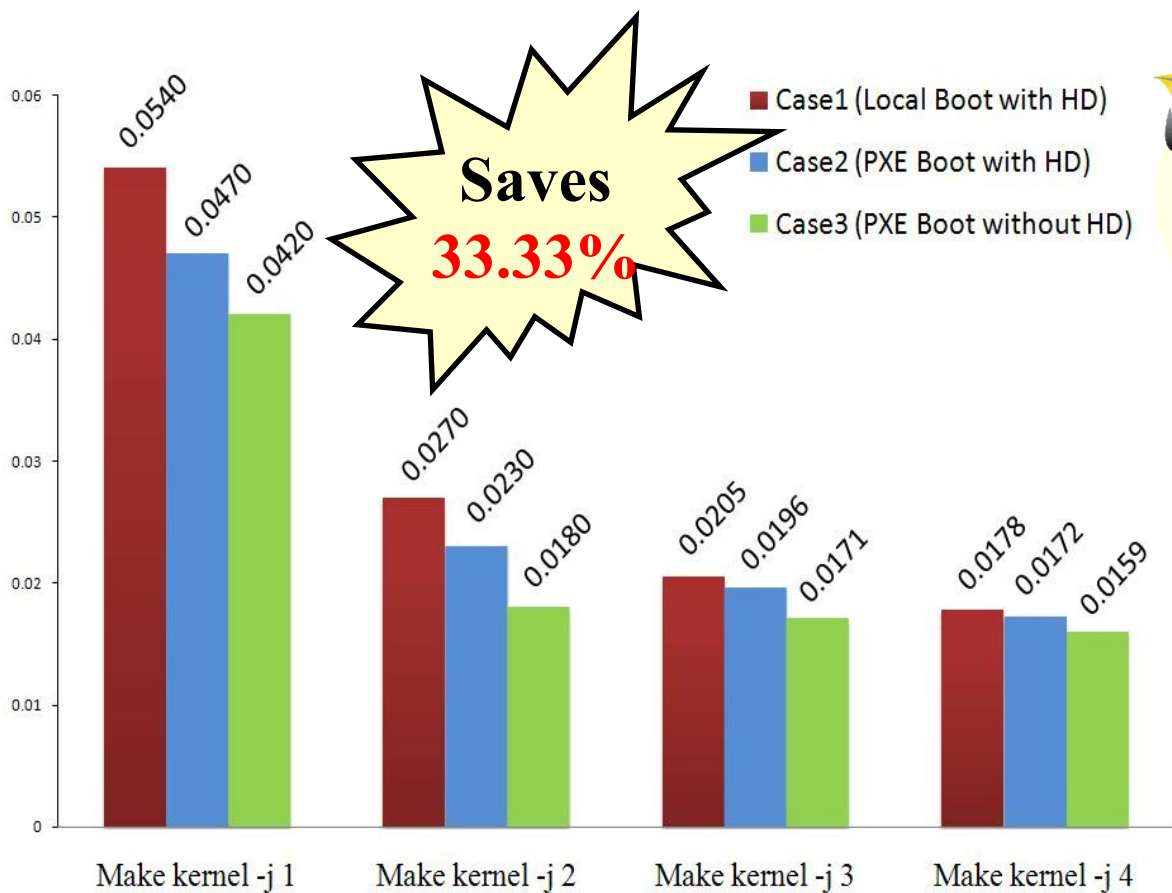
節省 **50 萬**
總**建置**成本

省 **17 萬**硬體
省 **33 萬**軟體

節省 **22 萬**
年度**營運**成本

省 **3 萬**電費 (60%)
省 **19 萬**工資 (57%)

若無很高的檔案讀寫需求，多善用 RAM Disk，企鵝龍 (DRBL) 無碟架構不僅省電最高達 33%，效能還比較好



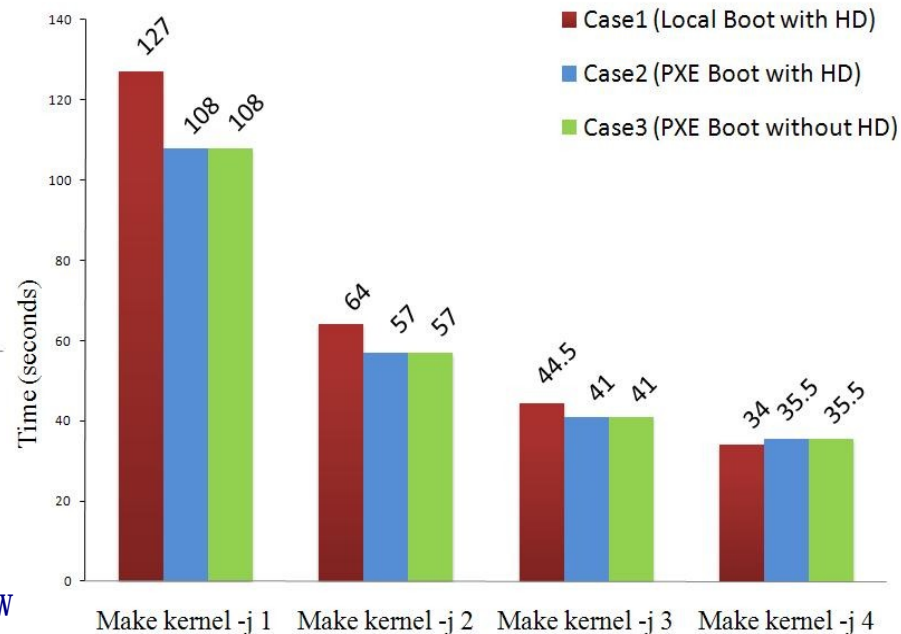
企鵝龍 DRBL
(Diskless Remote Boot in Linux)

適合將整個電腦教室轉換成純自由軟體環境



再生龍 Clonezilla

適用完整系統備份、裸機還原或災難復原



關於企鵝龍與再生龍的更多資訊，請參考

<http://drbl.nchc.org.tw>，<http://clonezilla.nchc.org.tw>

關於 E2CC 的更多資訊，請參考

<http://trac.nchc.org.tw/grid/raw-attachment/wiki/deliverable09/1003anav.pdf>

Future of Virtualization

虛擬化技術的未來發展

CIO

DRILLDOWNS Applications

虛擬化的資安 (VM Sprawl) 與讀寫效率 (VM Stall) 問題

Is 'VM Stall' the Next Big Virtualization Challenge?

http://www.cio.com/article/595639/Is_VM_Stall_the_Next_Big_Virtualization_Challenge_

Is 'VM Stall' the Next Big Virtualization Challenge?

Stalled virtualization deployment means the highly desirable outcomes of virtualization can stall or backslide. CA's Andi Mann discusses some of the possible causes for VM stall.

By Andi Mann on Tue, June 01, 2010 [Leave a comment](#)



CIO — There appears to be a challenger to 'VM sprawl' as the virtualization success — a problem I call 'VM stall'.



We know about 'VM sprawl' — because new virtual machines deploy, organizations can end up with more VMs that they can even use. This has the potential to cause severe problems to

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BACK TO MICROSOFT SUBNET

Microsoft Subnet Blog

by Julie Bort

← Previous Post

Microsoft's cheaper virtualization licensing to take effect July 1

Microsoft's revamped Windows VDI prices are an improvement, but there's still plenty of gotchas.

By [Microsoft Subnet](#) on Thu, 05/27/10 - 4:09pm.

虛擬化正在改變著軟體銷售的方式

Microsoft's cheaper virtualization licensing to take effect July 1

<http://www.networkworld.com/community/blog/microsofts-cheaper-virtualization-licensing>



Questions?

Slides - <http://trac.nchc.org.tw/cloud>

Jazz Wang
Yao-Tsung Wang
jazz@nchc.org.tw



Powered by **DRBL**