



深入解析雲端虛擬化技術

Part 2 : Deep Dive into Virtualization Technologies

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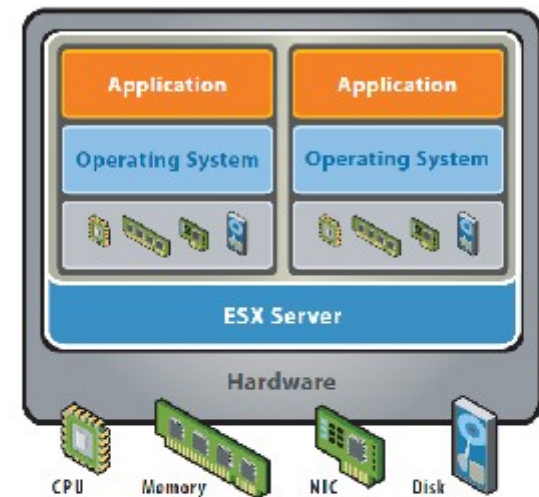


Powered by DRBL

Adjust #1: Virtualization

企業導入雲端參考策略 (1) Virtualization

- 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™



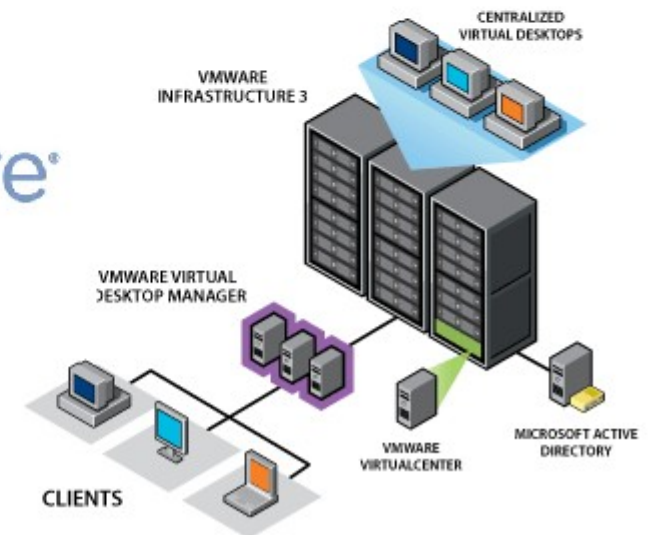
How to Evaluate the need of Virtualization ?

如何評估對虛擬化的需求??

- 關鍵驅動因素
 - 預算刪減？節約能源？提高現有硬體使用率？
- 導入評估工具
 - Microsoft Assessment and Planning (MAP) Toolkit for Hyper-V
 - Hyper-V 評估工具：收集 Server 使用情況，產生評估報告等
 - Open Source: MRTG, Ganglia, Nagios,
 - 蒐集 CPU 用量、記憶體用量、尖峰負載發生時間、批次排程時間
- 隱含額外成本
 - 若想獲得虛擬化帶來的好處（災害復原與動態負載平衡），需要額外建置共享的儲存設施。

Thin Client and VDI for next IT procurement ? 未來改採購精簡型電腦與桌面虛擬化??

- 桌面虛擬化的需求越來越高??
- 導入評量指標：
 - 總電源開銷、空調、管理人力
 - 既存共用儲存設施
 - 資料機敏性高，不容外洩
- 商業解決方案：
 - **VMWare** Viewer 4
 - **Microsoft** Hyper-V
 - **Citrix** XenDesktop
- 預期效益：
 - 降低電力損耗 (需評估)
 - 減少資料外洩 (搭配資安政策)



Another alternative of Virtualization

虛擬化番外篇：改用 **Terminal** + 無碟架構

用綠色自由軟體

GREEN OSS

打造綠色工廠

GREEN FACTORY

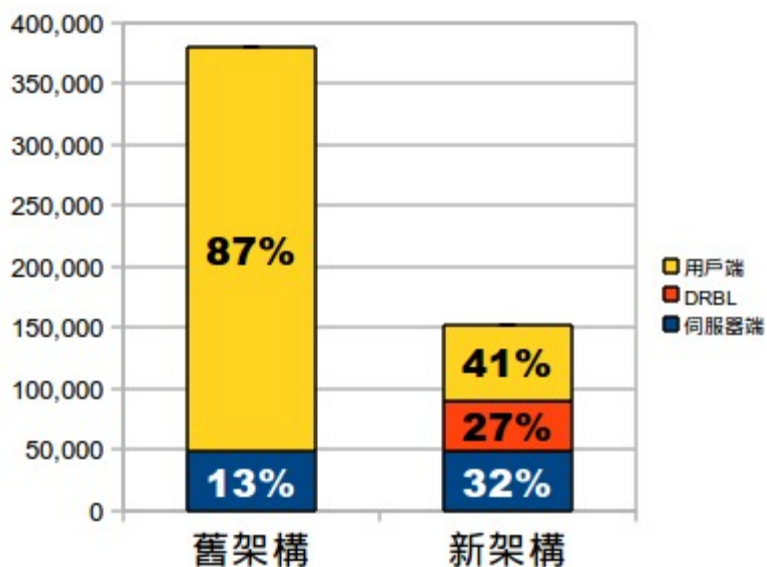
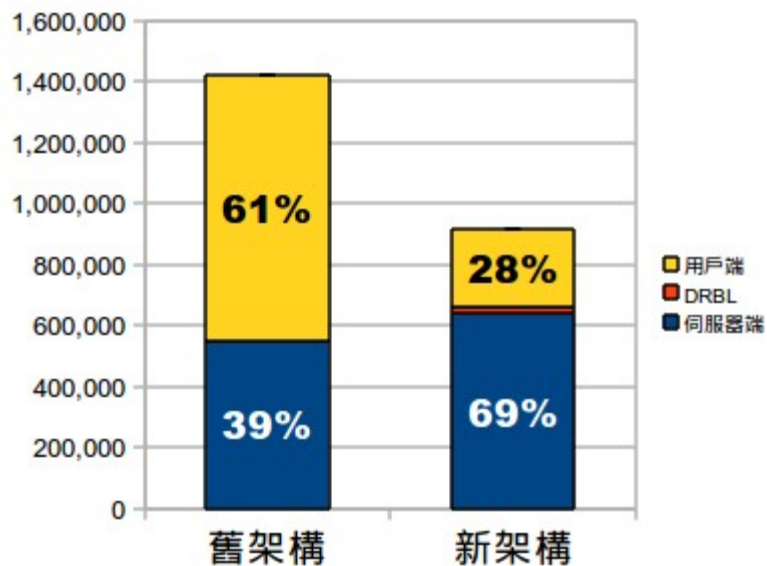
關於企鵝龍 (DRBL) 在金屬加工業的節能案例分享，請參考

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** 授權只爲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

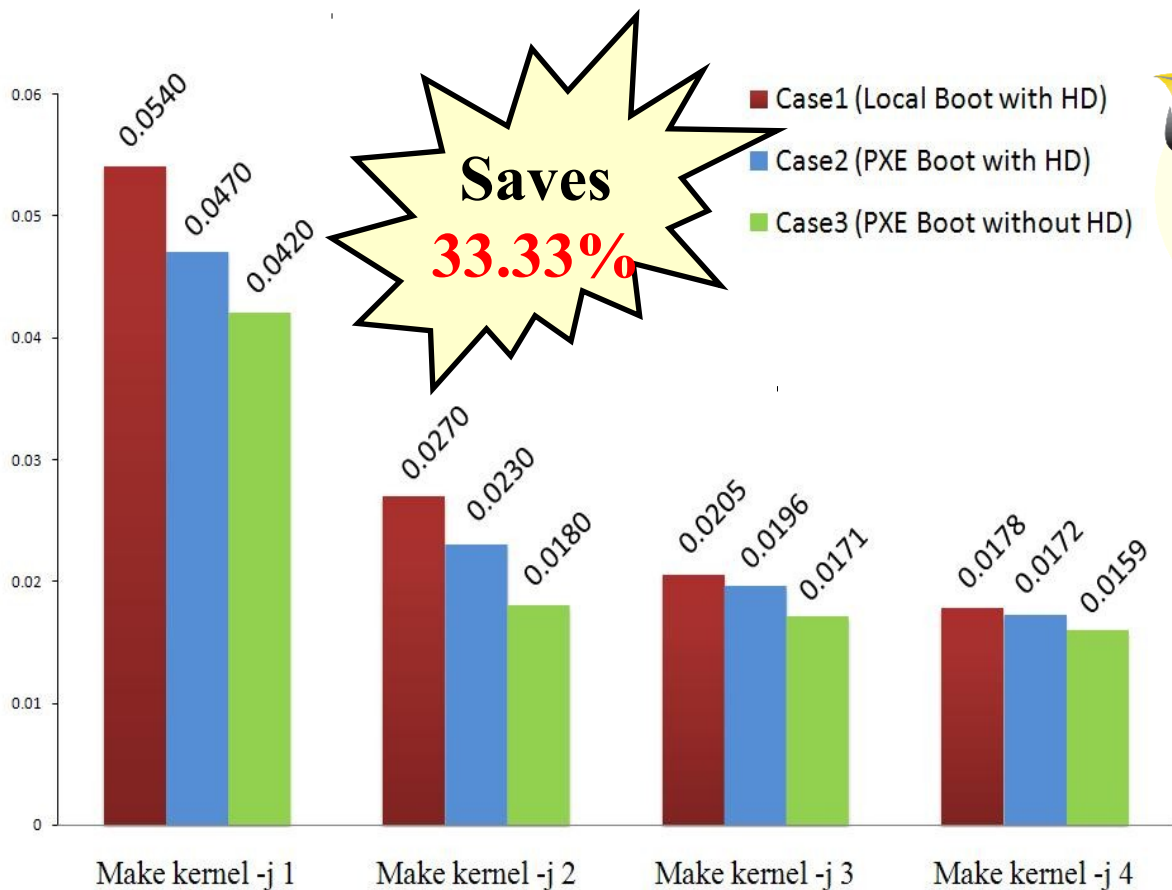
節省 **50 萬**
總建置成本

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，無碟架構不僅省電最高達 33%，效能還比較好



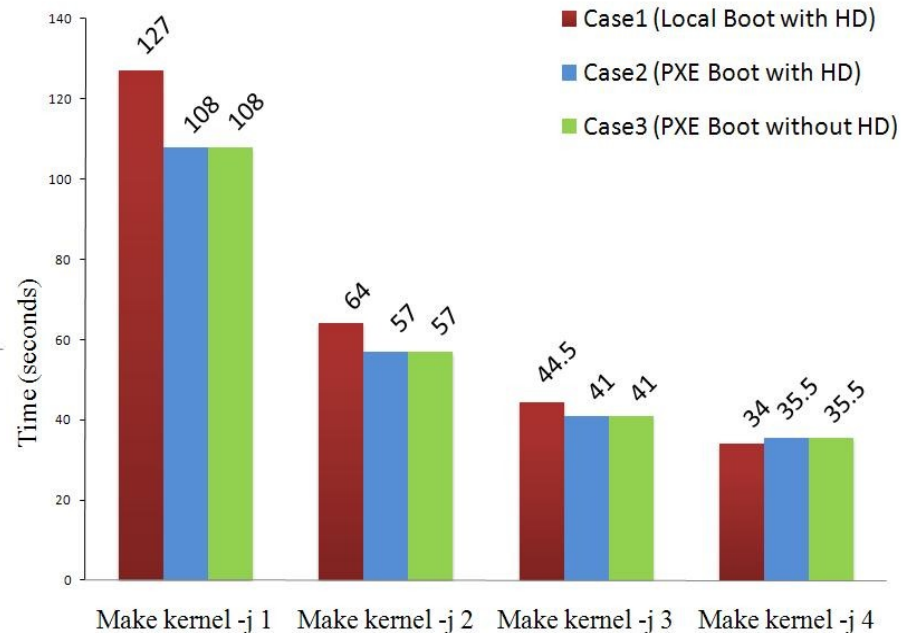
企鵝龍 DRBL
(Diskless Remote Boot in Linux)

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>

Adjust #2: Storage Virtualization

企業導入雲端參考策略(2) 儲存虛擬化

- **資料整合為跨單位整合的第一步 !!**
- 導入評量指標：
 - 資料所有權 / 散佈權 / 重覆比例
 - 資料成長量 = ?? PB/Year
 - 現有資料副本個數 / 災害復原能力
- 商業硬體方案：EMC、NetApp
- 商業軟體方案：IBM GPFS
- 自由軟體方案：
 - Lustre、ZFS、GlusterFS...
- 預期效益：
 - 減少資料重覆 (Data Deduplication)
 - 提供異地副本備份、災害復原機制



Reference Cloud Architecture

雲端運算的參考架構

應用軟體 Application

Social Computing, Enterprise, ISV, ...

程式語言 Programming

Web 2.0, Mashups, Workflows, ...

控制管理 Control

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

虛擬化 Virtualization

VM, VM management and Deployment

硬體設施 Hardware

Infrastructure: Computer, Storage, Network

User-Level

User-Level
Middleware

Core
Middleware

System Level

IaaS
PaaS
SaaS

Building IaaS with Open Source

用自由軟體打造 IaaS 服務

應用軟體 Application
Social Computing, Enterprise, ISV, ...

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

程式語言 Programming
Web 2.0, Mashups, Workflows, ...

Hadoop (MapReduce),
Sector/Sphere, AppScale

控制管理 Control
Qos Negotiation, Admission Control,
Pricing, SLA Management, Metering, ...

OpenNebula, Enomaly,
Eucalyptus, OpenQRM, ...

虛擬化 Virtualization
VM, VM management and Deployment

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

硬體設施 Hardware
Infrastructure: Computer, Storage,
Network

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

資料庫虛擬化

資料虛擬化

Virtualization

Data

Data Virtualization

大家對虛擬化的
狹義認知

Open Source for Virtualization 虛擬化技術對應的自由軟體

Application Virtualization

Ex. VMWare ThinApp

Desktop
Client

建置虛擬化叢集不可只
注重作業系統虛擬化，
須同時具備底層支援的
網路與儲存虛擬化！！

Redhat SPICE

Presentation

VNC, FreeNX

OS-level Virtualization

Xen, KVM, OpenVZ

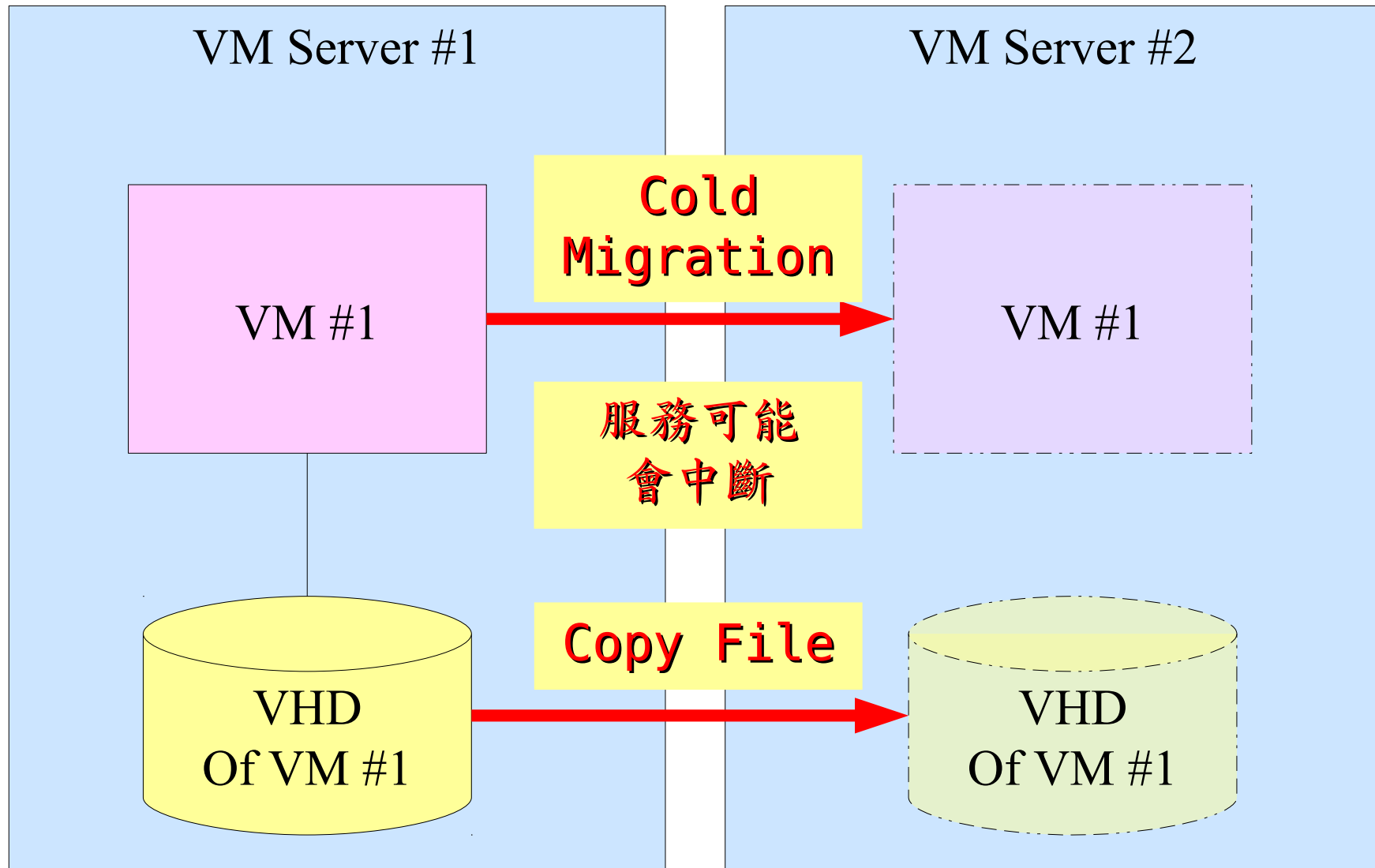
Network Virtualization

OpenFlow vSwitch

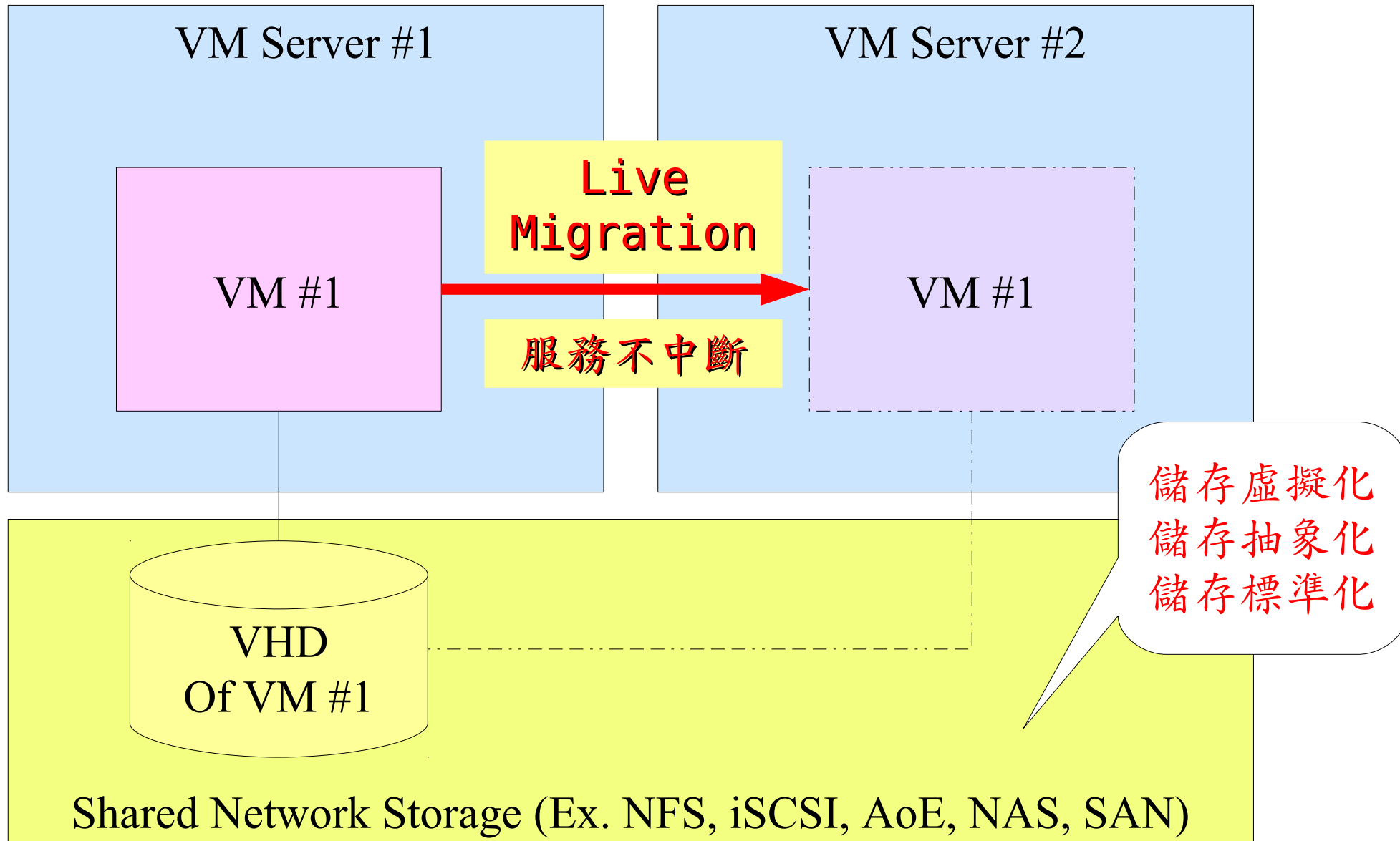
Storage Virtualization

Lessfs, SDFS

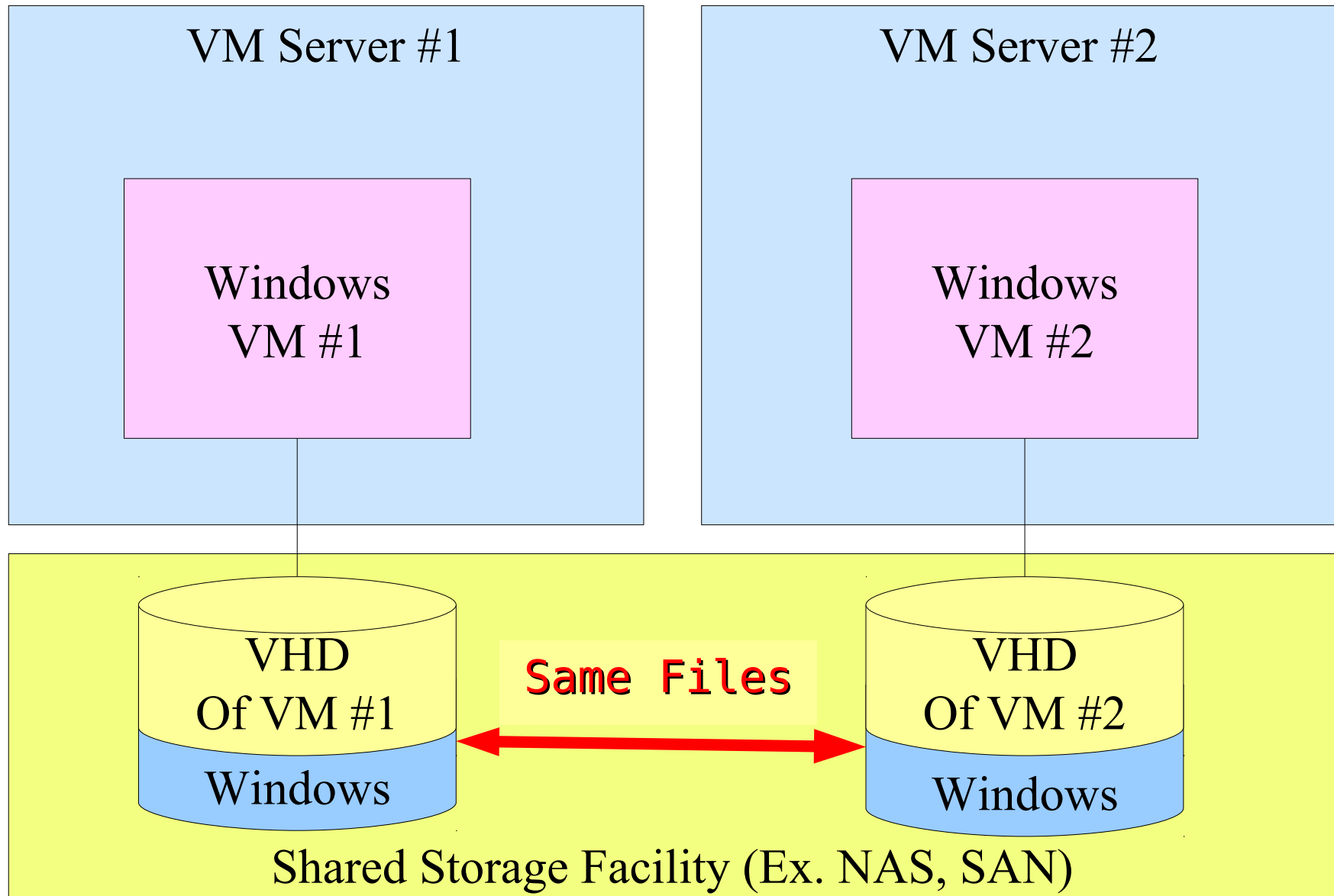
Why Storage Virtualization !! 為何需要儲存虛擬化？



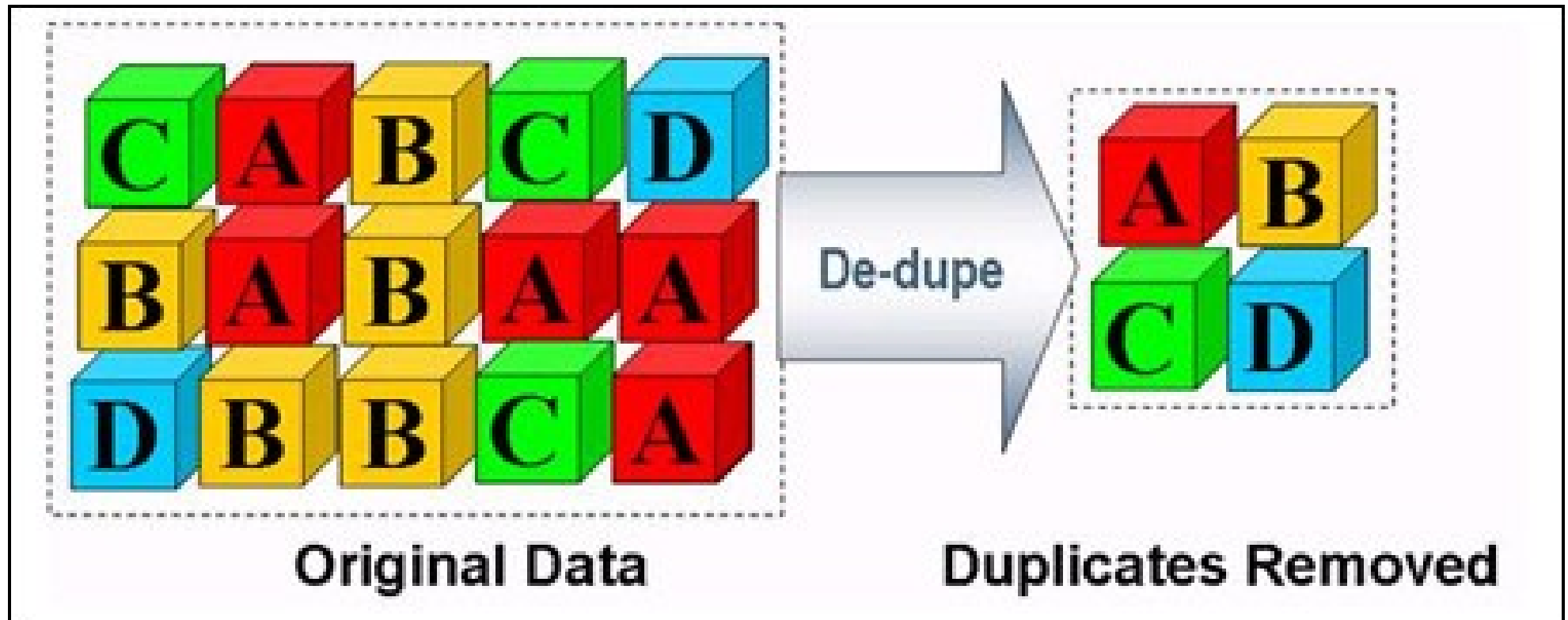
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Why Storage Virtualization !! 為何需要儲存虛擬化？



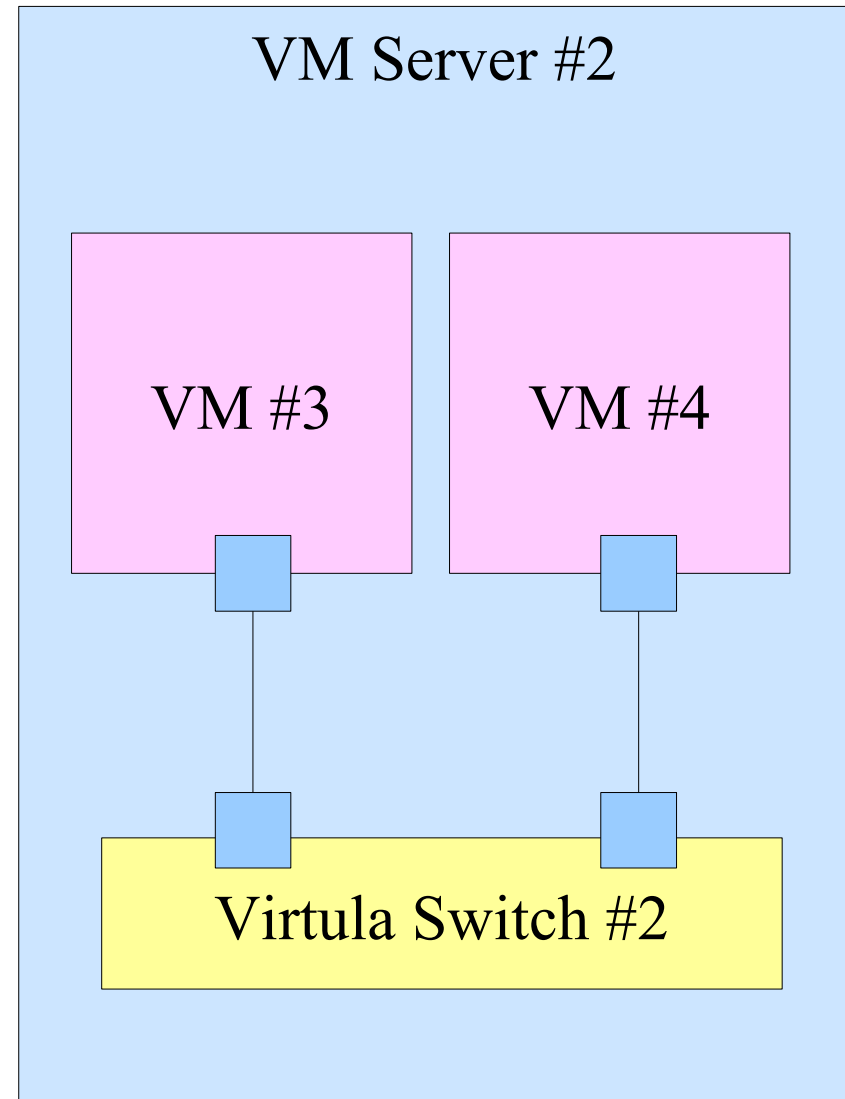
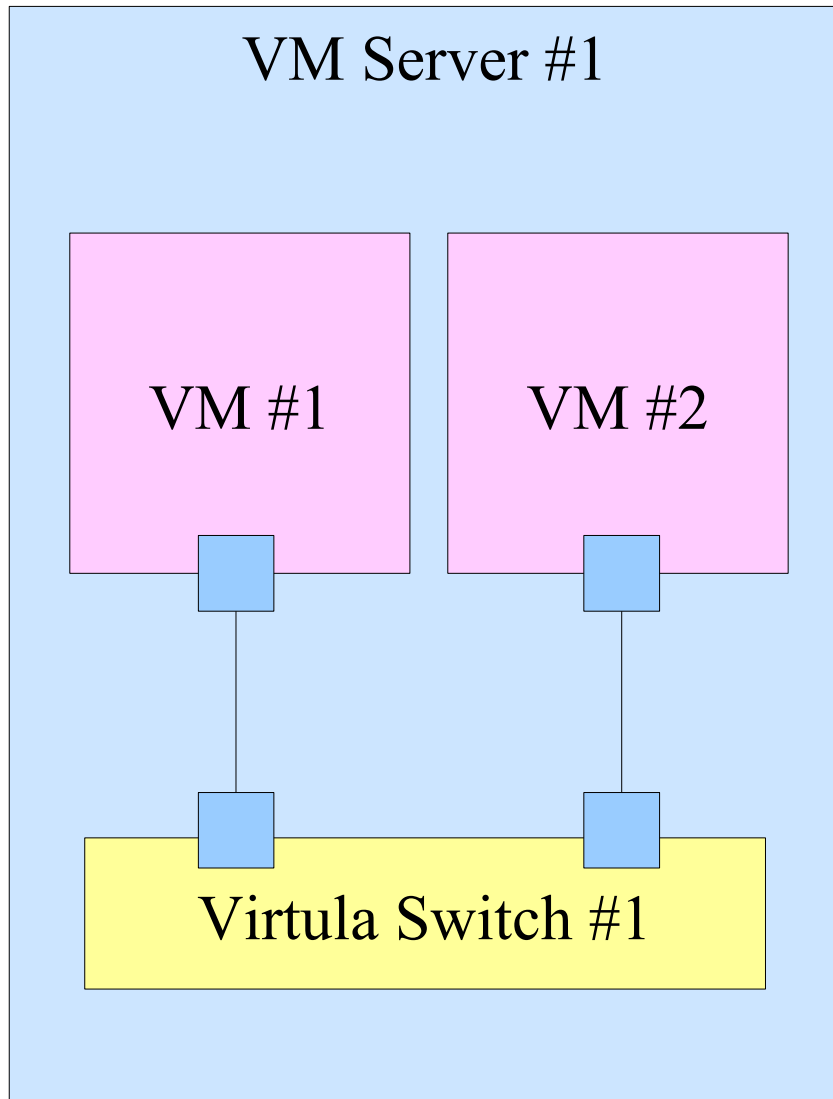
Deduplication? 去除重複儲存的資料?



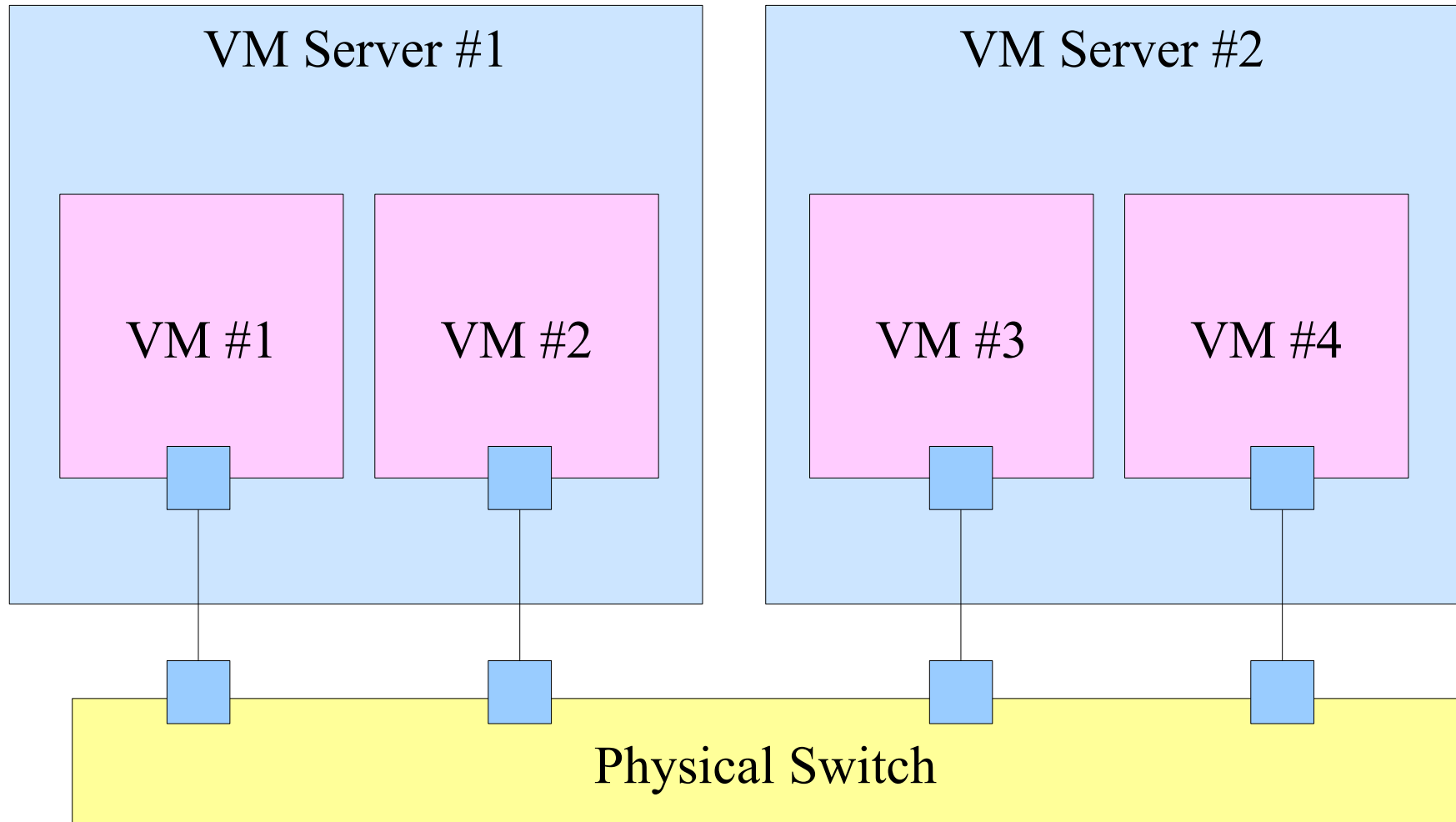
- 資料整合為跨單位整合的第一步 !!
- 商業硬體方案：EMC、NetApp
- 自由軟體方案：
 - ZFS、Lessfs、SDFS...



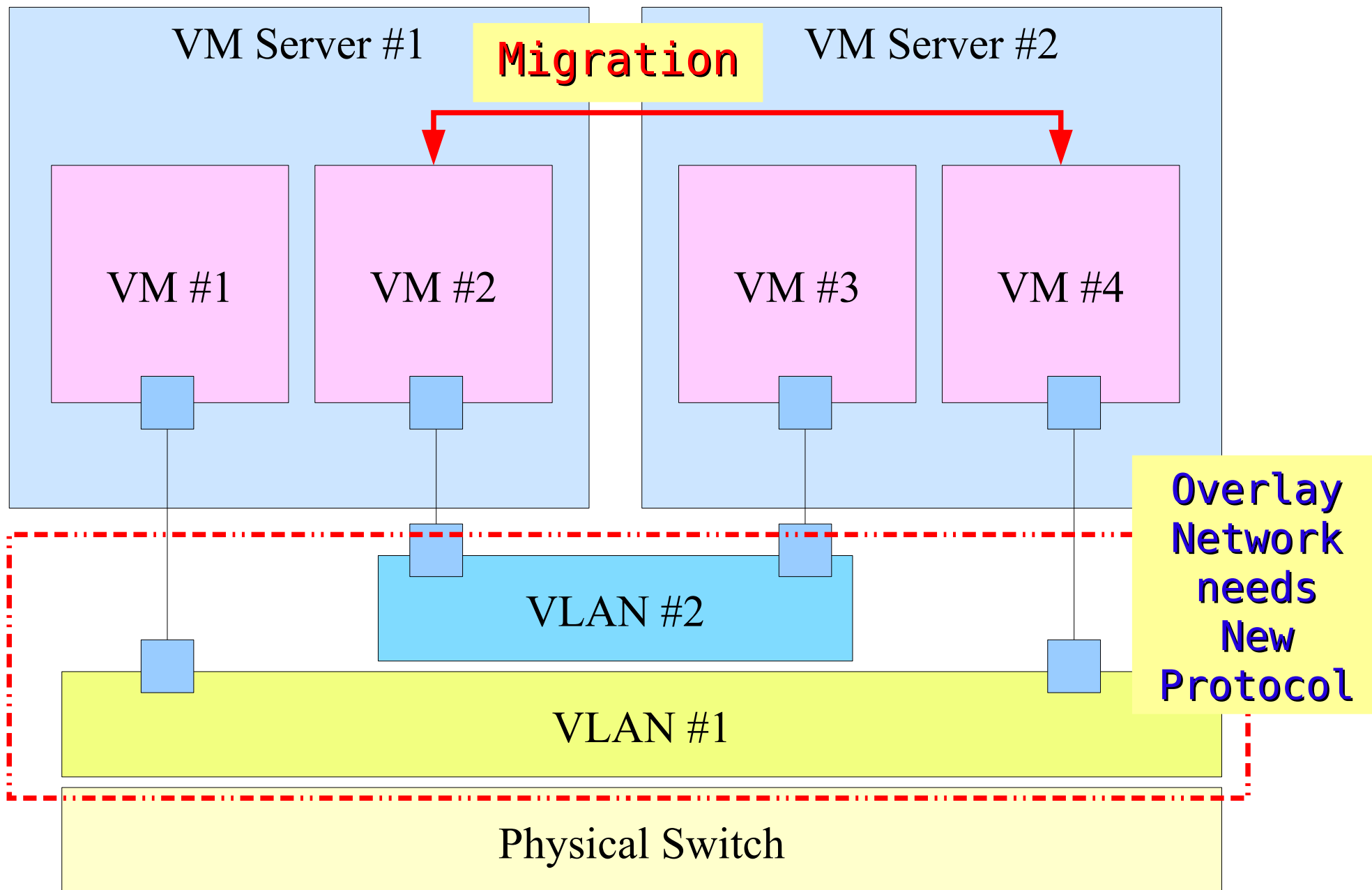
Why Network Virtualization !! 為何需要網路虛擬化？



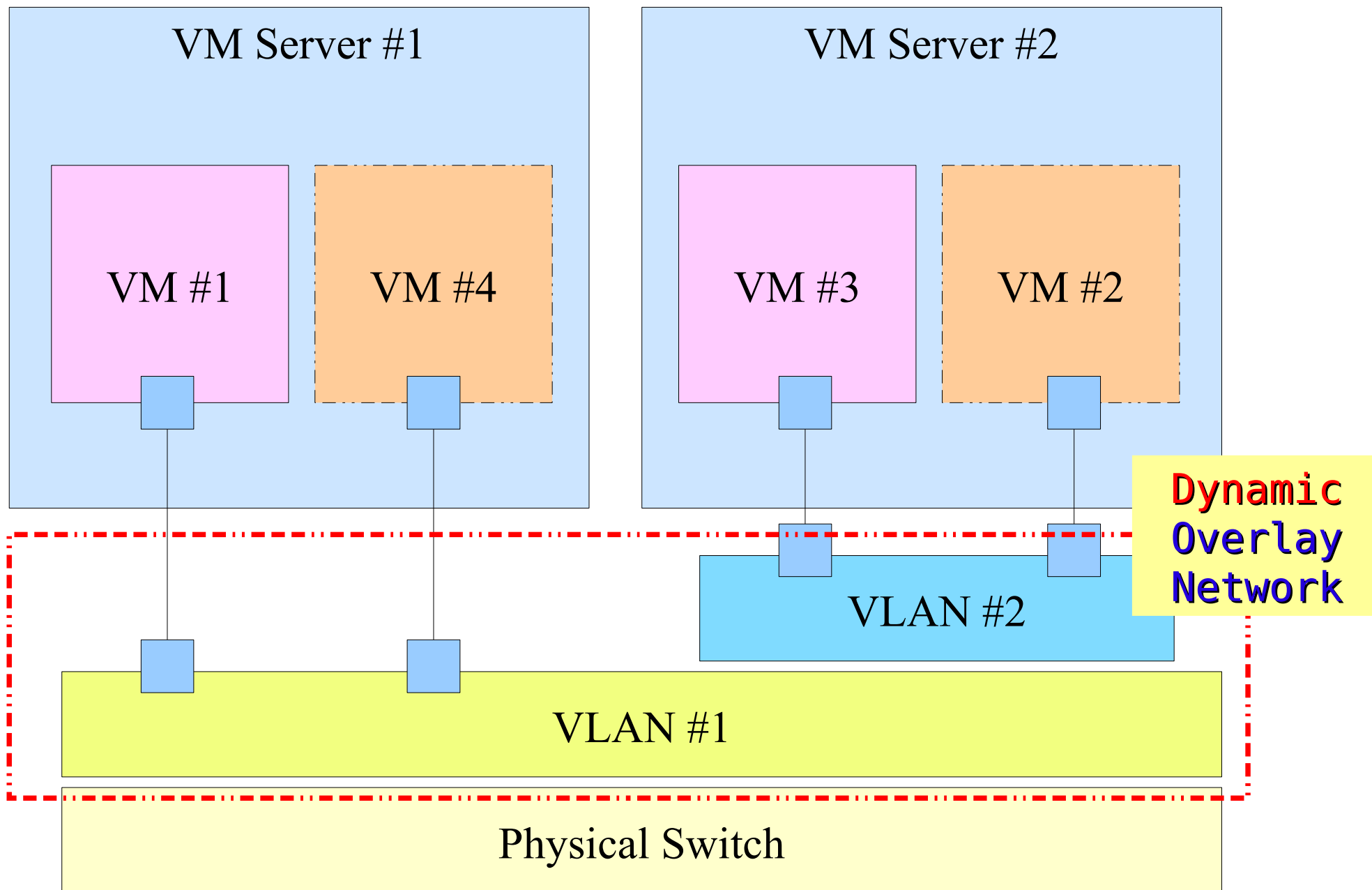
Why Network Virtualization !! 為何需要網路虛擬化？



Why Network Virtualization !! 為何需要網路虛擬化？



Why Network Virtualization !! 為何需要網路虛擬化？



OpenFlow Network Virtualization 網路虛擬化標準

- Open Networking Foundation 為非營利組織，致力推廣「軟體定義網路 (Software-Defined Networking; SDN)」的新網路方法
- SDN 包含幾個相當重要的元素，其中關鍵為 OpenFlow，其能為服務供應商提供更精確的網路基礎設施管理能力



The screenshot shows the OpenFlow website homepage. At the top left is the OpenFlow logo, which consists of a blue circular arrow pointing right, followed by the text "OpenFlow". To the right of the logo is a search bar with the text "Google™ Custom Search" and a "Search" button. Below the logo and search bar is a navigation menu with buttons for "Home", "Videos", "Documents", "News", "Research", and "About". The main content area features a dark blue banner with the heading "Innovate in Your Network" and a paragraph of text: "OpenFlow enables networks to evolve, by giving a remote controller the power to modify the behavior of network devices, through a well-defined 'forwarding instruction set'. The growing OpenFlow ecosystem now includes routers, switches, virtual switches, and access points from a range of vendors." To the right of this text are two buttons: "Learn More" with an information icon and "Develop" with an icon of two people and gears. Below the banner is a "Participate" section with text: "The Open Networking Foundation (ONF) is now the home of the OpenFlow project, the exciting standardization and commercial development and deployment of OpenFlow." Below that is an "OpenFlow News" section with a sub-heading "Boston CIO Workshop on Expanding OpenFlow/SDN Success" and a date "July 13th, 2011 by jvanrej". The text below the date reads: "The GENI CIO Workshop held in Boston on July 7 was a success with rep..."

<http://www.openflow.org/>



The screenshot shows the Open Networking Foundation website homepage. At the top is the Open Networking Foundation logo, which consists of a blue circular arrow pointing right, followed by the text "OpenNetworkingFoundation". Below the logo is a dark blue banner with the heading "Welcome to the Open Networking Foundation!" and a paragraph of text: "The Open Networking Foundation is a nonprofit organization dedicated to promoting a new approach to networking called Software-Defined Networking (SDN). SDN allows owners and operators of networks to control and manage their networks to best serve their users' needs. ONF's first priority is to develop and use the OpenFlow protocol. Through simplified hardware and network management, OpenFlow seeks to increase network functionality while lowering the cost associated with operating networks." To the right of the text is a photograph of network cables plugged into a switch.

NIST Mapping of Cloud Technologies

美國國家標準局的定義主要鎖定虛擬化技術

5. Measured Service
可被監控與量測的服務

Monitoring / AAA
狀態監控與認證收費機制

1. On-demand self-service
隨需自助服務

VM Management Tool
虛擬機器管理平台

2. Broad network access
隨時隨地用任何網路裝置存取

OS-level Virtualization
作業系統虛擬化

3. Resource pooling
多人共享資源池

Network Virtualization
網路虛擬化

4. Rapid elasticity
快速重新佈署靈活度

Storage Virtualization
儲存虛擬化

NIST Mapping of Open Source Cloud 美國國家標準局的定義對應自由軟體技術

Monitoring / AAA
狀態監控與認證收費機制

Ganglia, Nagios
/ OpenID, SAML

VM Management Tool
虛擬機器管理平台

OpenNebula, Eucalyptus

OS-level Virtualization
作業系統虛擬化

Xen, KVM, OpenVZ

Network Virtualization
網路虛擬化

OpenFlow vSwitch

Storage Virtualization
儲存虛擬化

Lessfs, SDFS, ZFS

- 原是加州大學聖塔芭芭拉分校 (UCSB) 的研究專案
- **It was a research project of UCSB, USA**
- 目前已轉由 Eucalyptus System 這間公司負責維護
- **Now Eucalyptus System provide technical supports.**
- 創立目的是讓使用者可以**打造自己的 EC2**
- **It designed to help user to build their own Amazon EC2**
- 特色是相容於 Amazon EC2 既有的用戶端介面
- **Its feature is compatible with existing EC2 client.**
- 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
- **You can register trail account at <http://open.eucalyptus.com/>**
- 缺點：目前仍有部分操作需透過指令模式
- **Cons : you might need to type commands in some case**

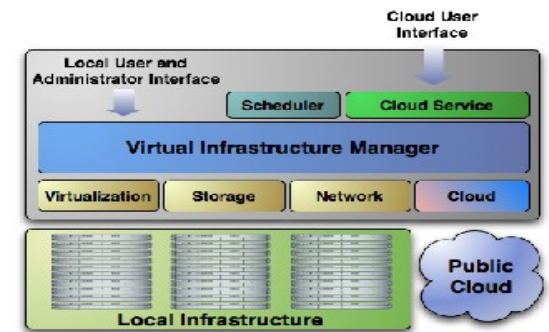


Eucalyptus

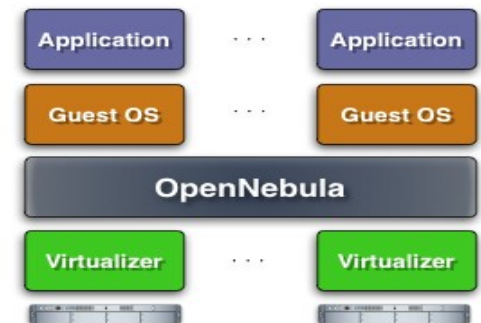
VMM Tool #2: OpenNebula

- <http://www.opennebula.org>
- 由歐洲研究學會 (European Union FP7) 贊助
- **Sponsor by European Union FP7**
- 將實體叢集轉換成具管理彈性的虛擬基礎設備
- Turn Physical Cluster into Virtual Cluster
- 可管理**虛擬叢集**的狀態、排程、遷徙 (migration)
- **manage status, scheduling and migration of virtual cluster**
- [Ubuntu 9.04 provide package of opennebula](#)
- 缺點：需下指令來進行虛擬機器的遷徙 (migration) 。
- **Cons** : You need to type commands to check or migration

OpenNebula.org



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



NIST Mapping of Open Source Cloud 美國國家標準局的定義對應自由軟體技術

Monitoring / AAA
狀態監控與認證收費機制

Ganglia, Nagios
/ OpenID, SAML

VM Management Tool
虛擬機器管理平台

OpenNebula, Eucalyptus

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作業系統虛擬化

Xen, KVM, OpenVZ

Network Virtualization
網路虛擬化

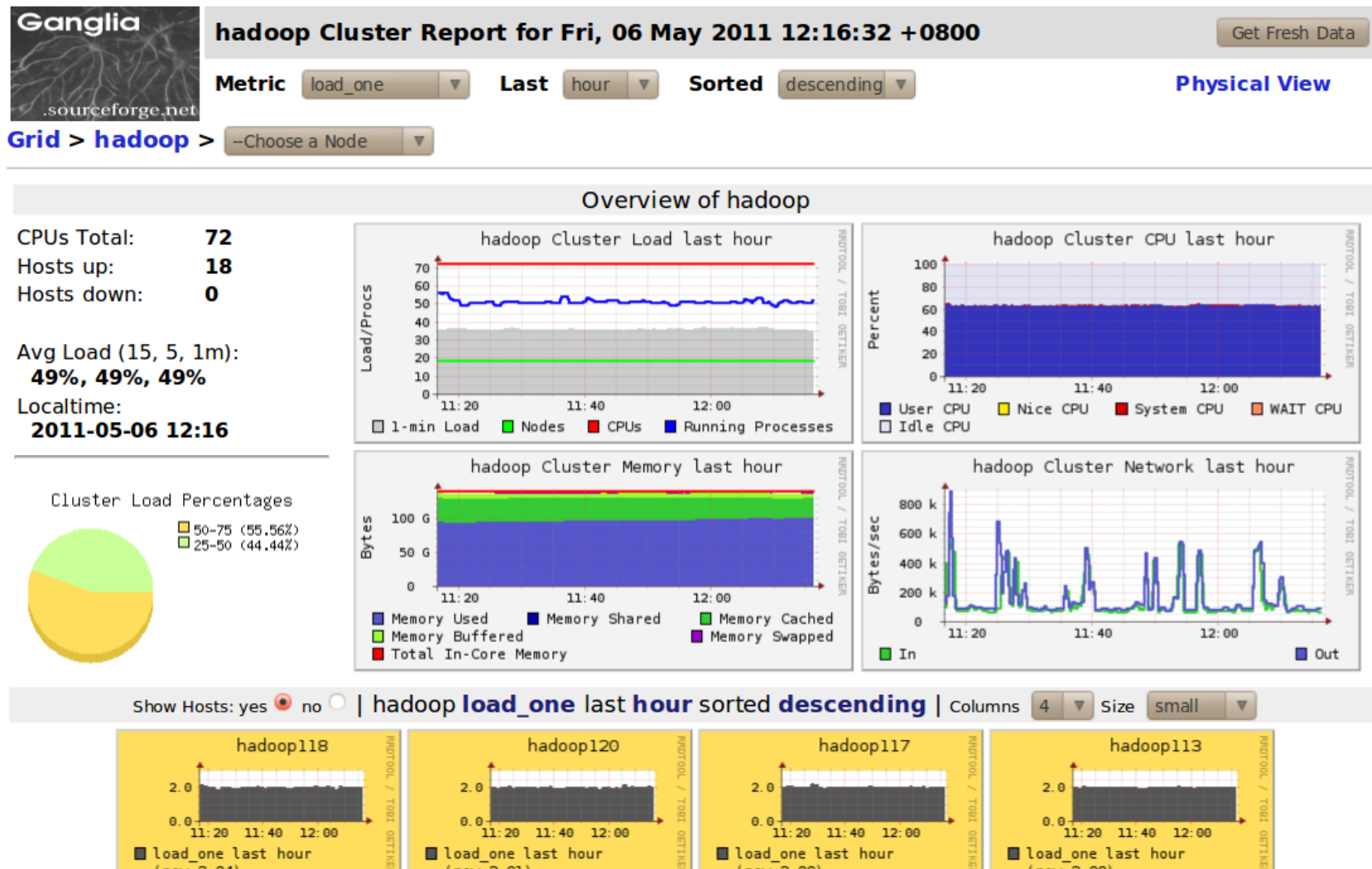
OpenFlow vSwitch

Storage Virtualization
儲存虛擬化

Lessfs, SDFS, ZFS

系統狀態監控 Ganglia

- 採用自由軟體 Ganglia 來蒐集電腦叢集的負載狀態
- <http://ganglia.sourceforge.net/>



日本政府已開始接受 OpenID

2010年3月9日 Nat Sakimura 發表「Government of Japan started accepting OpenID」。

日本經濟產業省開設了一個名為「IdeaBox」的網站，可以使用 mixi、Yahoo!、Livedoor 和 Google 等的帳號來登錄。IdeaBox 是經濟產業省用來向國民廣泛徵求意見，以促進國民間政策的討論的網站。在該網站上，人們可參與出謀劃策和討論，並進行表決。

經濟產業省是想基於網際網路開設一個向公眾開放的委員會。一個類似網站在去年10月到11月間運作並收集了1700多條政策建議。IdeaBox 2月23日開放的這個版本，它還有其它各種社交網站的組件，例如可以直接從這個網站發送 tweet 到 twitter、收藏到 delicious 和 hatena 書籤等。這個版本將運行到3月15日。

網站地址：<http://open-meti.go.jp/>



Virtualization for Embedded Device ?

虛擬化只用在「雲」嗎？那「端」呢？



Motivation for Embedded Virtualization

嵌入式軟體採用虛擬化技術的三大動機

多核心
Multiple
Cores

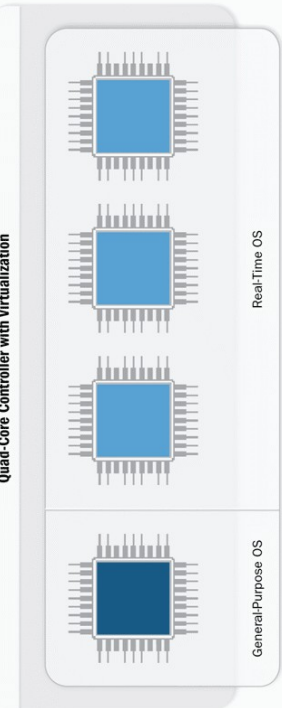
co-existence of different OS environment
on the same platform

讓同一個硬體平台上共存不同的作業系統

isolating critical components
from an untrusted OS environment
在不受信任的作業系統上建立獨立的管制區

an indirection level for remote control
of OS environments

為作業系統建立一個間接的遠端遙控機制



參考來源：**Embedded systems virtualization: Consider a Hypervisor**

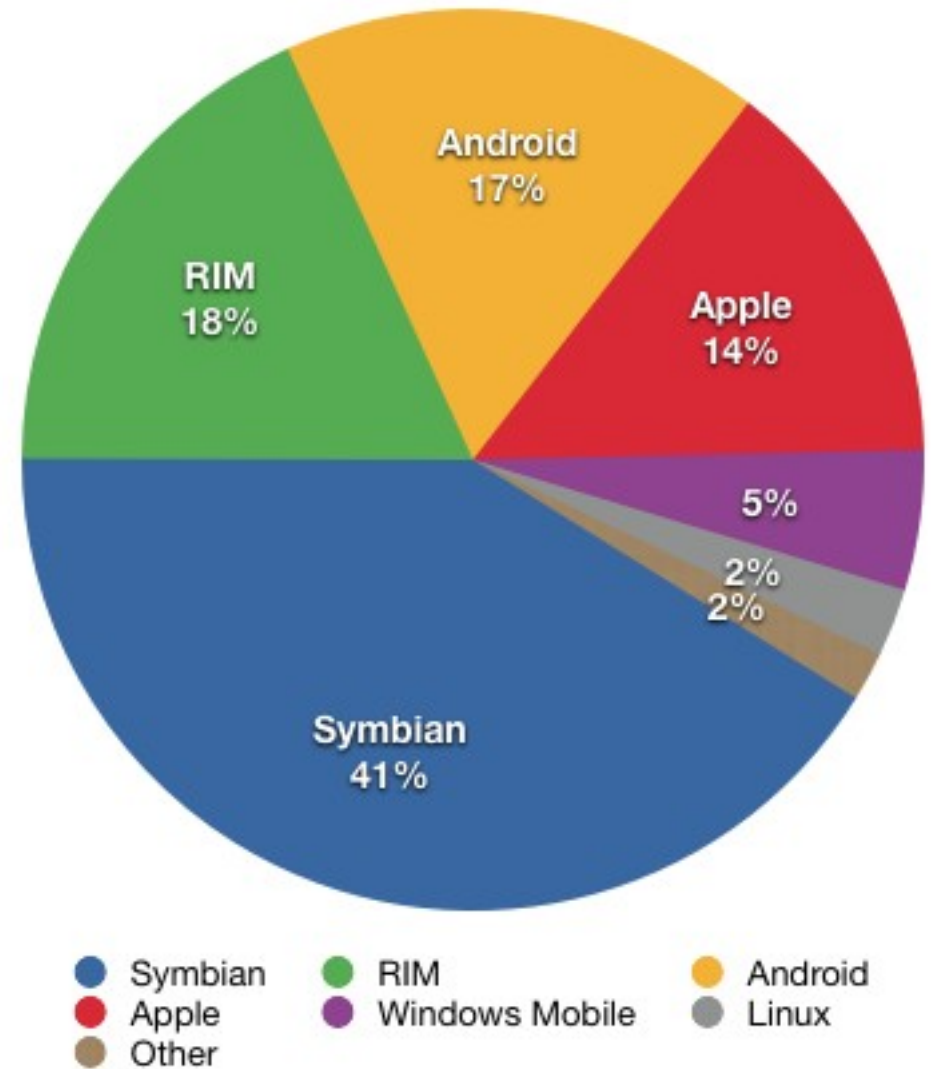
<http://www.eetimes.com/design/automotive-design/4016811/Embedded-systems-virtualization-Consider-a-Hypervisor>

參考來源：**10 questions to ask when choosing a virtualization solution**

<http://www.eetimes.com/design/eda-design/4006406/10-questions-to-ask-when-choosing-a-virtualization-solution>

Application : Key drivers of Multiple OS in one device

應用程式是在同一個裝置跑多作業系統的關鍵驅動力



圖片來源：http://www.iphonic.tv/iphone_screen_amaze.png

圖片來源：http://en.wikipedia.org/wiki/File:Smartphone_share_current.png

參考來源：**iPhone - Playing mame4iphone with a WiiMote**

<http://www.youtube.com/watch?v=2AqgIWPnr1c>

參考來源：**Android running on iPhone!**

<http://linuxoniphone.blogspot.com/2010/04/ive-been-working-on-this-quietly-in.html>

<http://www.youtube.com/watch?v=5yO2KQHkt4A>

參考來源：**Android on Motorola Rokr E6**

<http://www.youtube.com/watch?v=-QAWd4IjV3g>

參考來源：**Dual Boot Windows Mobile and Android**

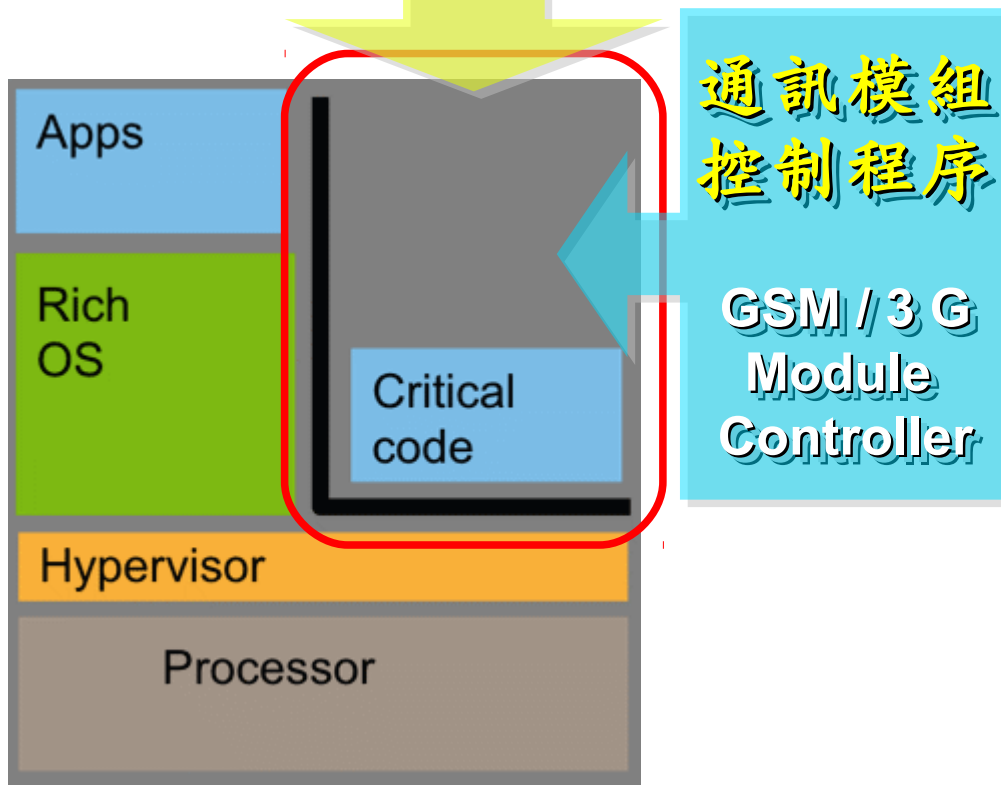
<http://www.redmondpie.com/how-to-dual-boot-windows-mobile-and-android-on-windows-phone-9140407/>

<http://www.youtube.com/watch?v=Nvj4ObHmxCI>

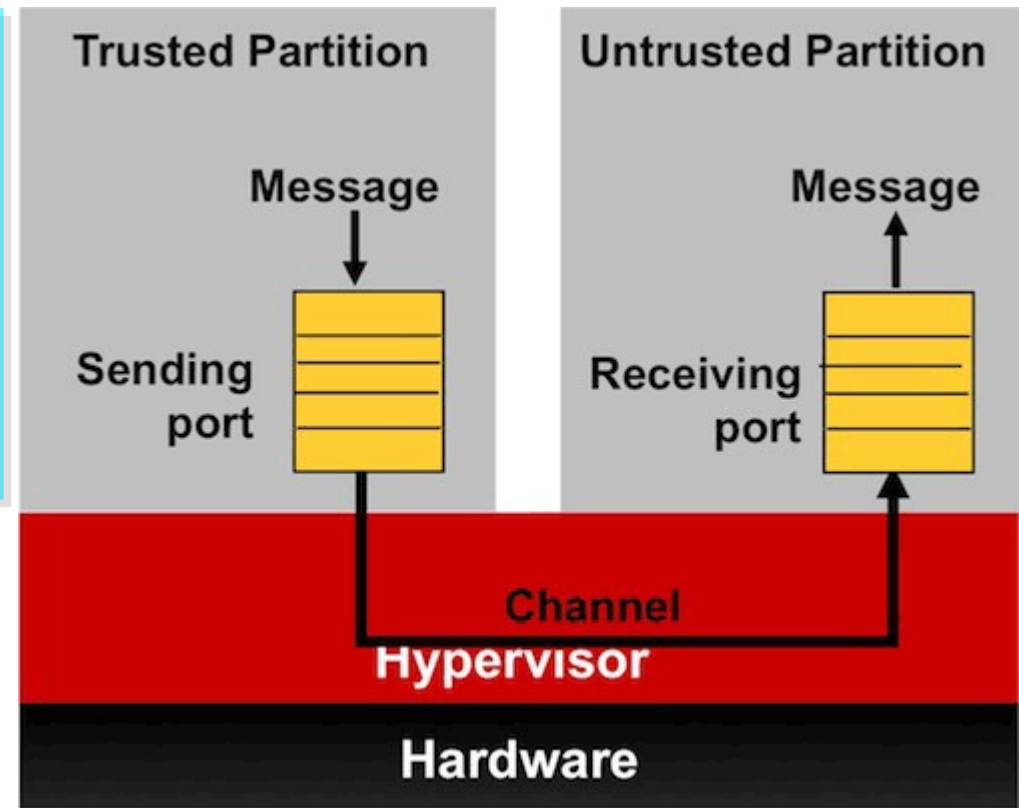
Virtualization for Embedded Security

爲了安全性，必須建立獨立的管制區

DRM 音樂授權
Digital Rights Management



區域間用訊息傳遞方式溝通
Communicate with Message Channel



參考來源：**Embedded systems virtualization: Consider a Hypervisor**

<http://www.eetimes.com/design/automotive-design/4016811/Embedded-systems-virtualization-Consider-a-Hypervisor>

參考來源：**Securing Smart Grid Devices - Using Virtualization to Protect the Grid**

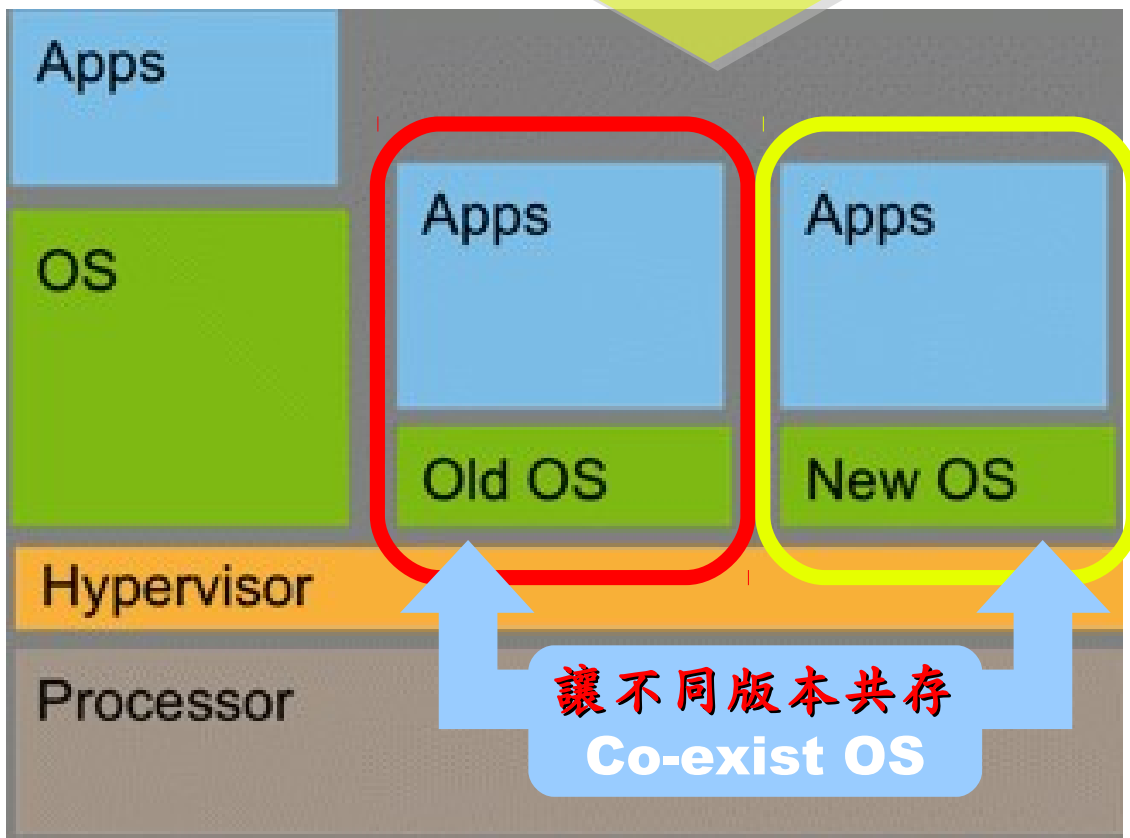
<http://embeddedinnovator.com/securing-smart-grid-devices>

Upgrade and Data Security : Key drivers of remote control

有助於作業系統升級並保護手機被偷時的資料安全

FOTA 韌體升級管制
firmware-over-the-air

遠距資料清除
Remote control to wipe data



***#06#**

參考來源：**Embedded systems virtualization: Consider a Hypervisor**

<http://www.eetimes.com/design/automotive-design/4016811/Embedded-systems-virtualization-Consider-a-Hypervisor>

Open Source for Embedded Virtualization

嵌入式虛擬化技術的自由軟體

Embedded **XEN** on ARM platforms

<http://embeddedxen.sf.net>

KVM for ARM

<http://www.ncl.cs.columbia.edu>

sourceforge FIND AND DEVELOP OPEN SOURCE SOFTWARE

[Find Software](#) [Develop](#) [Create Project](#) [Blog](#) [Site Support](#) [About](#)

SourceForge.net > Find Software > Embedded XEN on ARM platforms



Embedded XEN on ARM platforms Alpha by rossierd

[Summary](#) [Files](#) [Support](#) [Develop](#)

EmbeddedXEN is an academic project and consists of a single multi-kernel ARM-target binary image with bedded

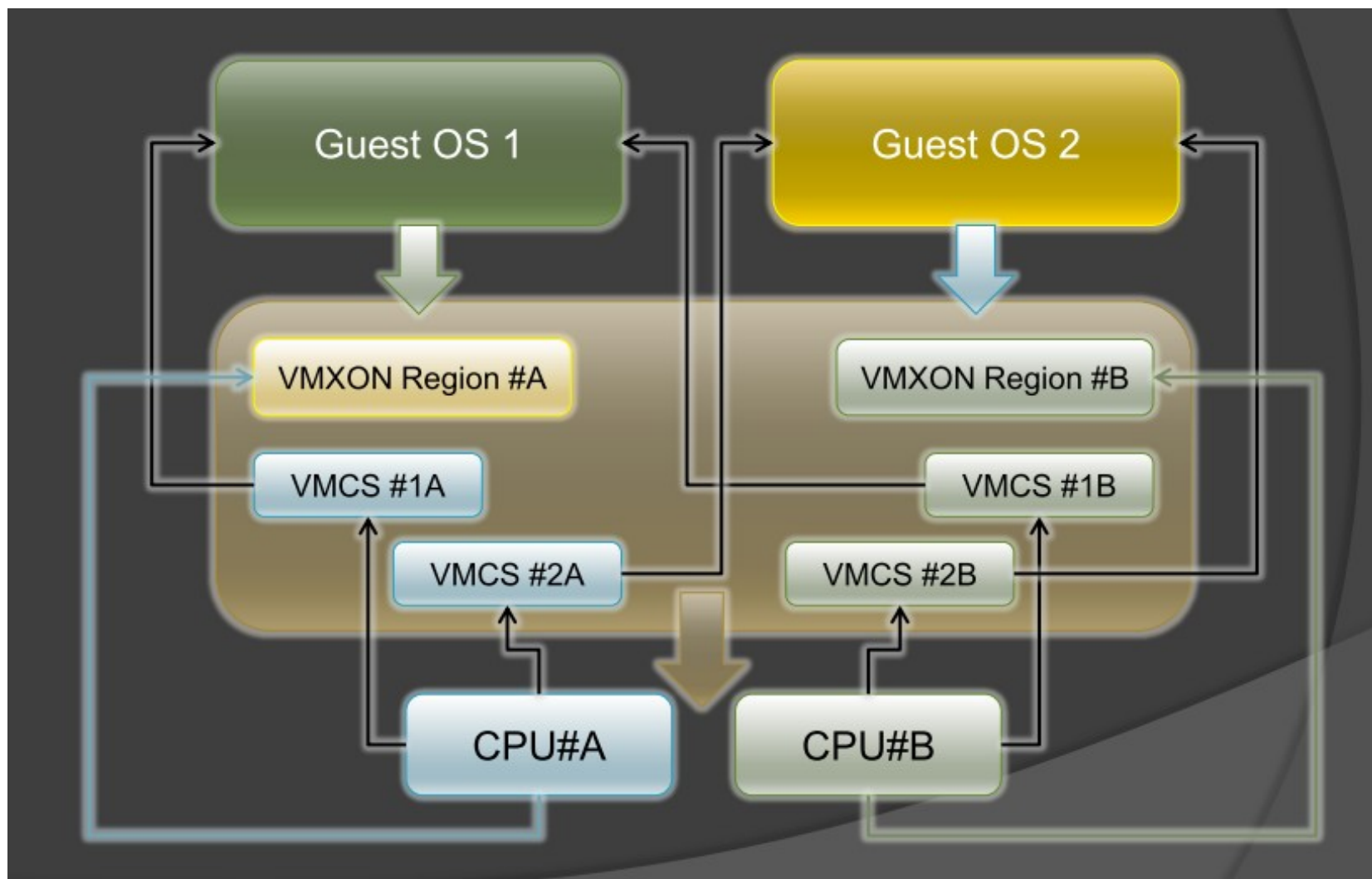
EDIT

[view project details](#)

Requirement	KVM	Xen	Embedded Hypervisor
Embedded Processor Support	no	yes	yes
Real-time	no	no	yes
Fast communication	no	no	yes
Footprint	>10MB	16MB	<64kB
Code size	100s kLoC	100s kLoC	10 kLoC

虛擬化衍生的新興資安問題

透過虛擬機器，竊取鍵盤輸入、植入後門



圖片來源： Hacks in Taiwan Conference 2010

http://www.hitcon.org/hit2010/download/6_New%20Battlefield%20For%20Malware%20Game.pdf

王大寶 & PK / Hypervisor - New Battlefield For Malware Game 虛擬機 - 惡意程式攻防的新戰場