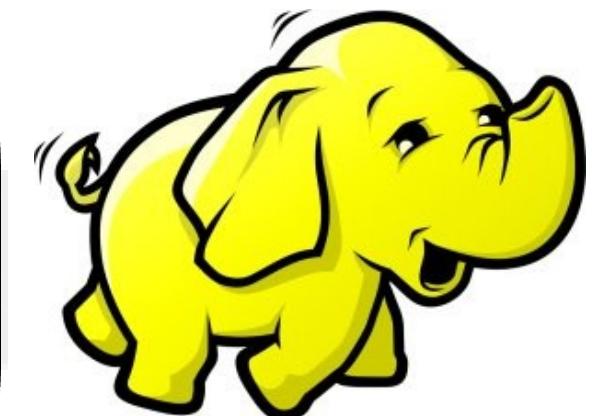




雲端時代嵌入式裝置虛擬化的新趨勢與資安隱憂

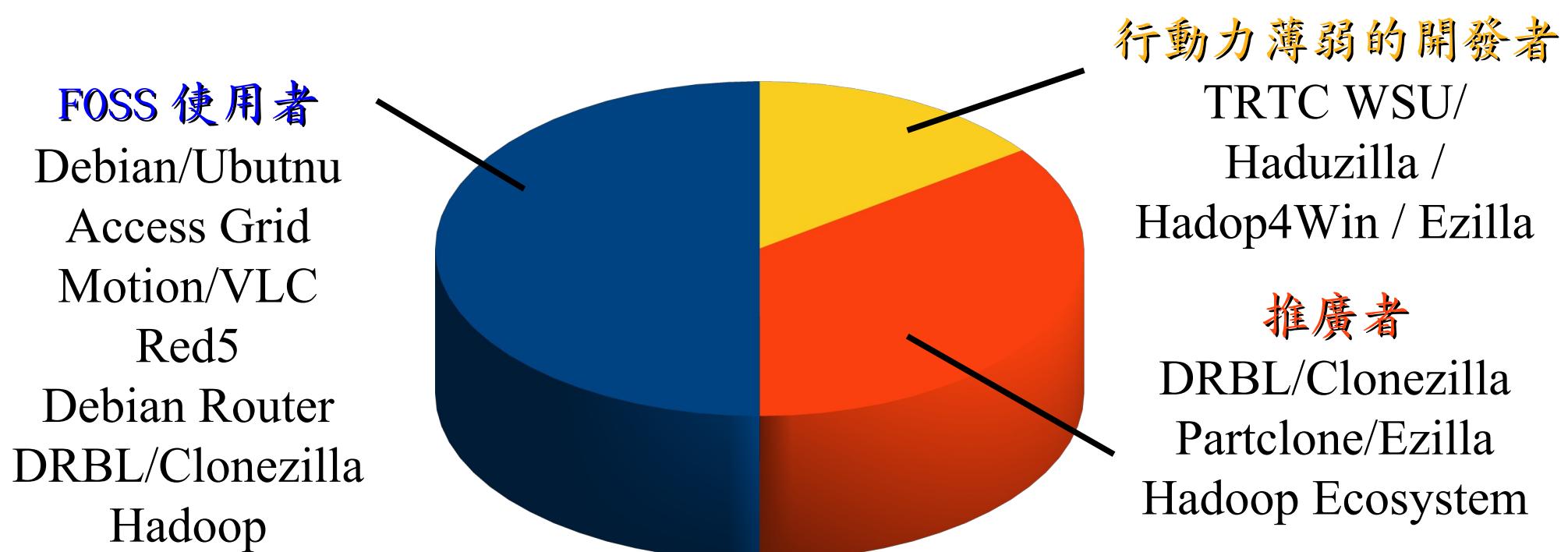
The trend of Embedded Virtualization and its security issue in Cloud Era

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



WHO AM I ? 這傢伙是誰啊？ JAZZ ?

- 講者介紹：
 - 國網中心 王耀聰 副研究員 / 交大電控八九級碩士
 - jazz@nchc.org.tw
- 所有投影片、參考資料與操作步驟均在網路上
 - <http://trac.nchc.org.tw/cloud>
 - 由於雲端資訊變動太快，愛護地球，請減少不必要之列印。



Agenda 演講大綱

雲端商業模式及三大關鍵技術

架構即服務的關鍵技術：虛擬化

有沒有裝置端的虛擬化技術呢？

雲端運算 + 物聯網 = 駭客的新天堂

結語



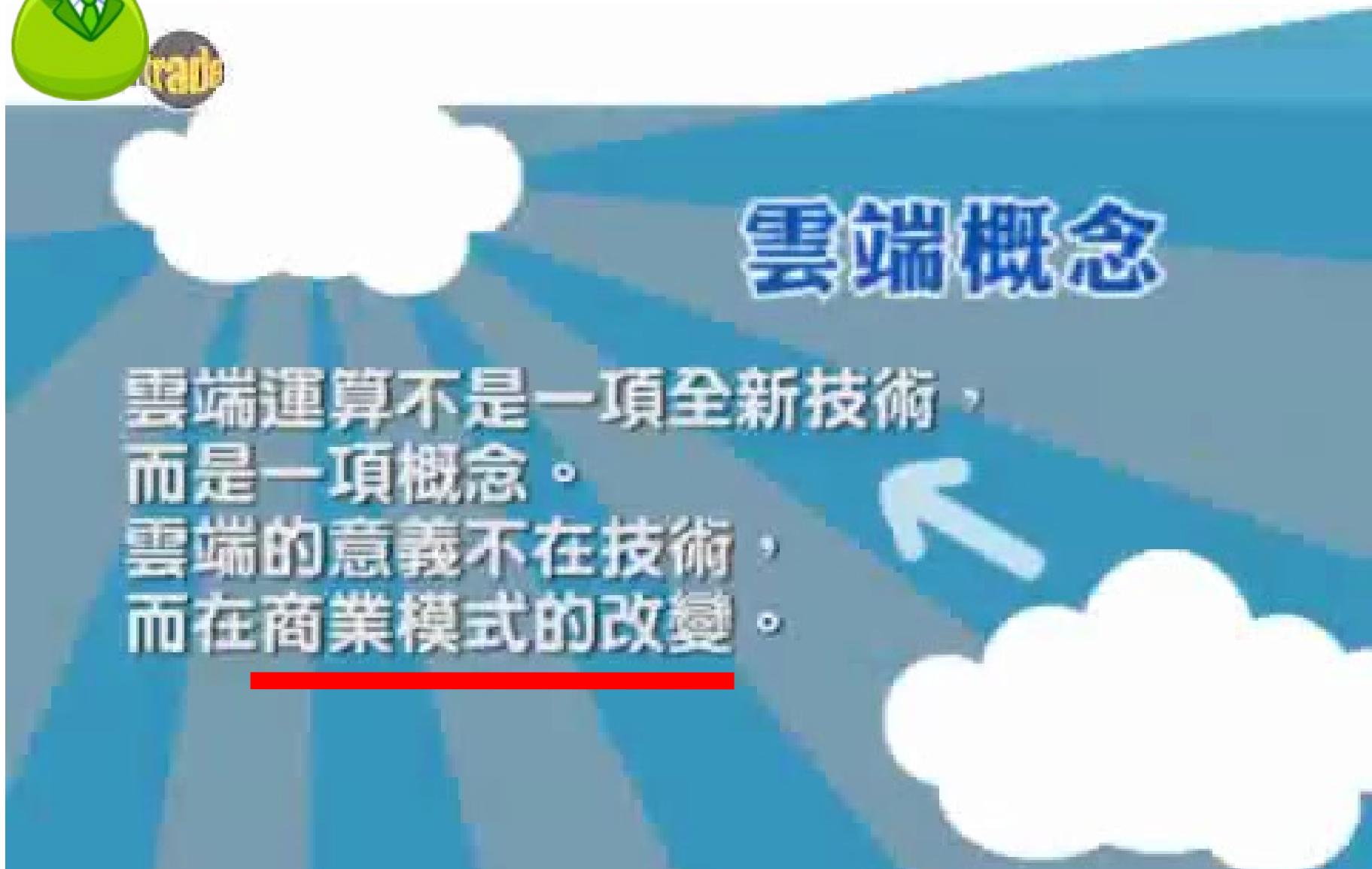
什麼是雲端運算啊？

What is Cloud Computing ?

雲端概念

雲端運算不是一項全新技術，
而是一項概念。

雲端的意義不在技術，
而在商業模式的改變。



Paradigm Shift of Cloud Business Model !!

雲端商業模式的典範轉移

軟體從買斷變成租賃

Office 2007 =>
Google Docs // Office 365

硬體從買斷變成租賃

PC // Server =>
Hosting // Colocation =>
Amazon EC2 // S3

軟體從單機變成行動

Outlook => Webmail =>
Mail Web Apps =>
Mail Mobile Apps

硬體從固定變成行動

PC // Server =>
NB // Tablet =>
Pad // Mobile

New IT Architecture toward Cloud Computing !!

用雲掌握資料，加以分析，形成智能給端用



雲

資料中心
提供服務

雲端設計新思維：端的智能來自於雲的服務

Devices share the wisdom of Cloud

端

各類裝置
存取服務



Supply Chain of Cloud Industry

雲端產業的供應鏈

應用軟體
供應商



端

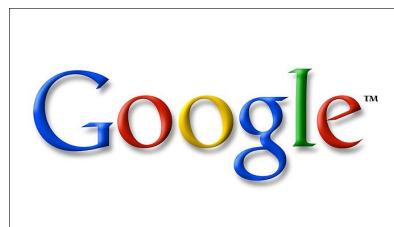
各類裝置
存取服務

行動裝置
共通平台

HTC
quietly brilliant



軟體服務
供應商



雲

資料中心
提供服務

資料中心
機房維運



acer

基本硬體
建設組件



FOXCONN
鴻海科技集團

英業達集團
Inventec

廣達電腦
Quanta Computer

Relation of different departments !! 各科系人才如何供給雲端產業

應用軟體供應商

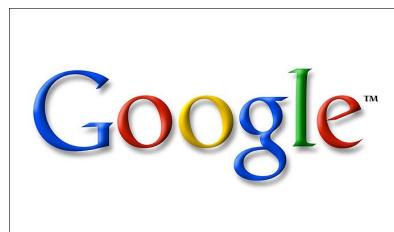


行動裝置共通平台

htc
quietly brilliant



軟體服務供應商



資料中心機房維運



acer®

基本硬體建設組件



英業達集團
Inventec

廣達電腦
Quanta Computer

資工
美術

資管
其他

電機

資工

資工

資管

統計

機械

土木

資管

電機

資工

Key Driving Forces of Cloud Computing

雲端運算的關鍵驅動力

端

Mobile Service

企業
租賃取代買斷
動態隨需付費

降低
經營成本

Cost Down

個人
刷任何連網裝置
都可以存取資料

因應
資料爆炸

Data Explore

全球
資料往雲擺
減少資料傳輸

雲

Three Key Technologies ■ 三種服務模式 vs. 三大關鍵技術



SaaS
Software as a Service
軟體即服務

PaaS
Platform as a Service
平臺即服務

IaaS
Infrastructure as a Service
架構即服務

Web 2.0
網頁服務

Big Data
資料分析

Virtualization
虛擬化技術

給資訊相關科系學生的建言

2

SaaS

Software as a Service
軟體即服務

Web 2.0

網頁服務

建議先學會怎麼用
Google Apps

PaaS

Platform as a Service
平台即服務

Big Data

資料分析

留意一下

Google Big Query
超龐大資料庫

IaaS

Infrastructure as a Service
架構即服務

Virtualization

虛擬化技術

1

虛擬化是畢業以後
有最高機率會用到
的技能！一定要會

Roadmap to build Your Enterprise Cloud !!

佈建企業雲端的時程規劃



智慧服務
SaaS

採用雲端服務
Cloud CRM

上下游整合
Mashup Service



分析平台
PaaS

建立 API
Public API

供應鍊共享
Supply Chain



基礎建設
IaaS

目前多數
還在這裡

初期常態租賃
Static VM

後期動態租賃
Dynamic VM

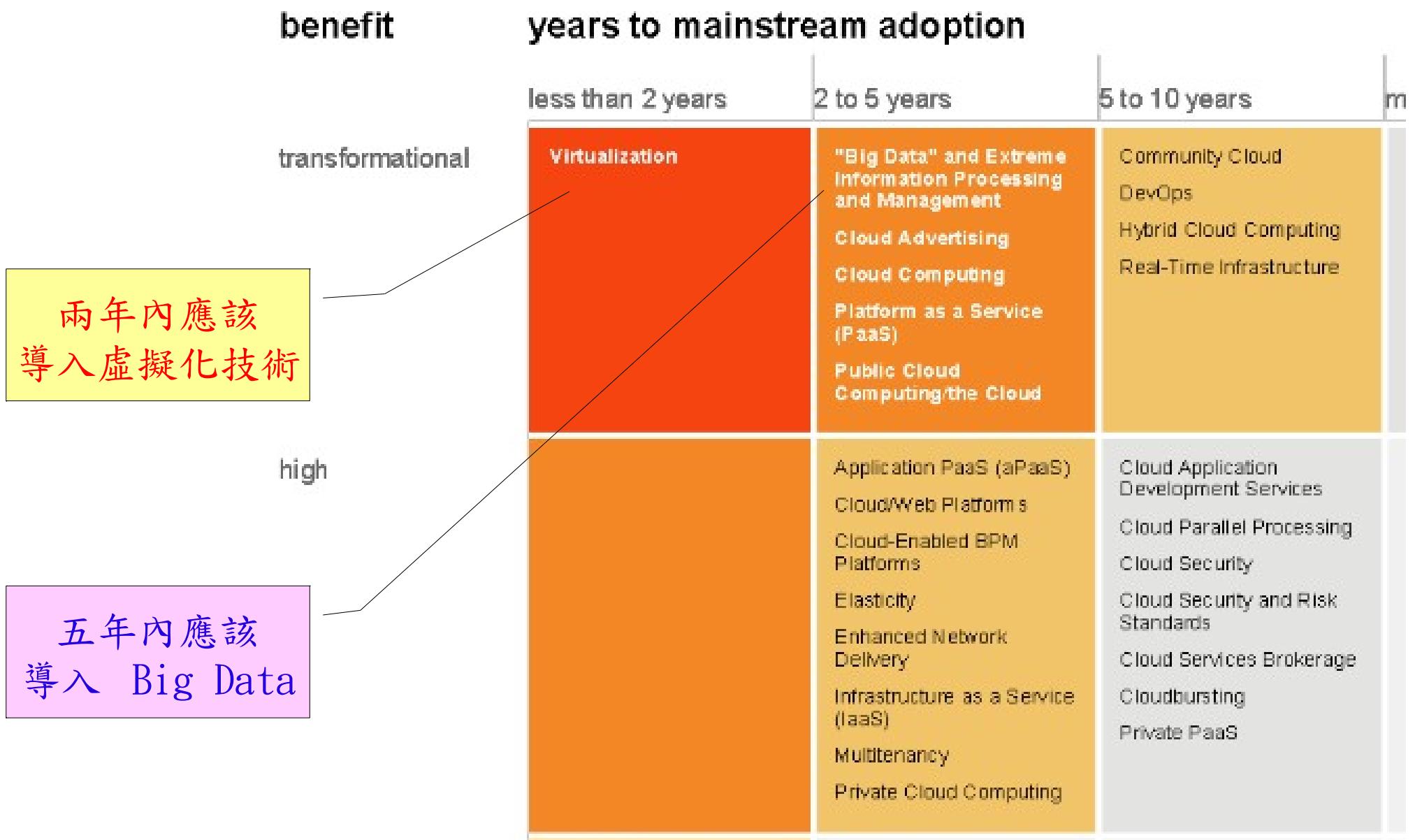
建立私有雲
Build Private Cloud

導入公有雲
Adopt Public Cloud
/ Community Cloud

形成混合雲
Be Hybrid Cloud

Gartner Priority Matrix for Cloud Computing, 2010 !!

連 Gartner 也是這麼說的 !



Source: "Hype Cycle for Cloud Computing, 2011", David Mitchell Smith, Gartner
<http://www.gartner.com/id=1753115>

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結語

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

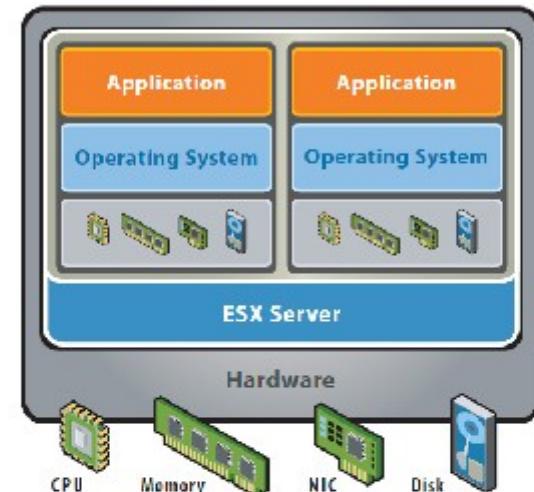
* New question for that year

Source: *Gartner Executive Programs : “Leading in Times of Transition: The 2010 CIO Agenda”* 15 / 45

First Wave of Cloud : Virtualization

企業導入雲端第一波主打：虛擬化！！

- 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™



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

Database Virtualization

資料虛擬化

Data Virtualization

Open Source for Virtualization

虛擬化技術對應的自由軟體

Application Virtualization



Ex. VMWare ThinApp

Desktop Virtualization
Client Virtualization



Redhat SPICE

Presentation Virtualization



VNC, FreeNX,
FreeRDP

OS-Level Virtualization



Xen, KVM, OpenVZ
QEMU, VirtualBox

Network Virtualization



OpenFlow vSwitch

Storage Virtualization



Lessfs, SDFS

OS-level Virtualization

作業系統虛擬化

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

Database Virtualization

資料虛擬化

Data Virtualization

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



Mac4Lin



Powered by
ubuntu
Trademark of Canonical Ltd.



Physical Hardware / OS 實際硬體 // 作業系統

3 kinds of Virtualization

三種作業系統虛擬化技術

http://en.wikipedia.org/wiki/Full_virtualization

Full Virtualization

全虛擬化

完全模擬出抽象的硬體

優點：舊的硬體就可以～

缺點：額外的系統負擔！

http://en.wikipedia.org/wiki/Operating_system-level_virtualization

Container (OS-level Virtualization)

容器

完全模擬出抽象的硬體

優點：系統負載最輕～

缺點：只能跟母系統相同

Para- Virtualization

半虛擬化

需要底層硬體支援

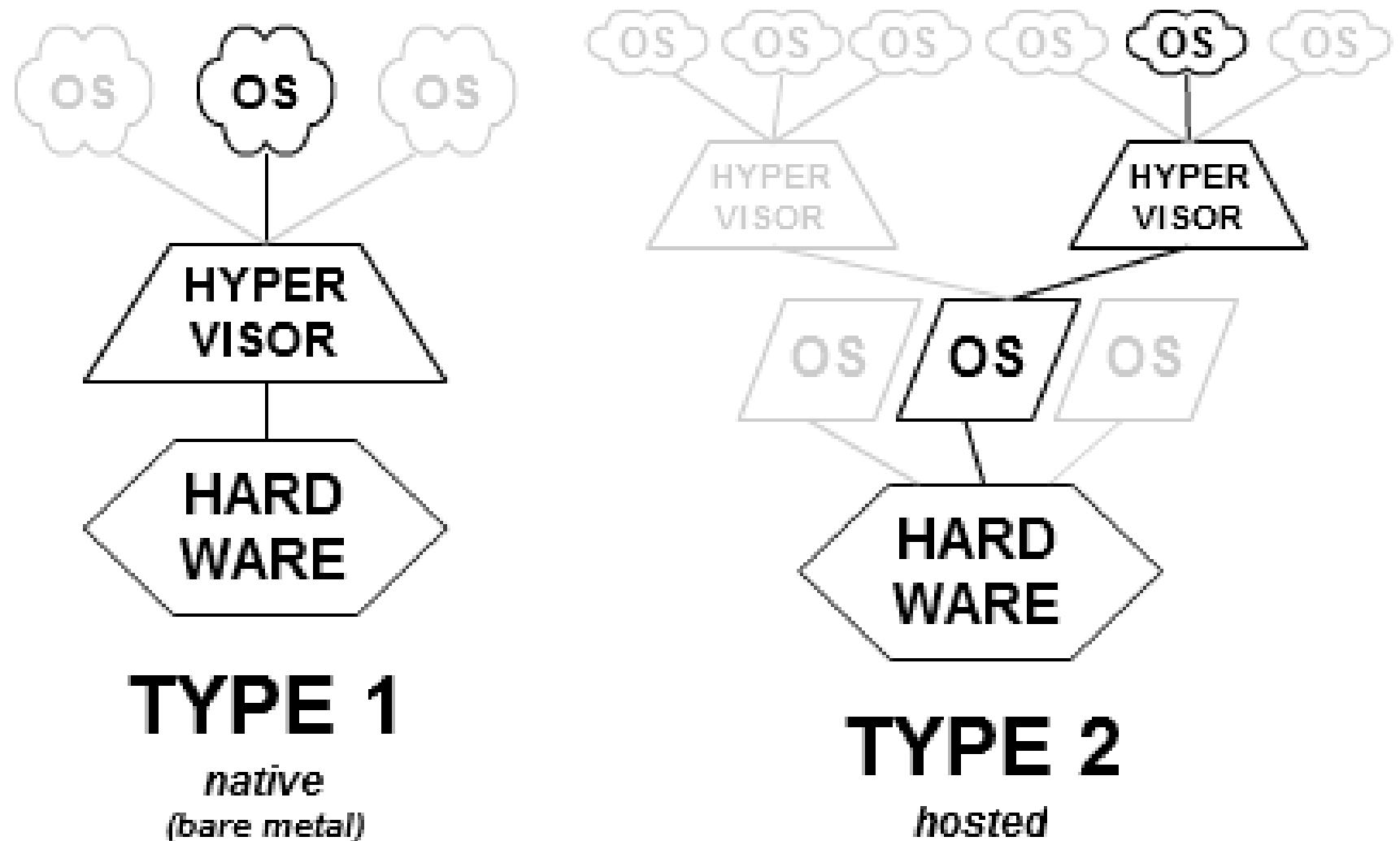
優點：額外負載較輕～

缺點：要採購新硬體！

<http://en.wikipedia.org/wiki/Paravirtualization>

2 Types of Hypervisor

兩種虛擬化型態



Storage Virtualization

儲存虛擬化

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

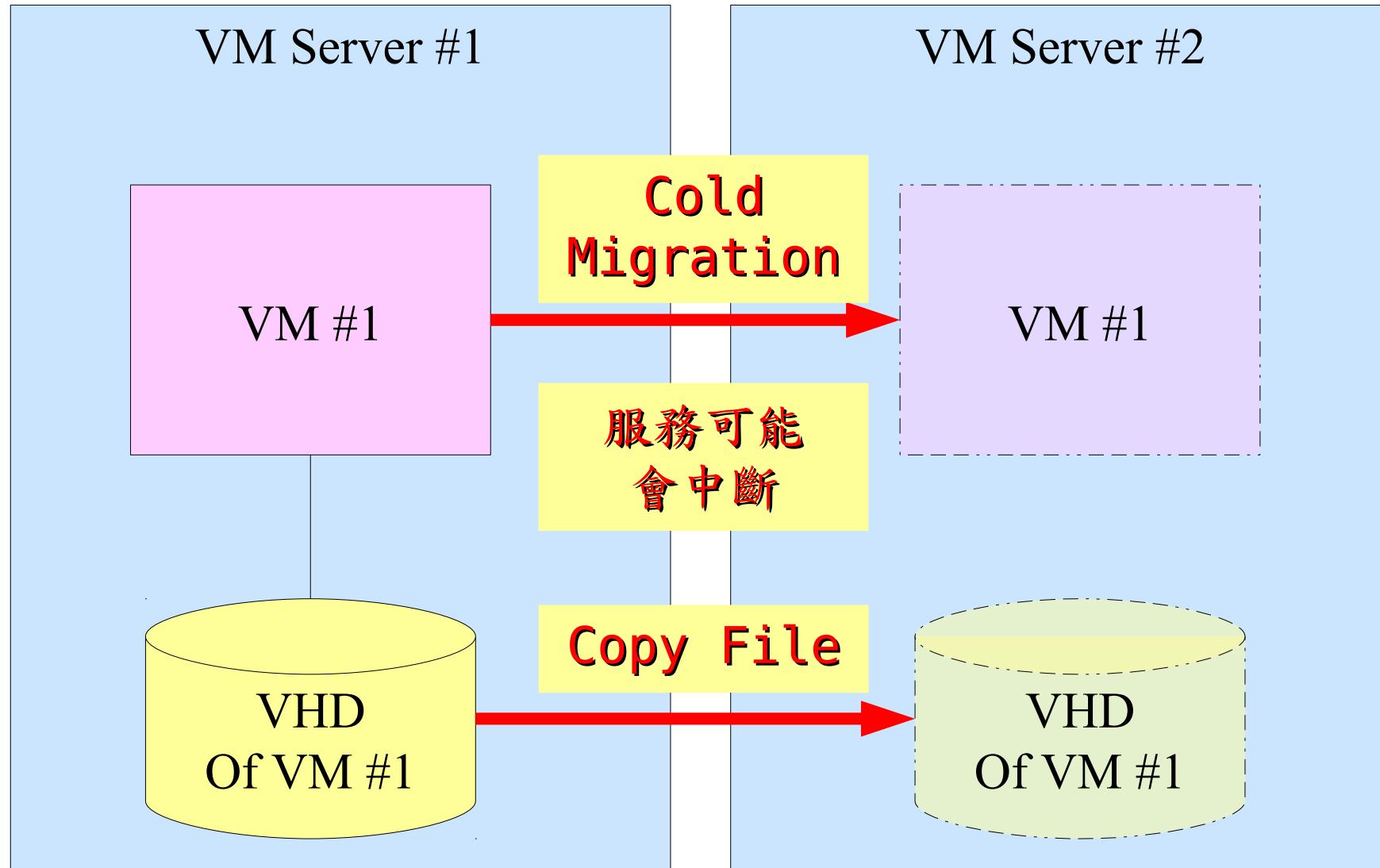
資料庫虛擬化

Database Virtualization

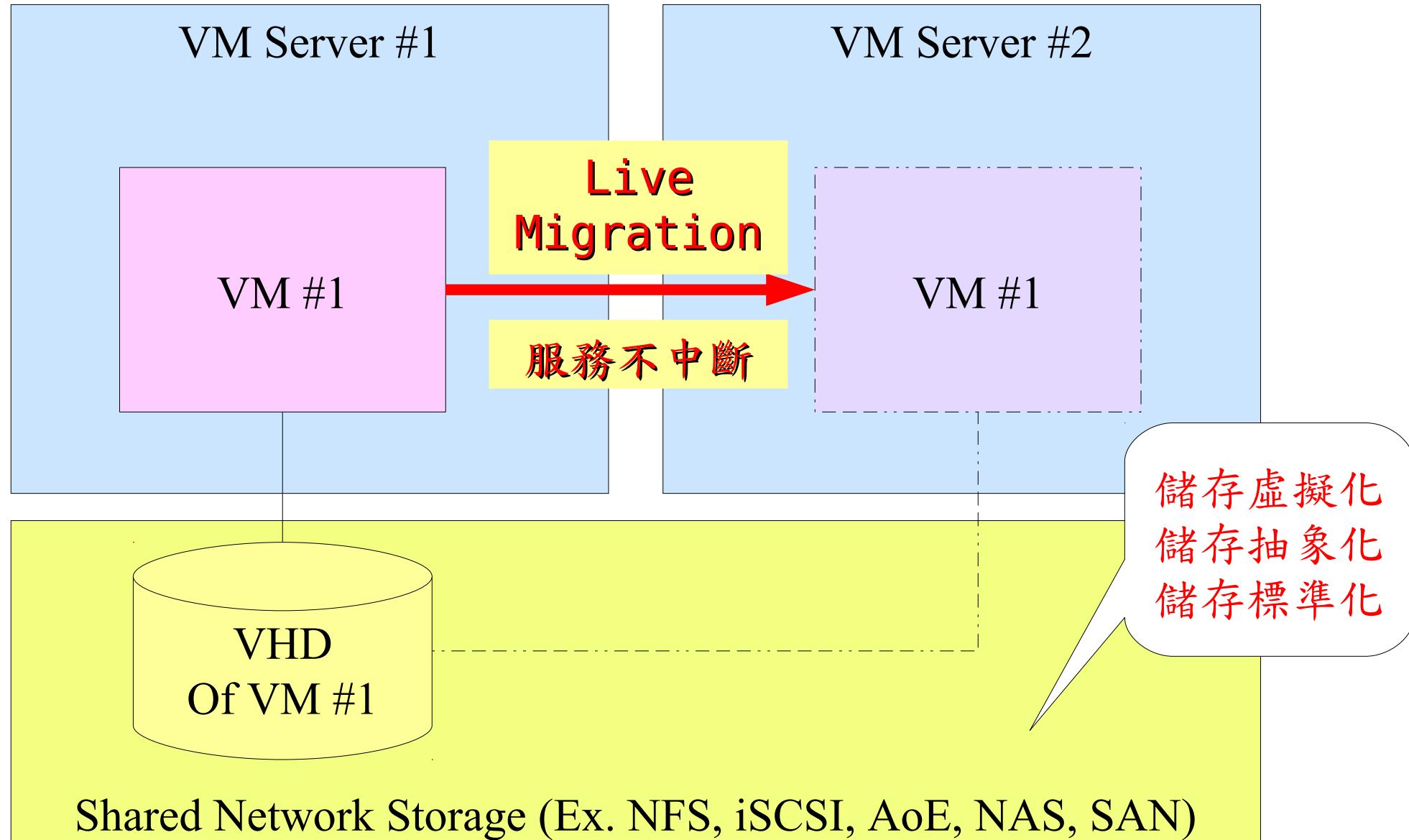
資料虛擬化

Data Virtualization

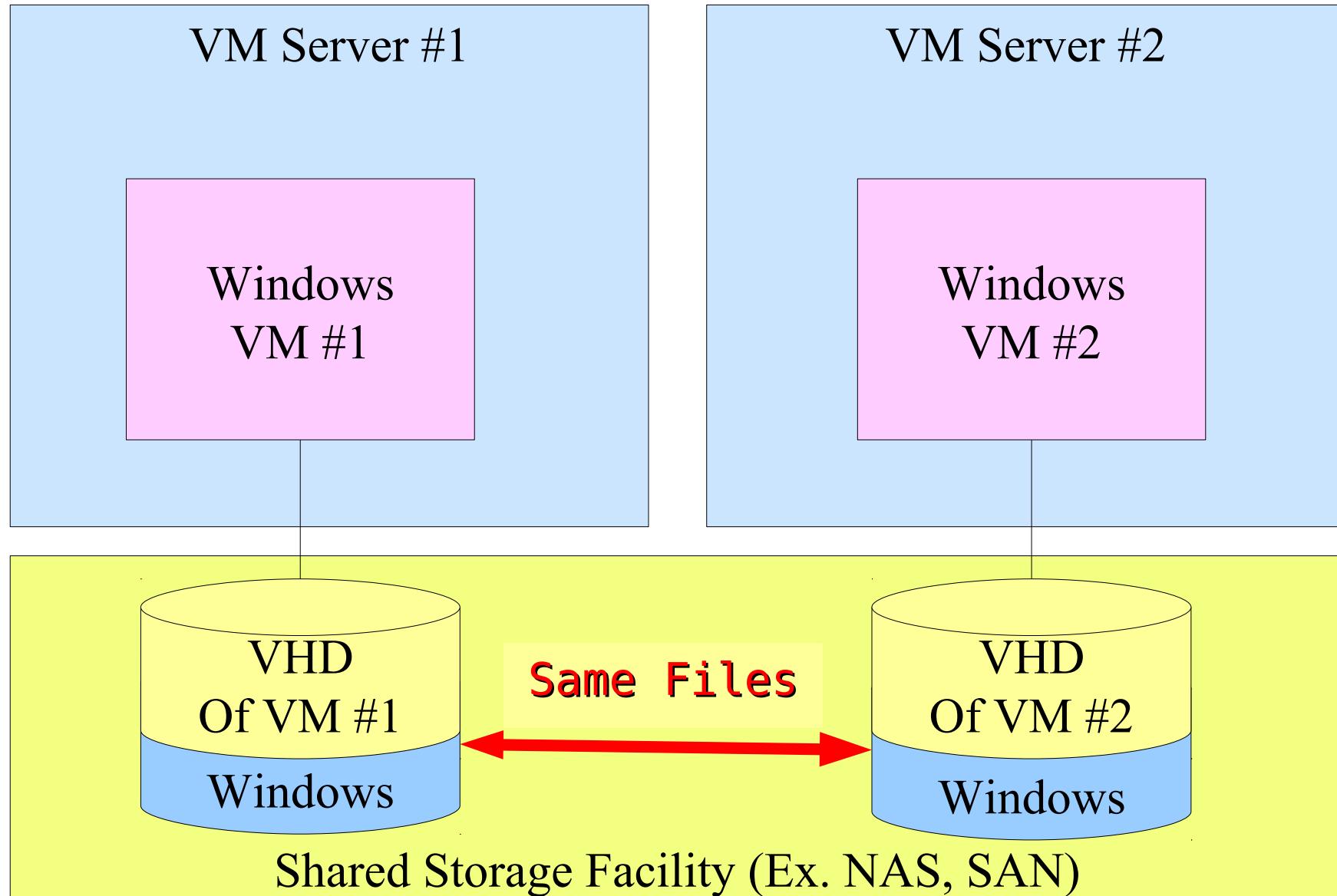
Why Storage Virtualization !! 為何需要儲存虛擬化？



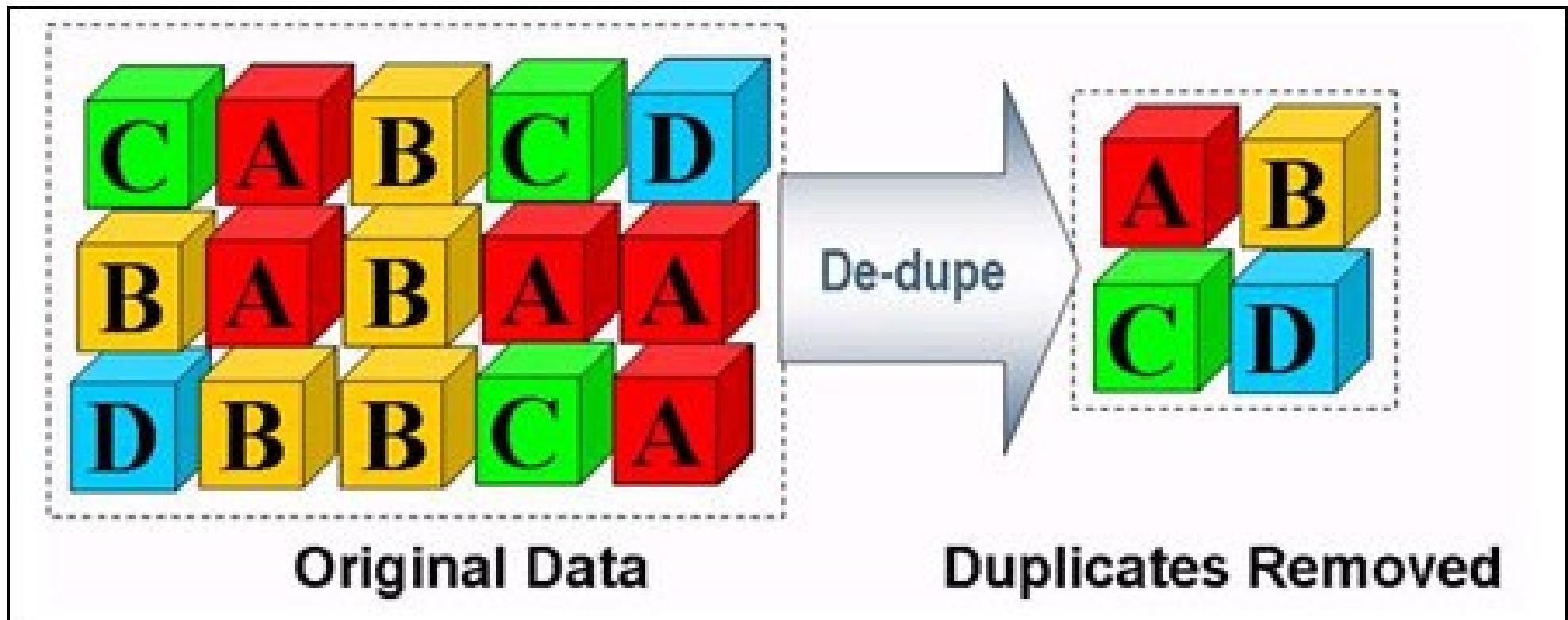
Why Storage Virtualization !! 為何需要儲存虛擬化？



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...



Network Virtualization

網路虛擬化

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

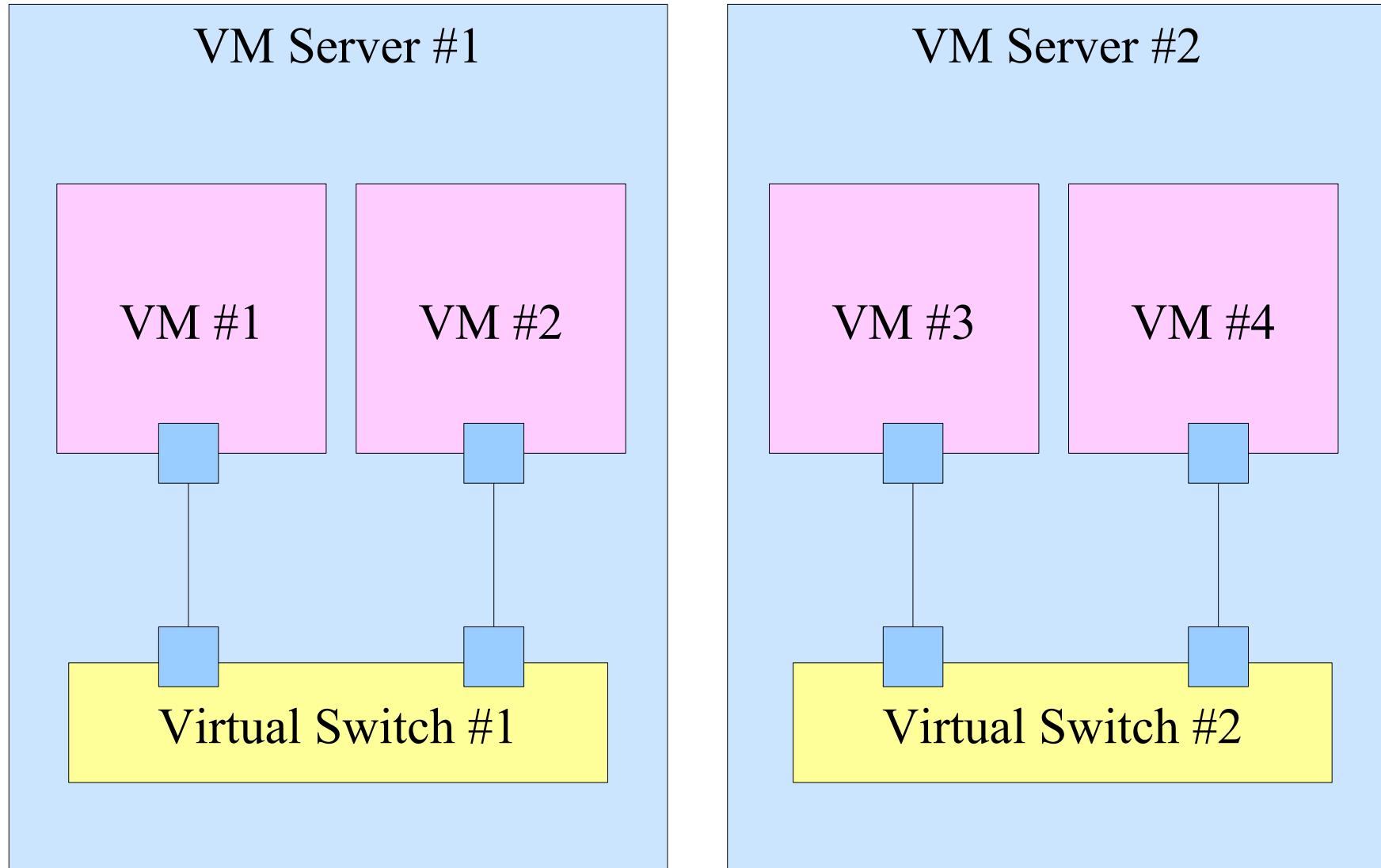
Database Virtualization

資料庫虛擬化

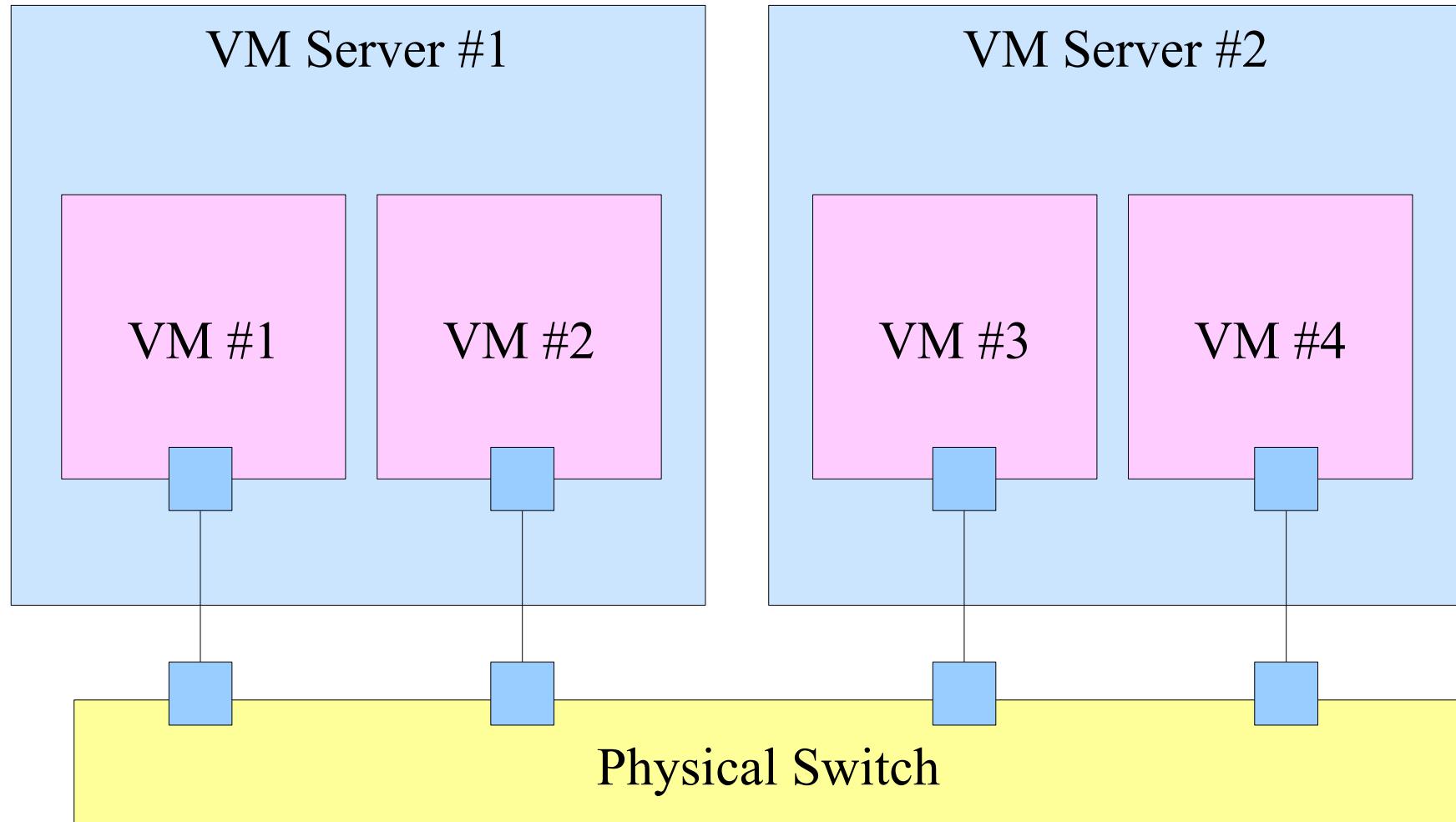
Data Virtualization

資料虛擬化

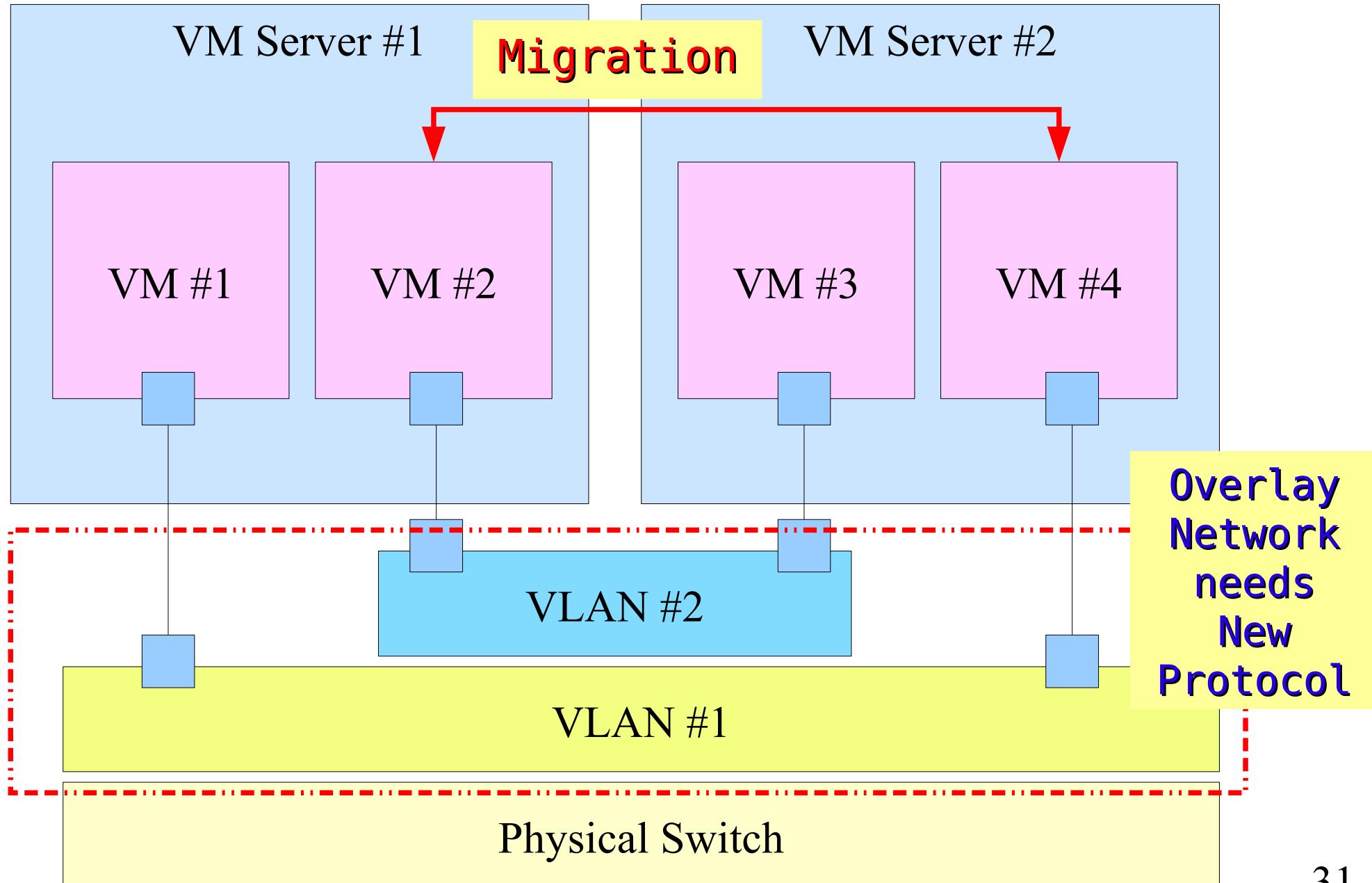
Why Network Virtualization !! 為何需要網路虛擬化？



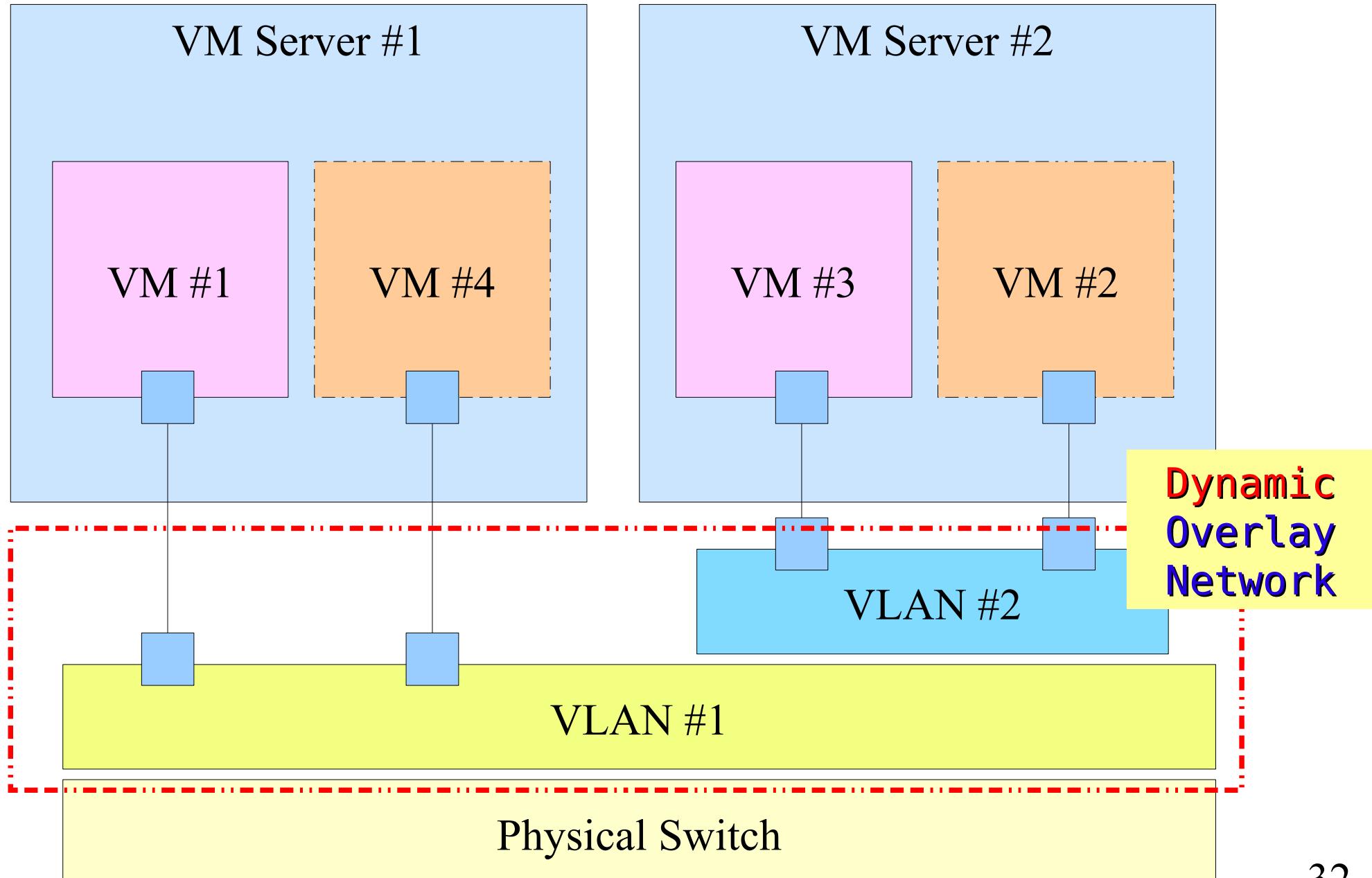
Why Network Virtualization !! 為何需要網路虛擬化？



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



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 stylized blue 'C' with an arrow pointing through it. To its right is the word "OpenFlow". On the far right of the header is a Google Custom Search bar and a "Search" button. Below the header, there is a navigation menu with links for Home, Videos, Documents, News, Research, and About. The main content area has a dark blue background. On the left, there's a section titled "Innovate in Your Network" with a description of what OpenFlow enables. On the right, there are two large buttons: one labeled "Learn More" with a blue 'i' icon, and another labeled "Develop" with icons of two people and gears. Below this, there's a section titled "Participate" with a description of the Open Networking Foundation. Further down, there's a section titled "OpenFlow News" with a link to a news article about a Boston CIO Workshop.



The screenshot shows the OpenNetworking Foundation website homepage. At the top is the OpenNetworking Foundation logo, featuring a stylized 'Q' icon followed by the text "OpenNetworking Foundation". Below the logo is a large banner with the text "Welcome to the Open Networking Foundation!". The banner contains a paragraph of text explaining the foundation's mission to promote Software-Defined Networking (SDN). To the right of the text is a photograph of several network cables in various colors (blue, green, red) and connectors. The overall design is clean and professional.

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

Presentation Virtualization

顯示虛擬化

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

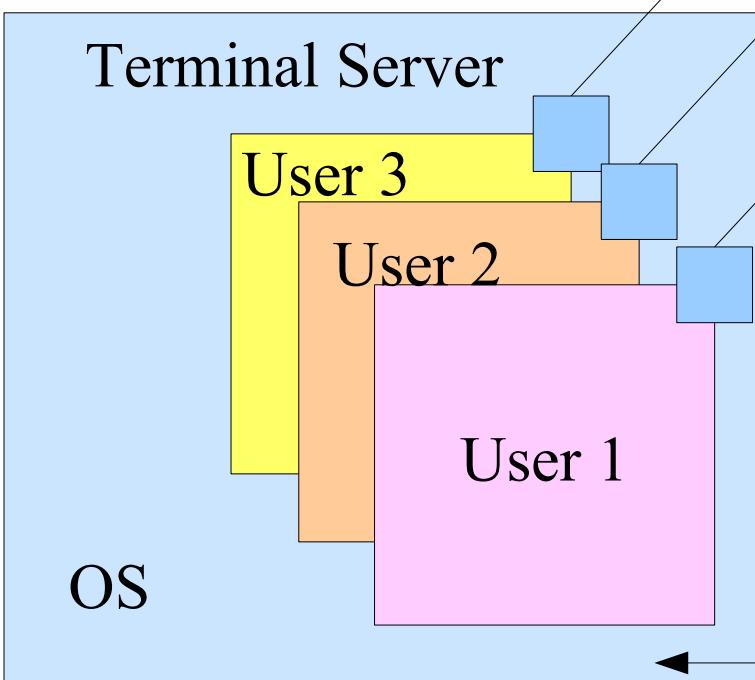
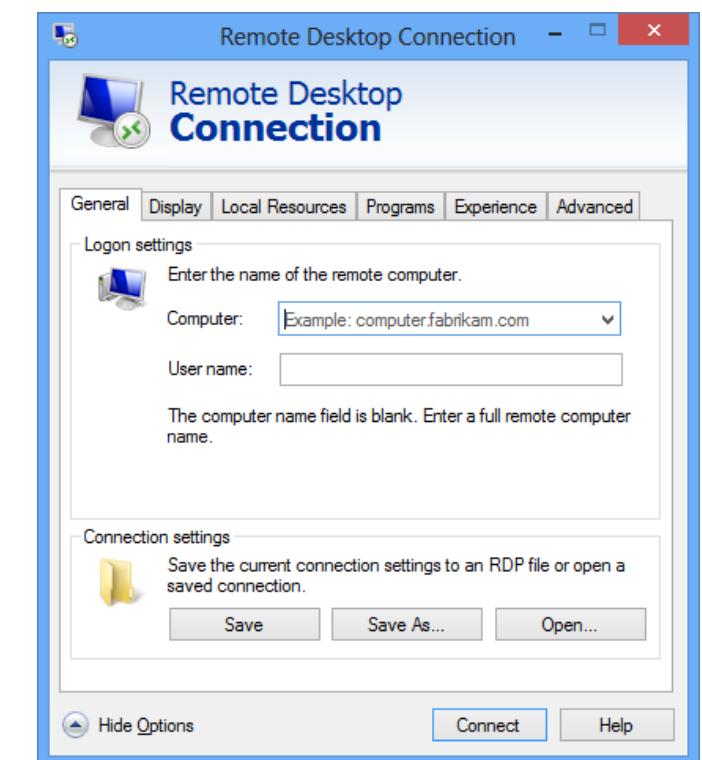
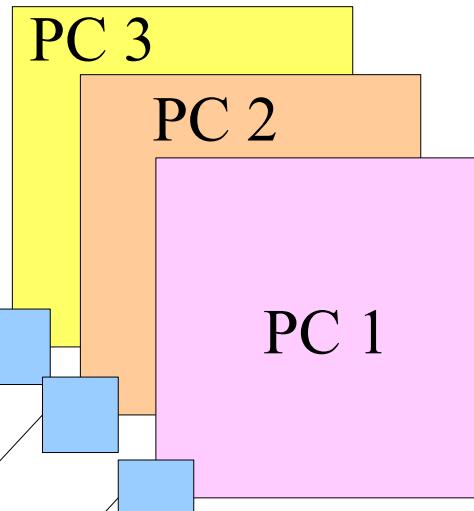
Storage Virtualization 儲存虛擬化

資料庫虛擬化

Database Virtualization

資料虛擬化

Data Virtualization



把顯示卡虛擬化

**REAL
VC**

典型應用：**Windows Terminal Server**
一個人中毒 = 所有人的困擾！

Desktop Virtualization

桌面虛擬化

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

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Storage Virtualization 儲存虛擬化

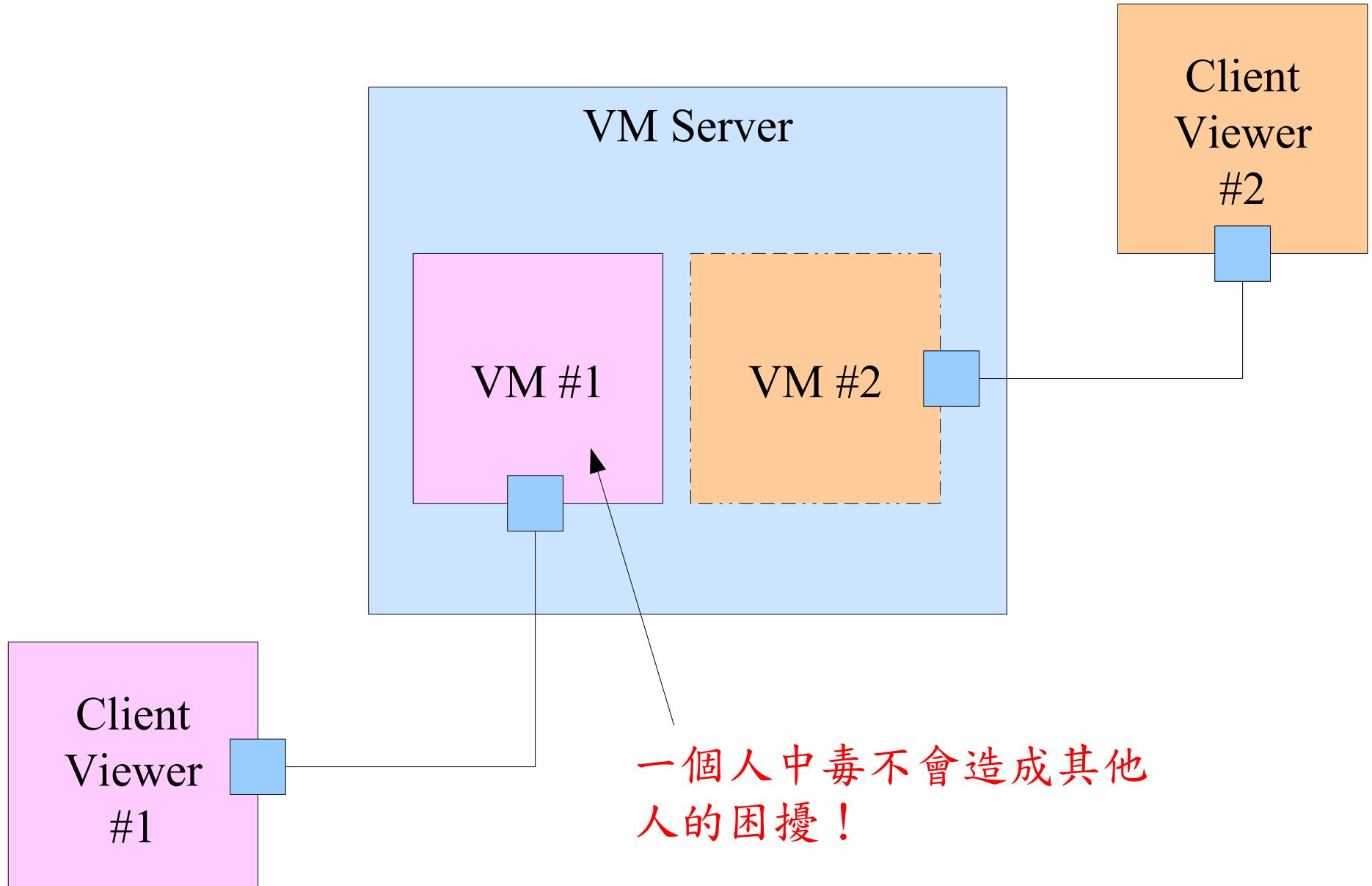
資料庫虛擬化

Database Virtualization

資料虛擬化

Data Virtualization

Desktop Virtualization !! 為何需要桌面虛擬化？

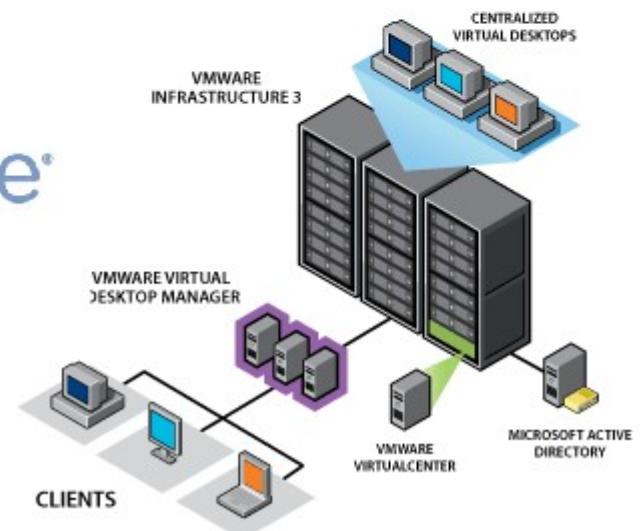


Thin Client and VDI for next IT procurement ? 未來改採購精簡型電腦與桌面虛擬化 ??

- 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)



Windows Server 2008
Hyper-V™



Desktop Virtualization and Thin Client

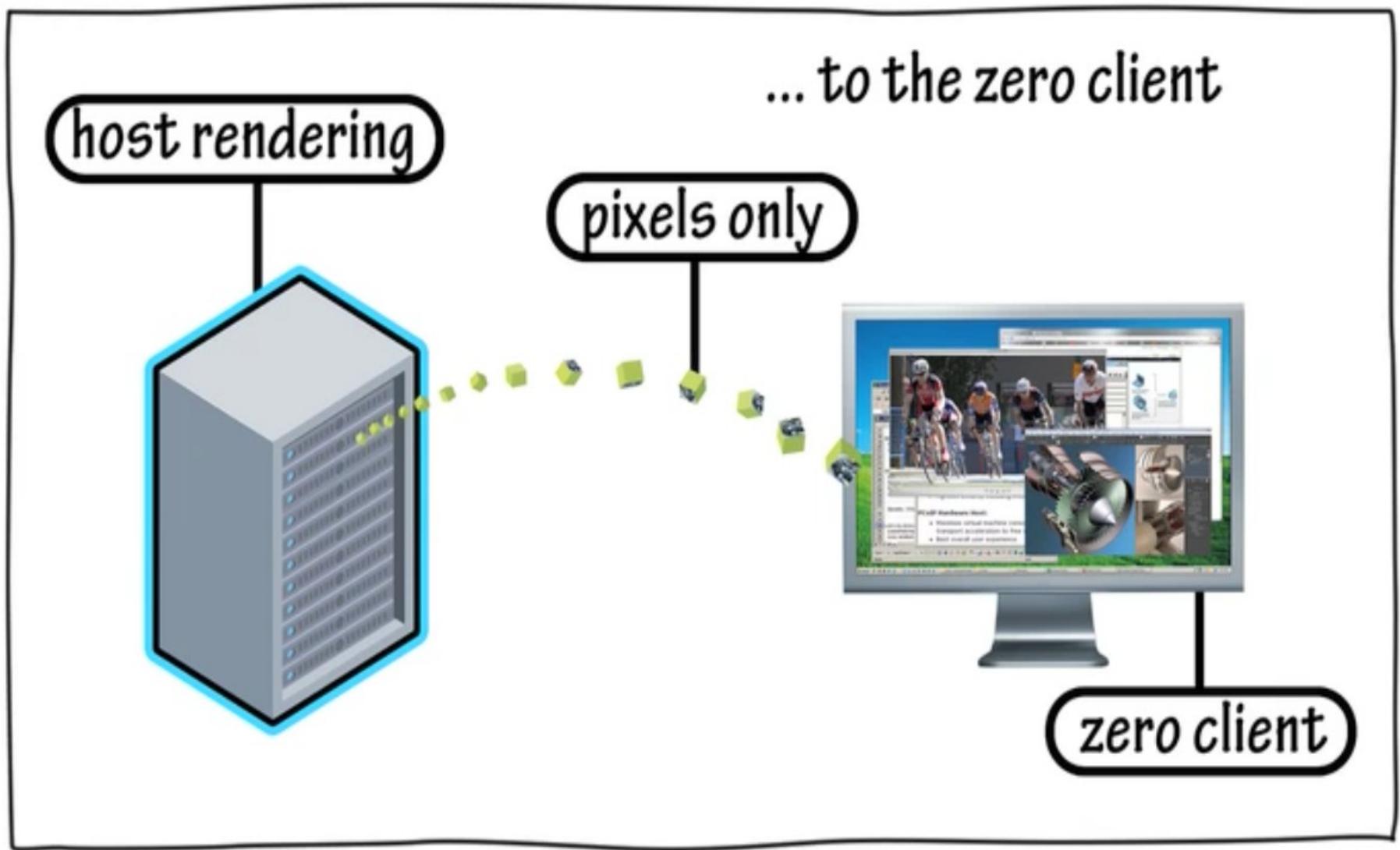
桌面虛擬化技術對未來辦公環境的改變

影片：<http://www.youtube.com/watch?v=XuYh95y9ROU>



Zero Client ? Take a look at PCoIP

無敵精簡型電腦 ?? 靠硬體支援的桌面虛擬化 !



參考：<http://pcoip.leadtek.com/tc/index.html>

http://www.teradici.com/media/videos/PCoIP_zero-client_690_stereo.mov

Application Virtualization

應用程式虛擬化

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

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資料庫虛擬化

Database Virtualization

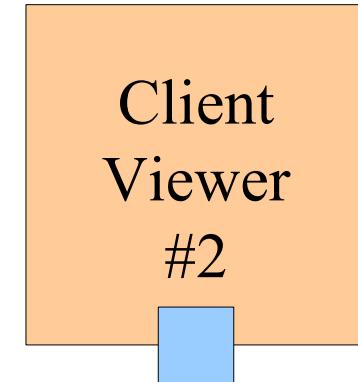
資料虛擬化

Data Virtualization

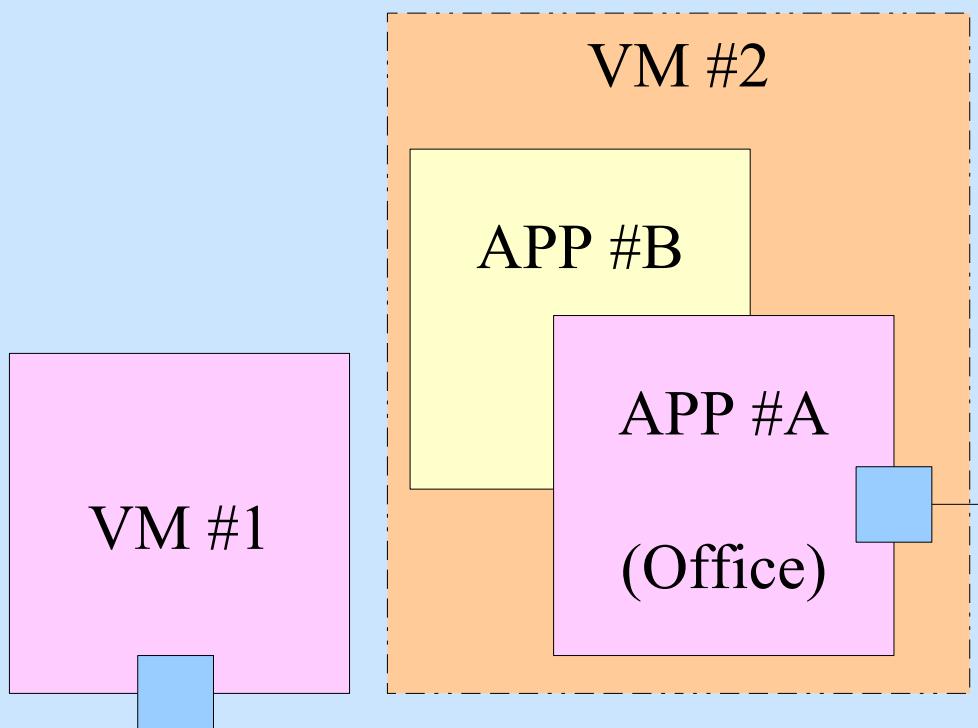
Application Virtualization !! 為何需要應用程式虛擬化？

讓 Terminal Server 只需要安裝、設定應用程式
一次的優點，在虛擬化的環境中實現！

動態佈署應用程式！依權限彈性修改 VM !



VM Server



Agenda 演講大綱

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有沒有裝置端的虛擬化技術呢？

雲端運算 + 物聯網 = 駭客的新天堂

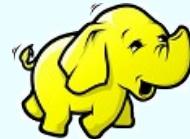
結語

Virtualization for Embedded Device ?

虛擬化只用在「雲」嗎？那「端」呢？



Eucalyptus



雲

集中，大廠
Centerized ,
Enterprise



端



symbian
OS

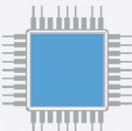


多元，中小廠
Diversify ,
SMB

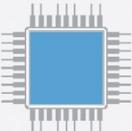
Motivation for Embedded Virtualization

嵌入式軟體採用虛擬化技術的三大動機

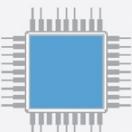
多核心
Multiple Cores



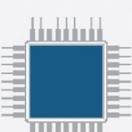
Real-Time OS



Quad-Core Controller with Virtualization



General-Purpose OS



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

在不被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

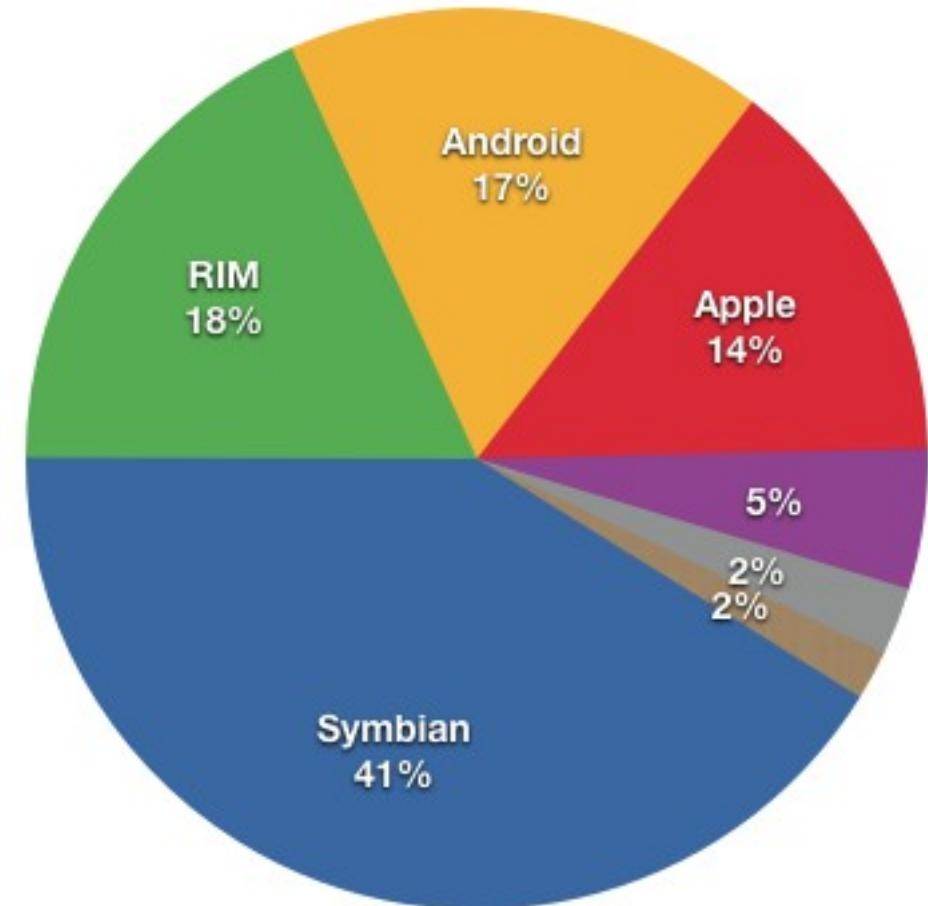
參考來源：**Embedded systems virtualization: Consider a Hypervisor**

<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=-QAWhd4ljV3g>

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>

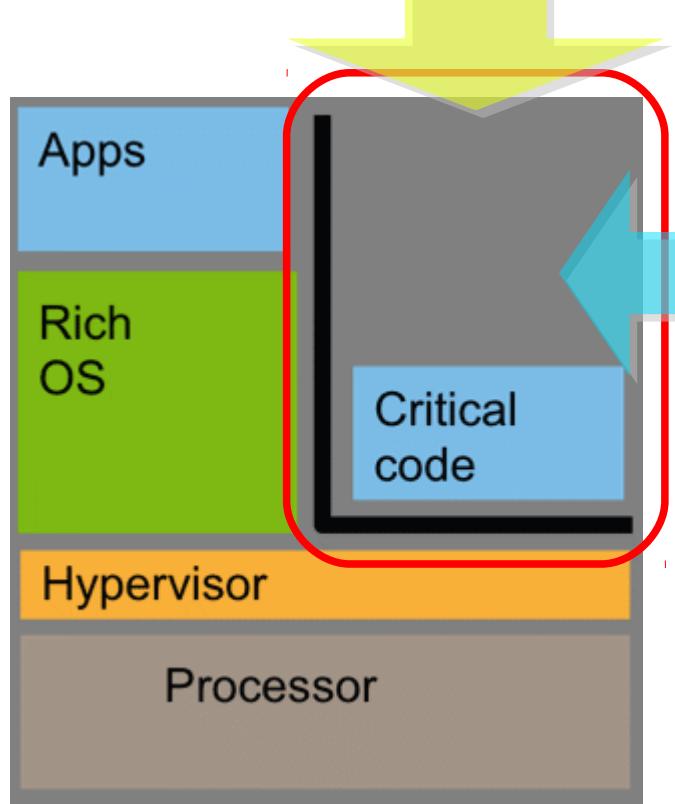
- Symbian
- Apple
- Other
- RIM
- Windows Mobile
- Android
- Linux

Virtualization for Embedded Security

為了安全性，必須建立獨立的管制區

DRM 音樂授權

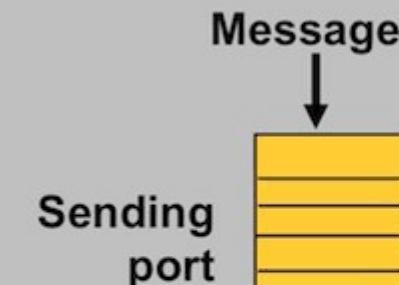
Digital Rights Management



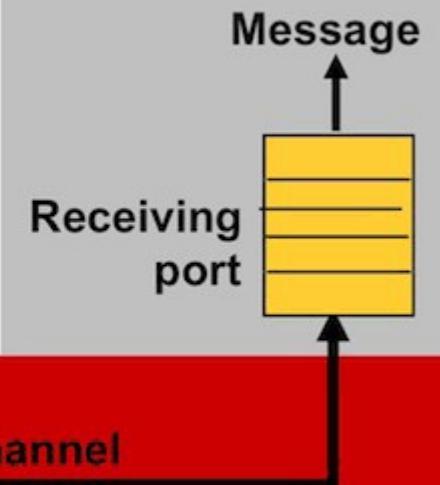
區域間用訊息傳遞方式溝通

Communicate with Message Channel

Trusted Partition



Untrusted Partition



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

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

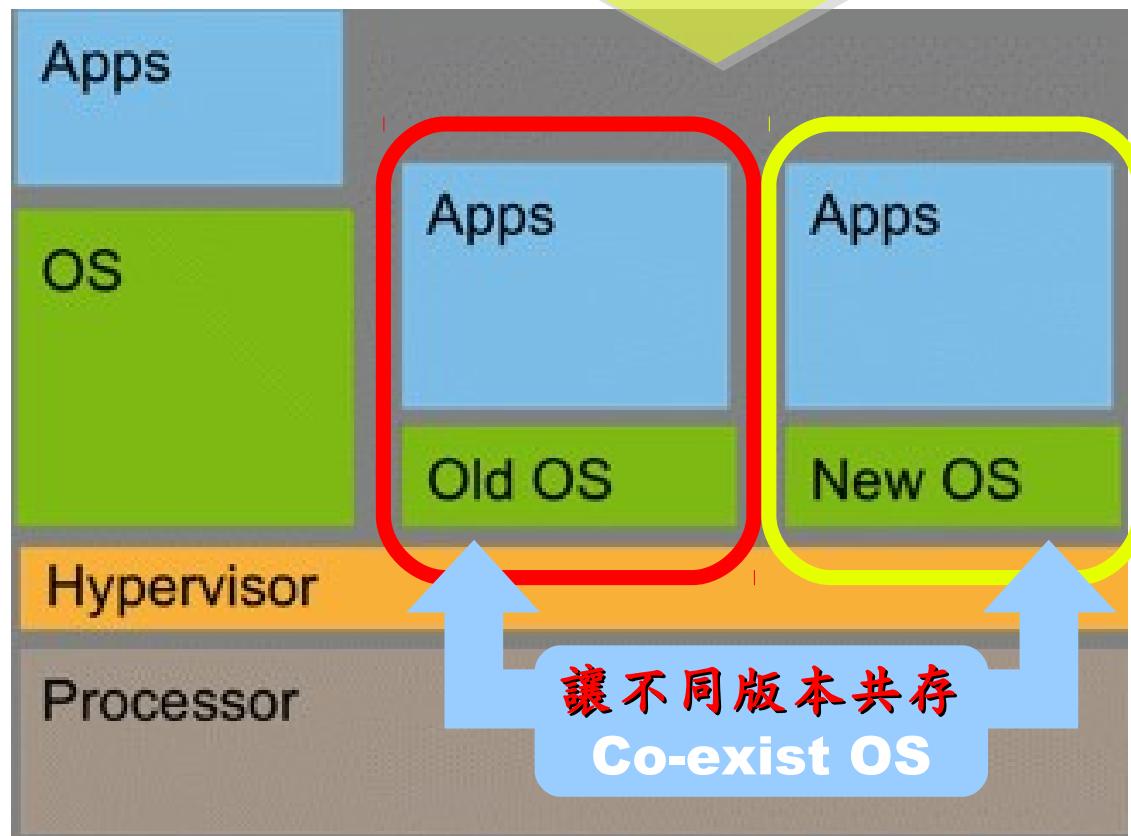
參考來源： **Securing Smart Grid Devices - Using Virtualization to Protect the Grid**

<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 勿體升級管制
firmware-over-the-air

遠距資料清除
Remote control to wipe data



輸入 *#06# 查 IMEI

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>



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

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

Agenda 演講大綱

雲端商業模式及三大關鍵技術

架構即服務的關鍵技術：虛擬化

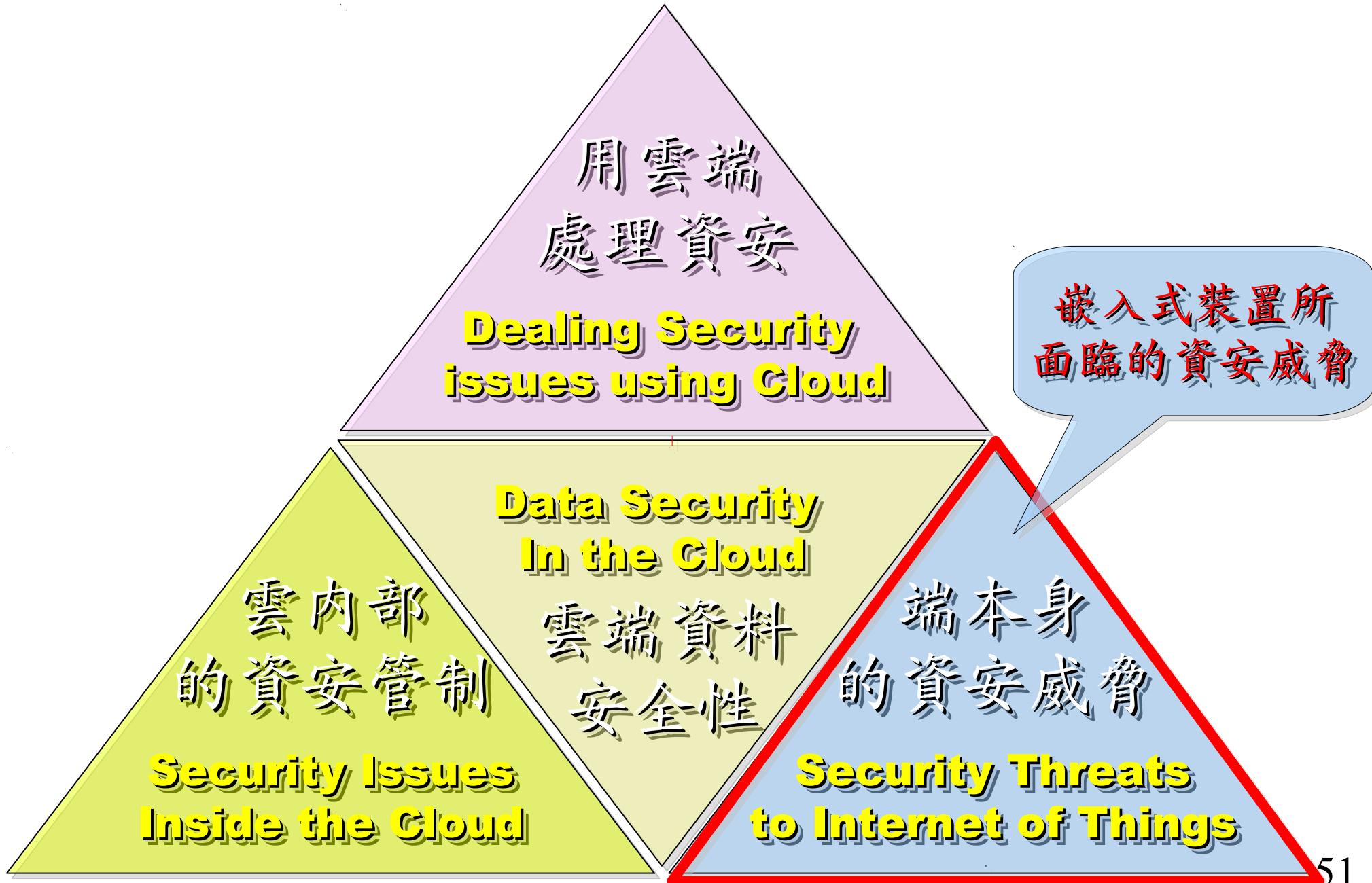
有沒有裝置端的虛擬化技術呢？

雲端運算 + 物聯網 = 駭客的新天堂

結語

Scope of Cloud Security

雲端資安的四大範疇



以前你只有電腦需要防毒，現在



端

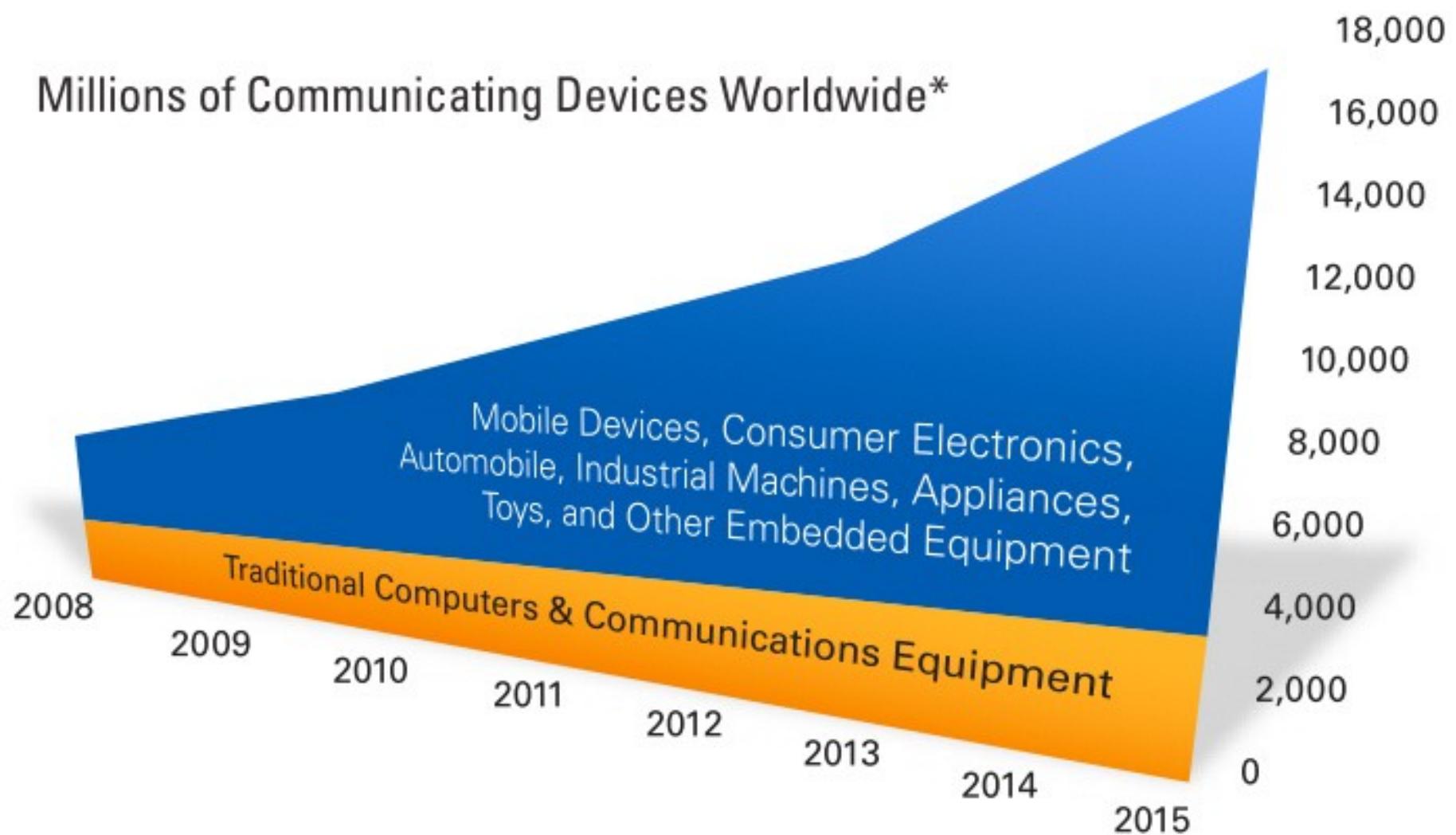


symbian
OS



多元，中小廠
Diversify ,
SMB

全球連網裝置急速成長中



Source: IDC Device Base Model, 2009

*Excludes voice- and SMS-only phones

物聯網的時代來臨

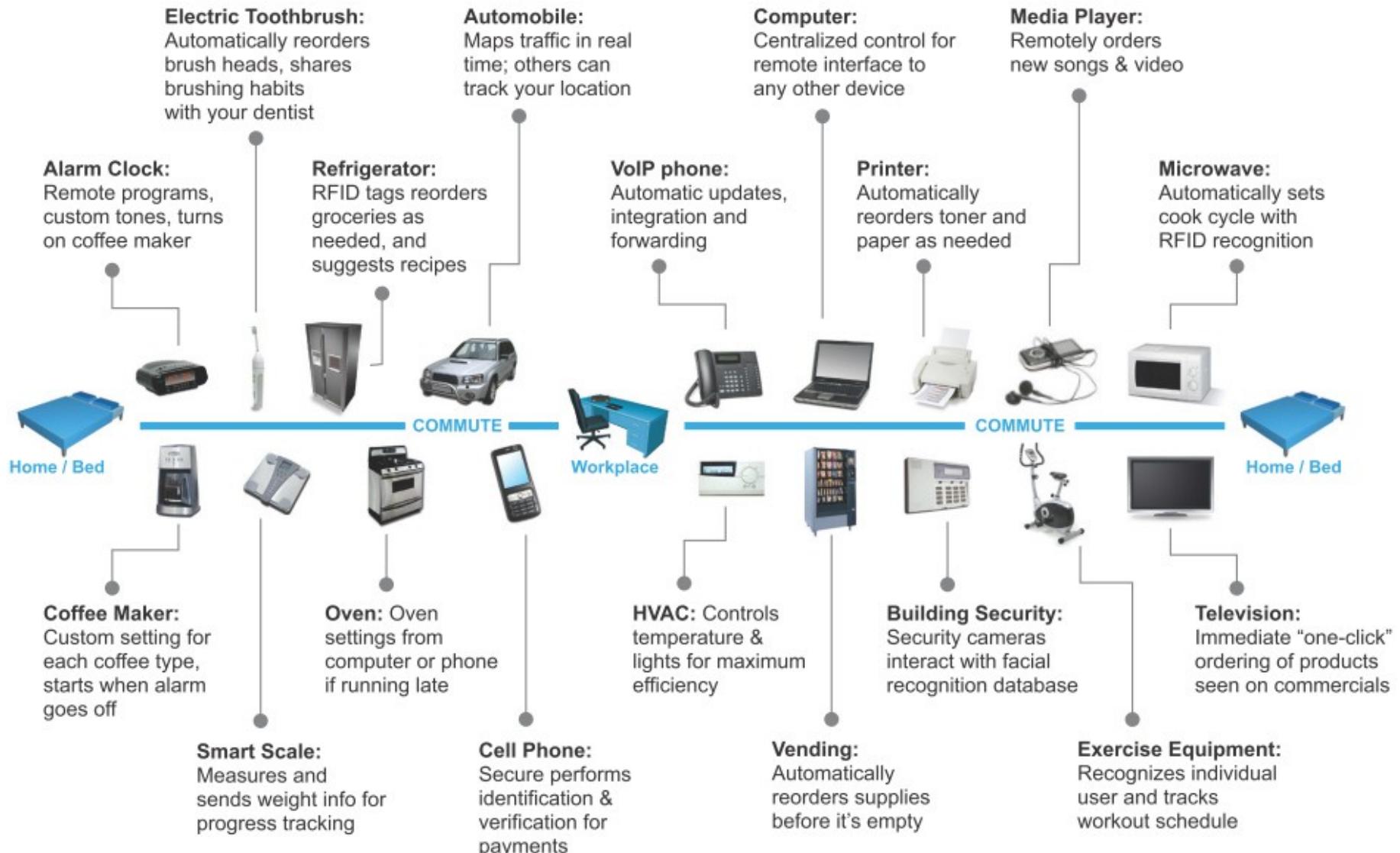
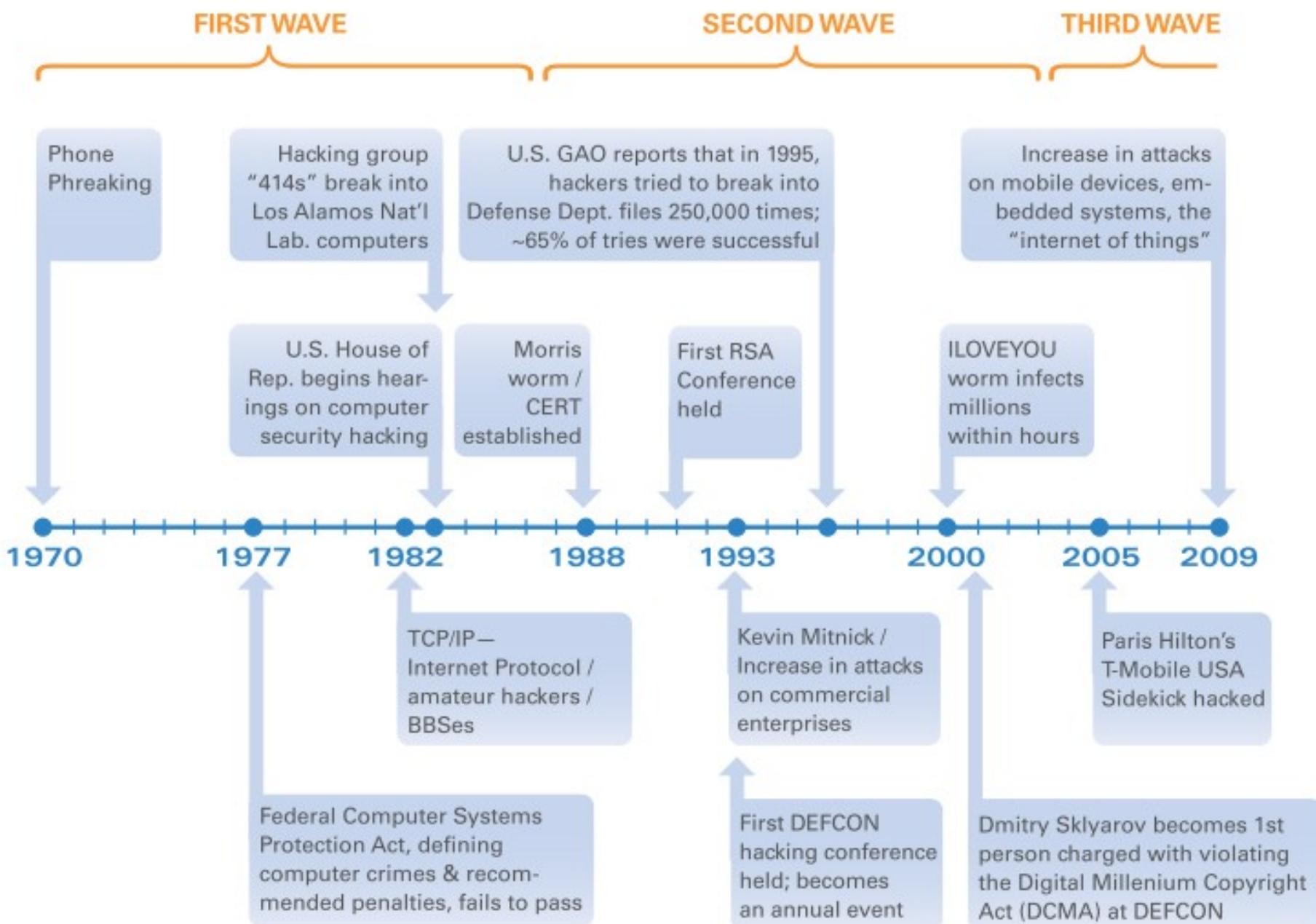


Figure 3. The Internet of Things

第三波網路入侵對象將鎖定在『物聯網』



針對行動裝置的各種資安問題與經驗

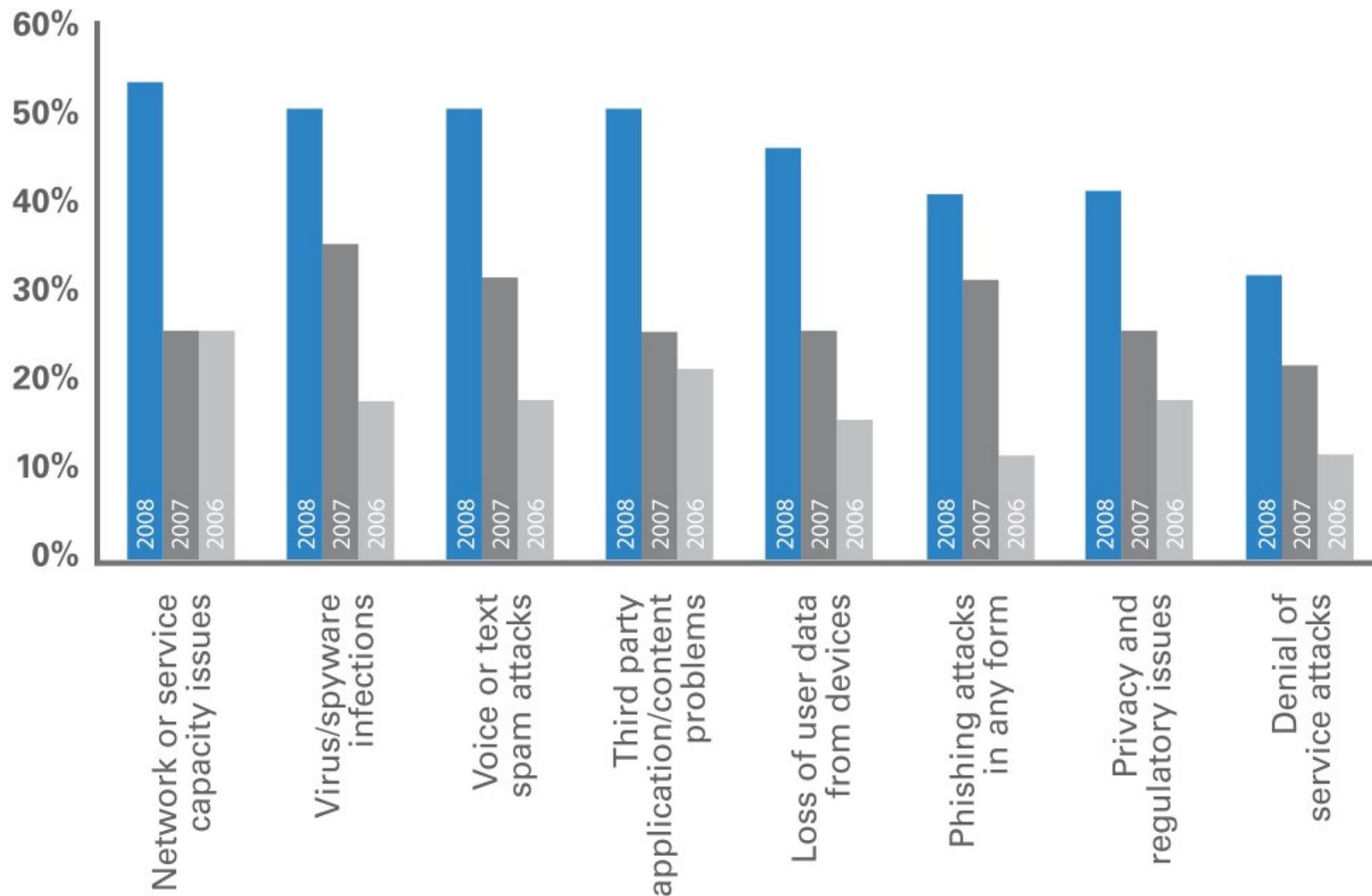
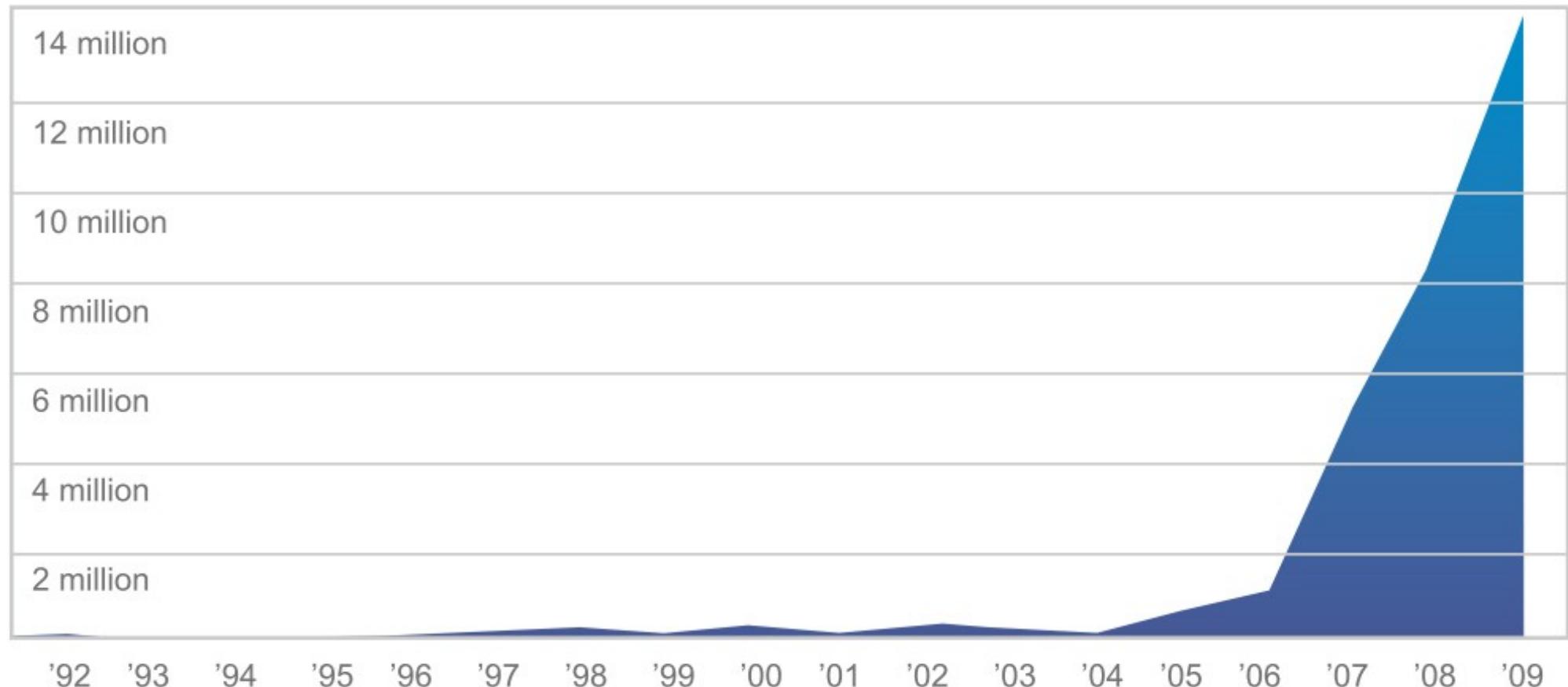


Figure 6. The increase in security issues experienced by mobile device users from 2006 to 2008; % of respondents. McAfee Mobile Security Report 2009

圖片來源：[Attacks on Mobile and Embedded Systems: Current Trends by Mocana](#)

網路惡意程式 (Malware) 逐年激增

Malware detected by year



Over 3,000 new “species” of PC malware are released onto the Internet every hour. Now that malware is setting its sights on Device platforms.
Source: AV LABS

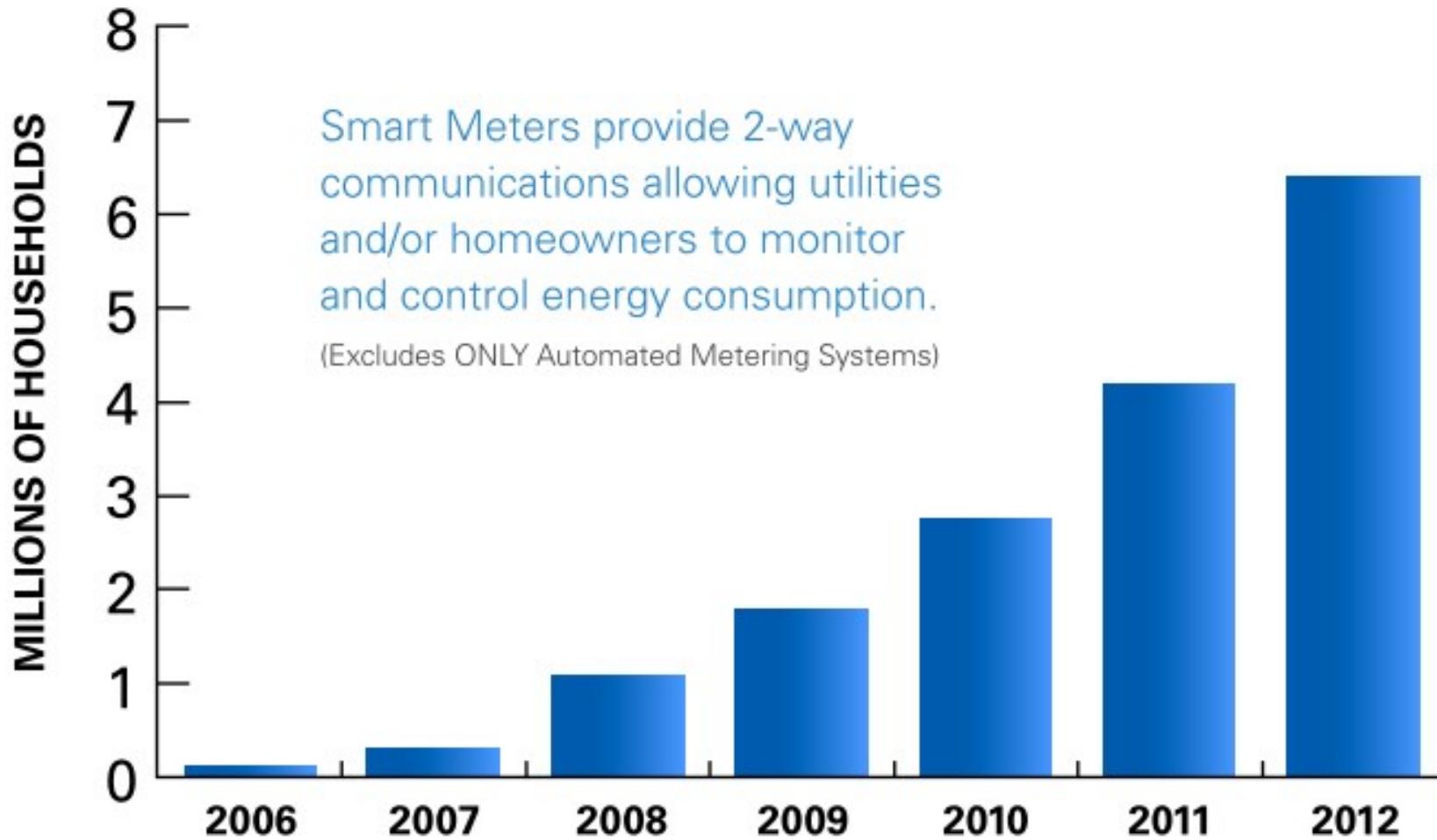
圖片來源：

U.S. Unprepared for Internet Device Flood: Unaddressed Security Problems & Talent Drought Threaten Long-Term Commercial, Government Interests

By: Kurt Stammberger, CISSP, Adrian Turner and Mat Small, Mocana With: Rich Nass, Sarah Friar, Goldman Sachs

如果你家的智慧電錶被入侵會怎樣？

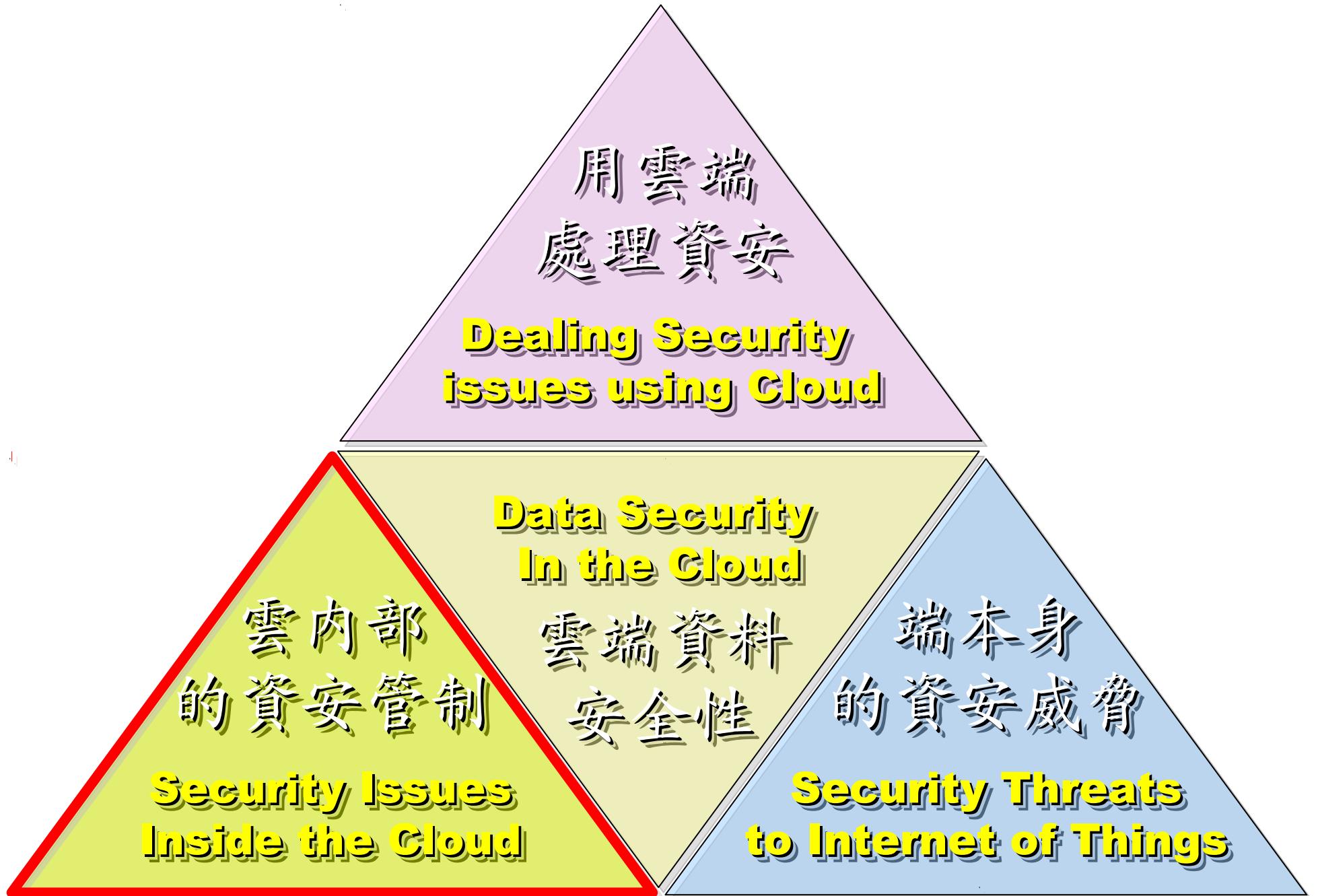
U.S. Households with Smart Meters

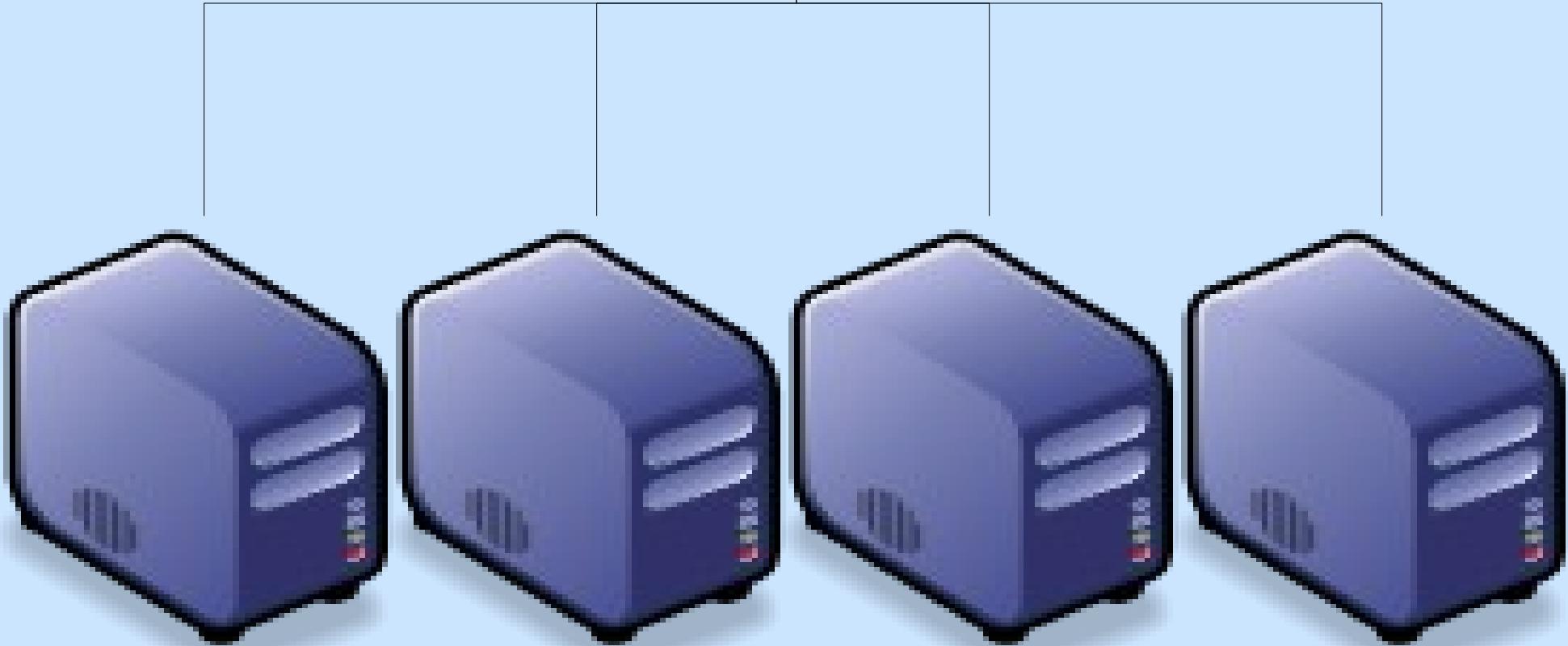


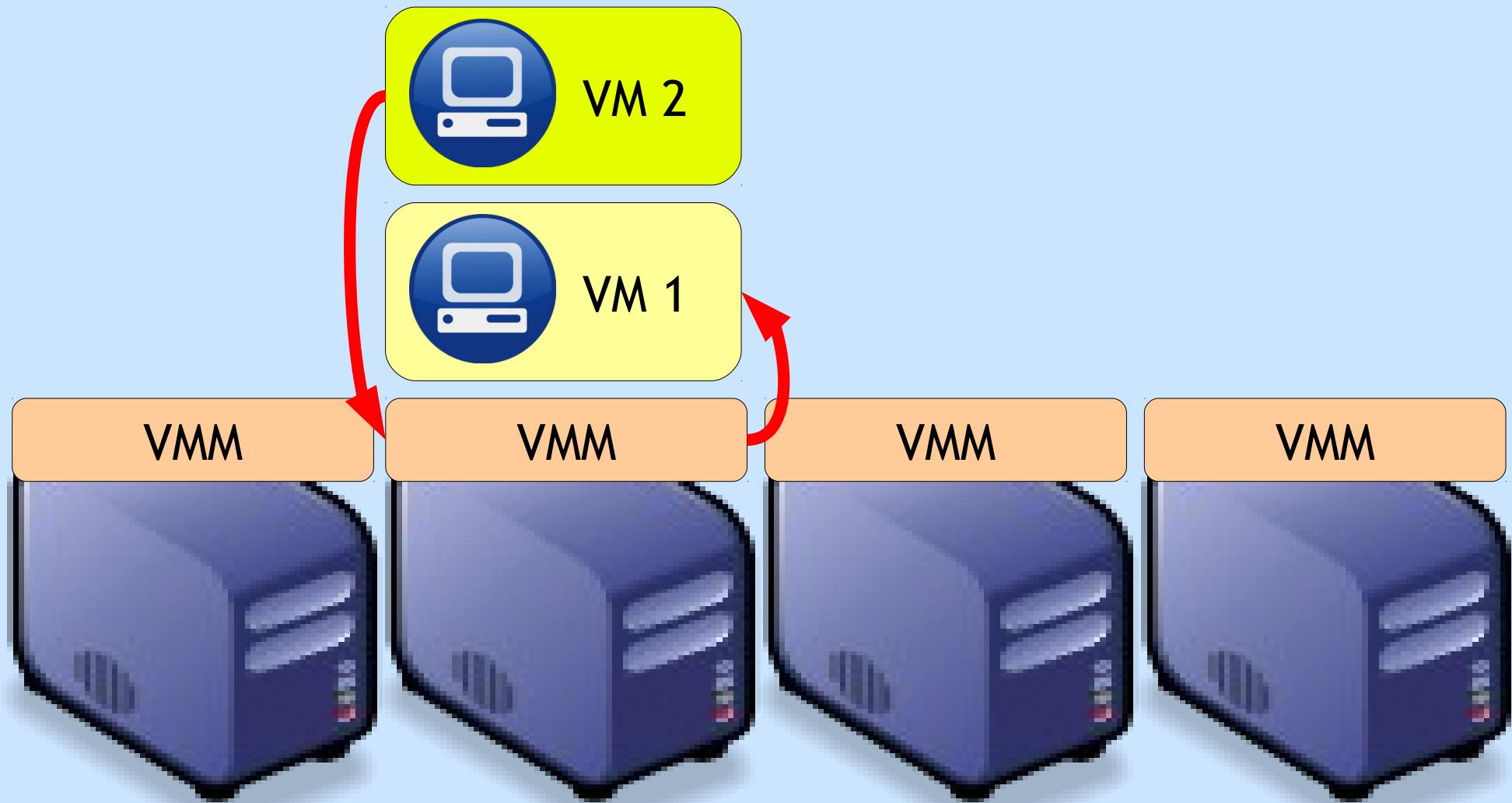
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By: Kurt Stammberger, CISSP, Adrian Turner and Mat Small, Mocana With: Rich Nass, Sarah Friar, Goldman Sachs

再來談談「雲的安全」

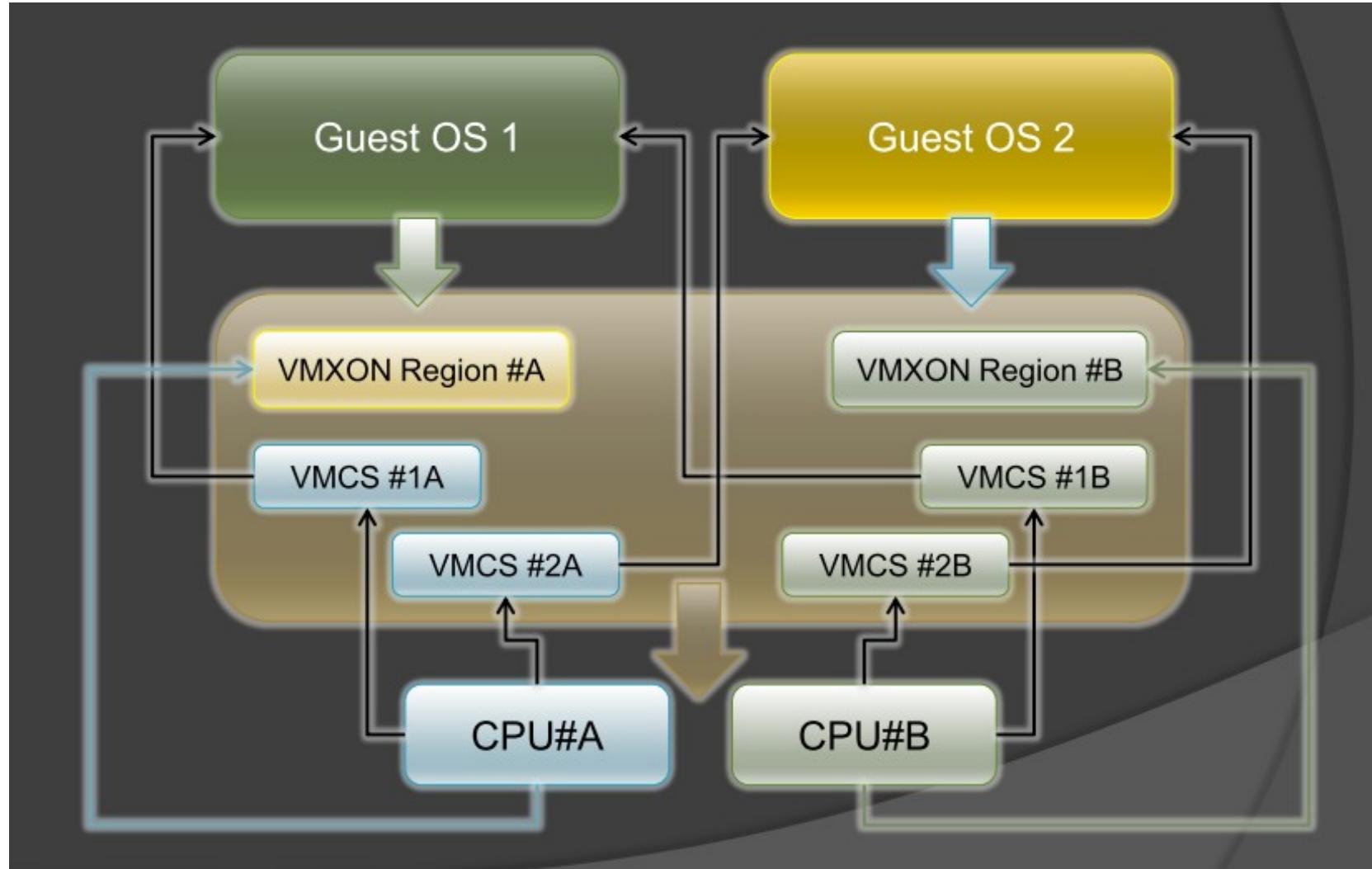






虛擬化衍生的新興資安問題

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



Virtual Switch



VM 2



VM 1



VMM



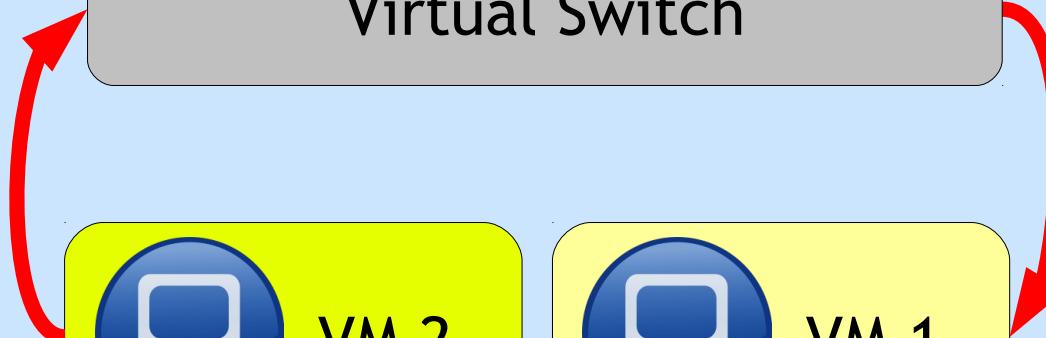
VMM



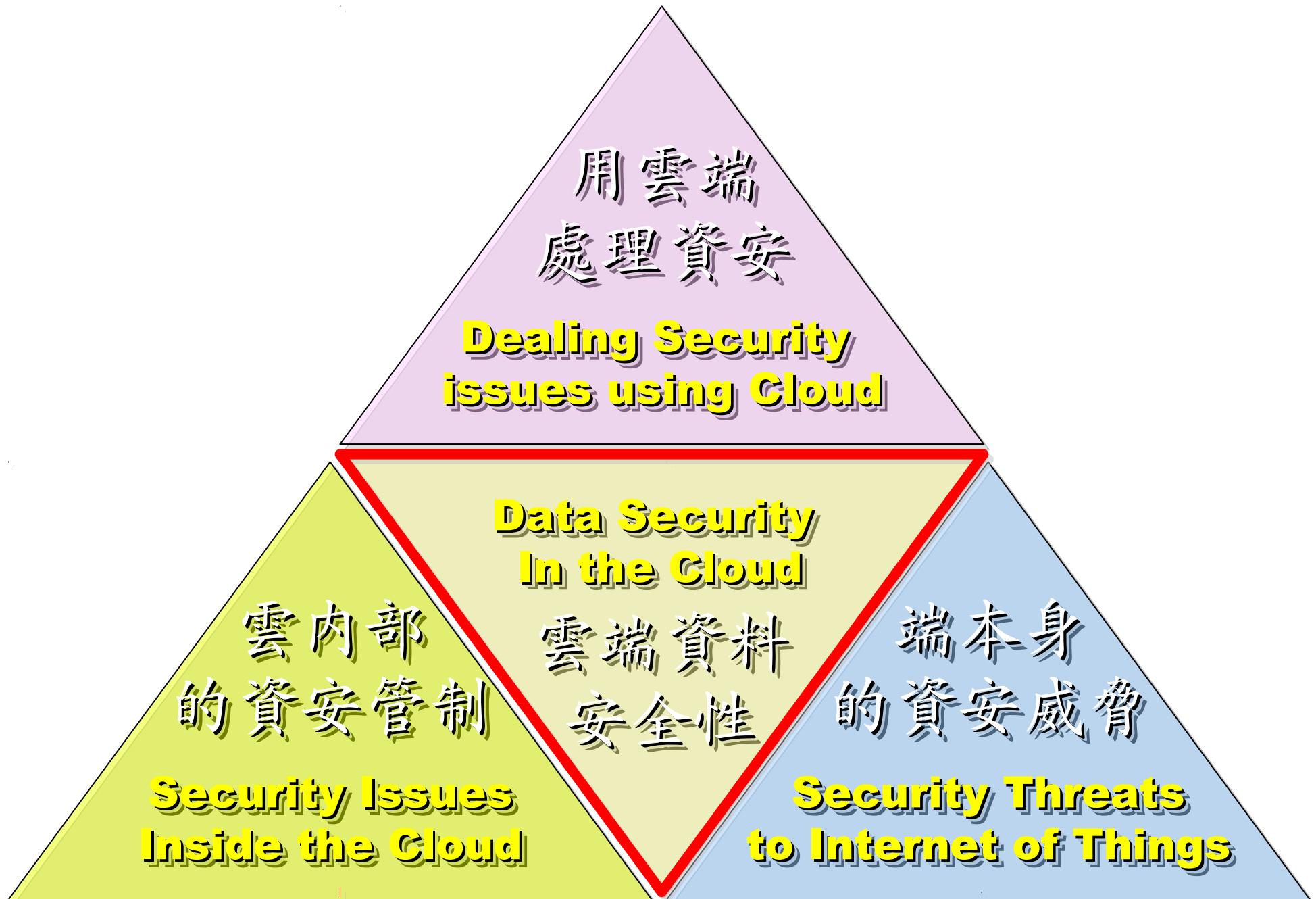
VMM



VMM



三談「資料安全」



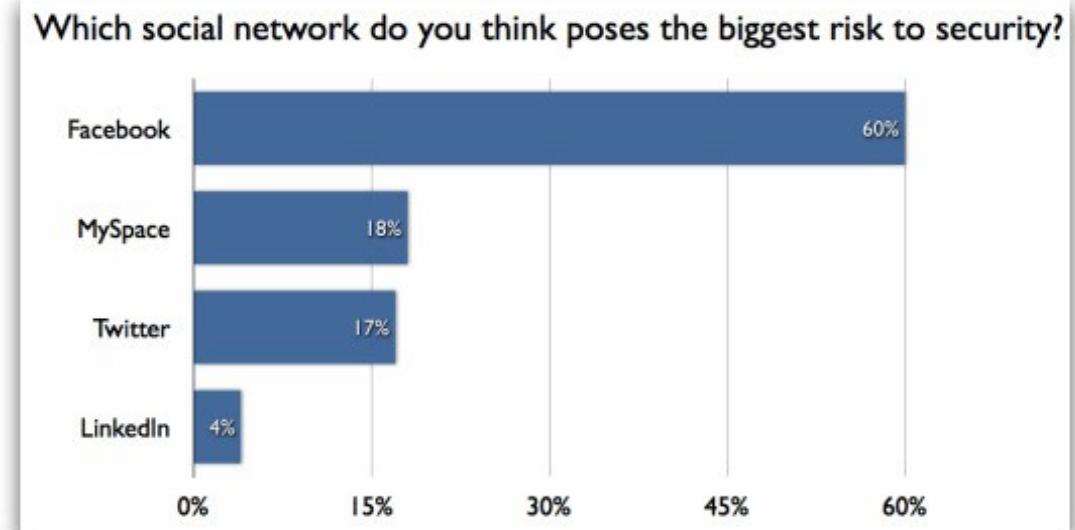
Ex. 無名照片外流、臉書個資外洩

轟動一時黑澀會妹妹容瑄親密自拍照片外流



圖片來源：

[Wikileaks and Facebook Privacy / Security: Do we care?](#)



圖片來源：

[Report Ranks Facebook As Greatest Corporate Security Risk](#)
<http://www.allfacebook.com/facebook-corporate-risk-2010-02>

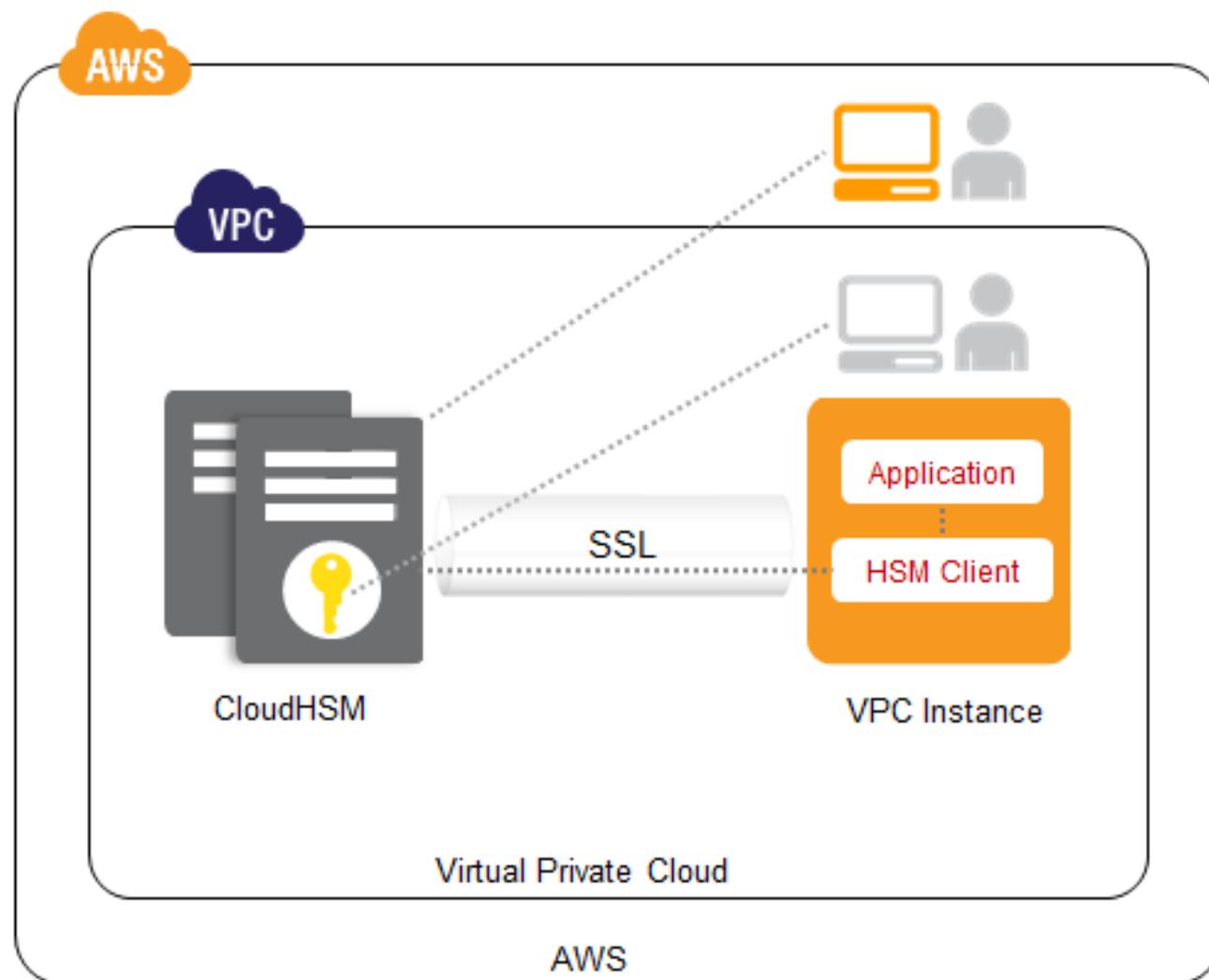
WikiLeaks

“... could become as important a journalistic tool as the Freedom of Information Act.”

— Time Magazine

[Submit documents](#)

你的 DropBox 其實放在 Amazon S3 上 是有加密的哦！



<http://aws.typepad.com/aws/2013/03/aws-cloud-hsm-secure-key-storage-and-cryptographic-operations.html>

Agenda 演講大綱

雲端商業模式及三大關鍵技術

架構即服務的關鍵技術：虛擬化

有沒有裝置端的虛擬化技術呢？

雲端運算 + 物聯網 = 駭客的新天堂

結語

雲端資安面向很多，還有許多問題等待挖掘！

DDoS 瘋瘋 Internet 落伍了！三個潛水夫企圖割斷海底電纜

續



janus 發表於 2013年3月29日 09:00 | 收藏此文



就當我們昨天才在感恩組織的戰爭撼動全世界，
並非遙不可及的事，現在有三個埃及潛水夫，
什麼 DDoS 技術，只會讓全世界！

亞馬遜雲端運算凸槌，Netflix聖誕夜大斷線

2012/12/26 08:30

精實新聞 2012-12-26 08:30:14 記者 陳瑞哲 報導



美國隨選視訊(Video On Demand)業者Netflix發生大當機，真不是時候，剛好是平安夜耶誕假期正當開始時，亞馬遜(Amazon.com)伺服器也遭逢禍，並連夜搶修一直到次日早上才回復服務。

Sponsored by:

NETWORK WORLD

This story appeared on Network World at

<http://www.networkworld.com/research/2013/050213-data-centers-under-water-what-269389.html>

Data centers under water: What, me worry?

By Arielle Emmett, Computerworld

May 03, 2013 08:29 AM ET

Computerworld - Given the [dire warnings about climate change](#), some business and IT people are pondering this

[ALSO: [The world's coolest data centers](#)]

Some experts suggest that managers of mission-critical IT centers simply need to harden existing facilities, others are calling for a move to land and a third group says both strategies are needed.

But one thing is certain, experts say: Few IT organizations -- even those that suffered or narrowly [escaped damage](#) during Superstorm Sandy -- are prepared for such a disaster. Most IT leaders are, if anything, taking the path of least resistance and expense.

機房失火TPIX台北網際網路交換中心也受波及

文/[蘇文彬](#) (記者) 2013-02-26

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是方電訊及其負責管理的TPIX台北網際網路交換中心，與國內其他網路交換中心，及中華電信、遠傳、台灣固網等大型ISP互連，國際海纜業者也與其連線，因此麗源大樓停電對國內用戶上網連線品質產生不小影響，出現連線速度變慢、不穩的問題。

<http://www.bnnext.com.tw/focus/view/cid/103/id/26788>



Questions?

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

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

