



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

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Trends about Cloud Computing & Internet of Things

關鍵字搜尋趨勢：雲端運算 > 感測網路 > 物聯網

雲端運算急速攀升，感測網路逐年下降，物聯網悄悄上揚。



- A [Microsoft's cloud computing system is gi](#)
Philadelphia Inquirer - Nov 17 2009
- B [Google looks to be 'cloud-computing' rain](#)
Winnipeg Free Press - Mar 10 2010
- C [Host Analytics Named to 2010 AlwaysOr
Cloud Computing Companies](#)
MarketWatch - Apr 6 2010
- D [Cloud computing and the economy](#)
CNET - Apr 13 2010
- E [Dell, HP, Fujitsu to offer Windows Azure](#)

Regions

1. [Philippines](#)
2. [Ireland](#)
3. [Singapore](#)
4. [South Africa](#)
5. [Taiwan](#)
6. [Australia](#)

Cities

1. Beijing, Ch

Regions

1. [Philippines](#)
2. [Ireland](#)
3. [Singapore](#)
4. [South Africa](#)
5. [Taiwan](#)

以搜尋總量來看，台灣偏愛『雲端運算』與『感測網路』，僅次於新加坡！



淺談雲端運算的新趨勢

Part 1 : Overview the trend of Cloud Computing

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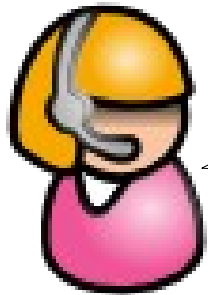


什麼是雲端運算啊？可以個簡單的定義嗎？

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

1. On-demand self-service.

隨需自助服務

2. Broad network access

隨時隨地用任何網路裝置存取

3. Resource pooling

多人共享資源池

4. Rapid elasticity

快速重新佈署靈活度

5. 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

SaaS

Software as a Service

軟體即服務

PaaS

Platform as a Service

平台即服務

IaaS

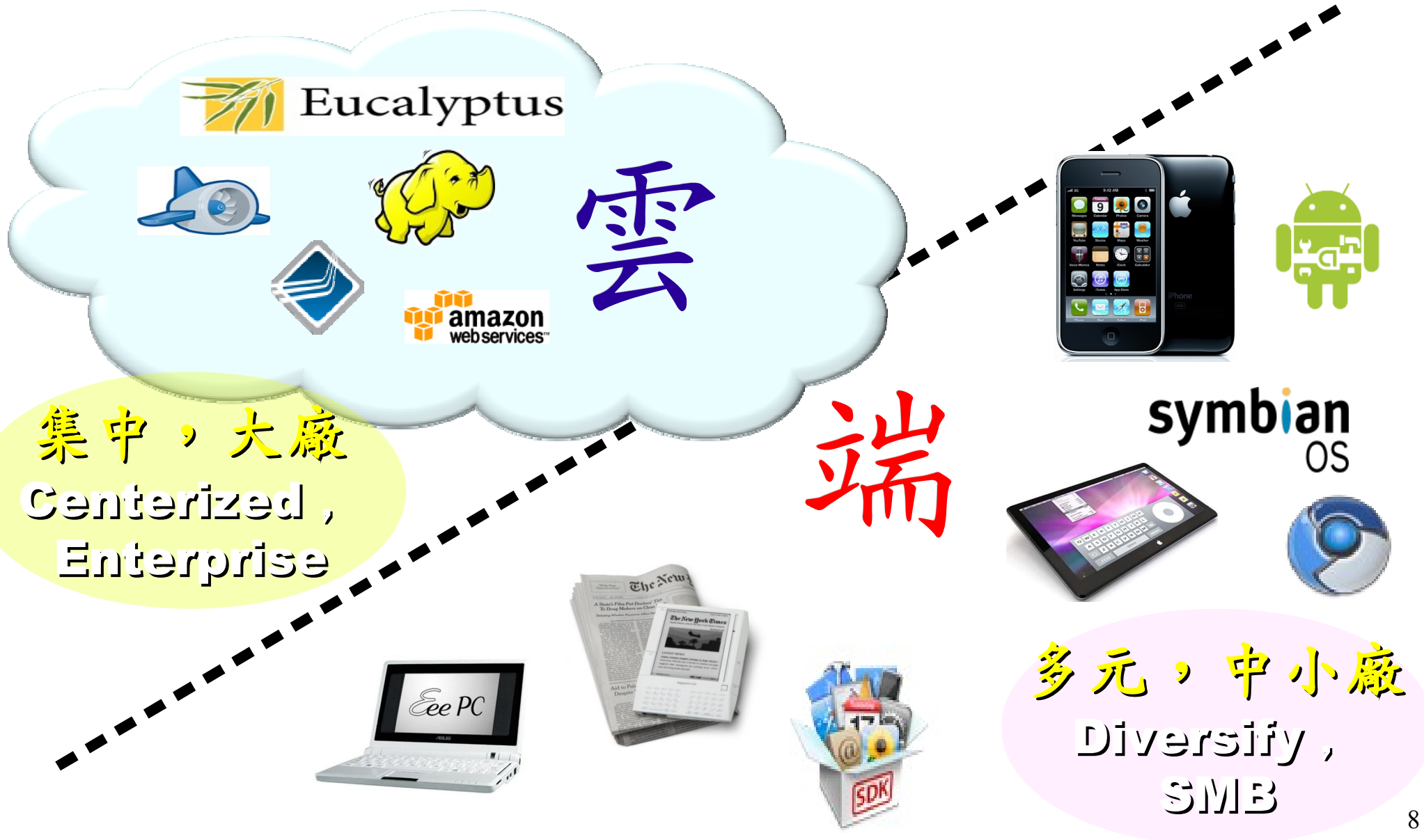
Infrastructure as a Service

架構即服務



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

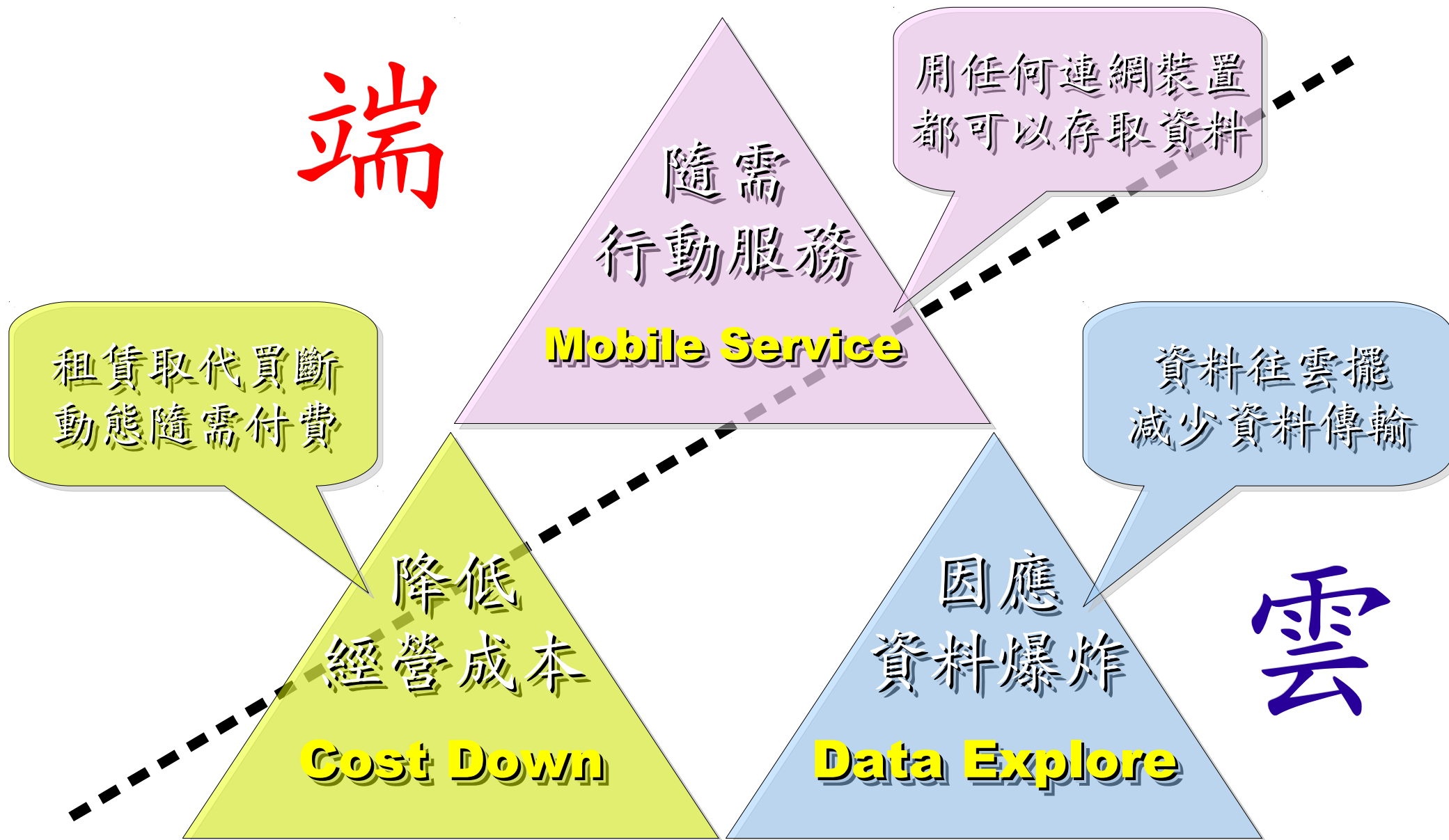
Key spirit of Cloud ~

形成服務才是重點！！

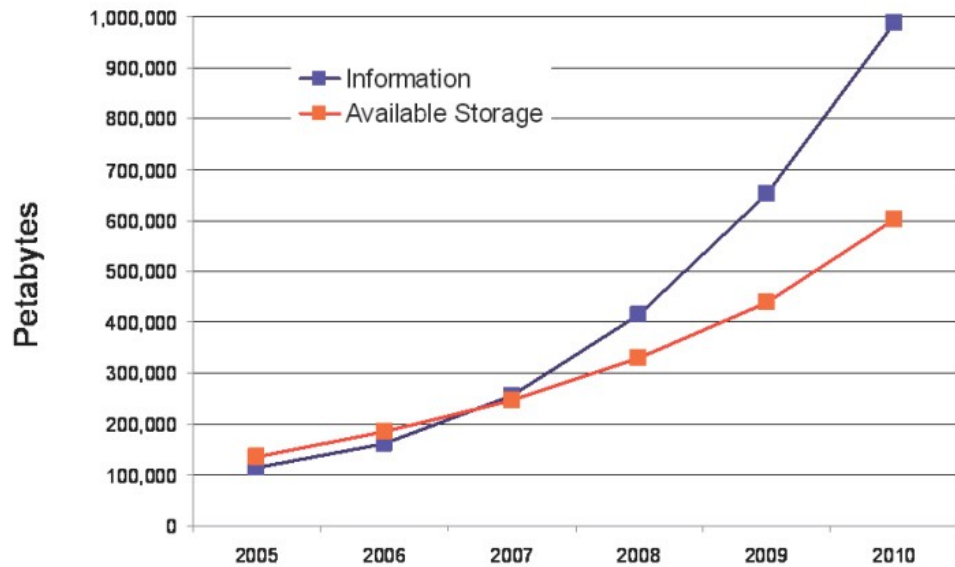
Everything as a Service !!

Key Driving Forces of Cloud Computing

雲端運算的關鍵驅動力

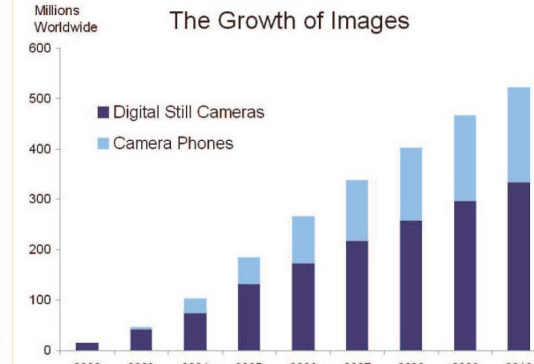


Information Versus Available Storage



2007 Data Explore

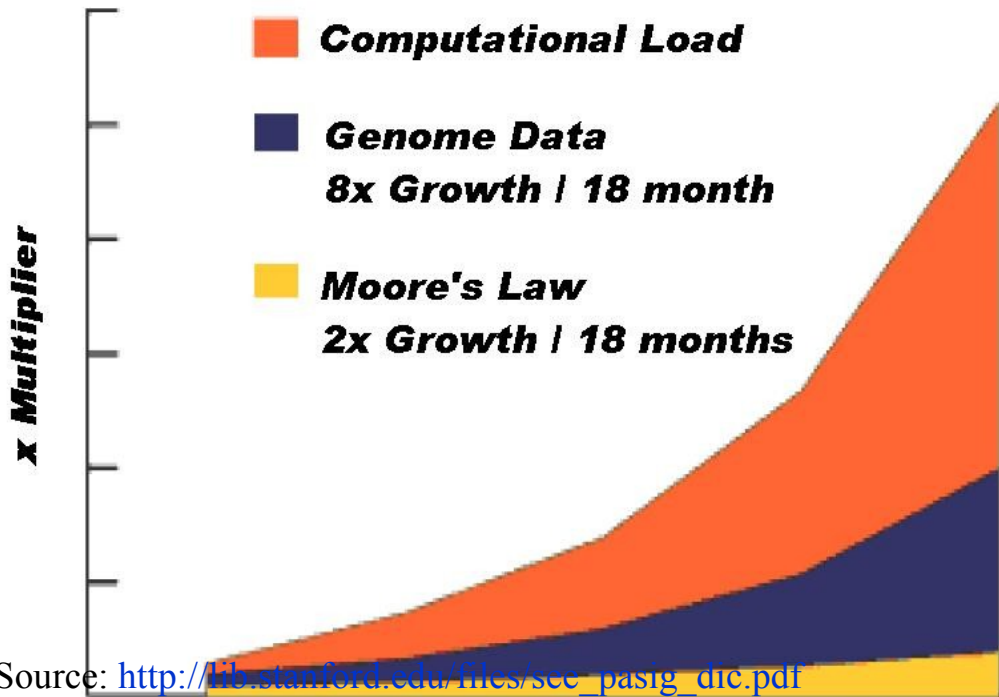
Top 1 : Human Genomics - 7000 PB / Year
Top 2 : Digital Photos - 1000 PB+ / Year
Top 3 : E-mail (no Spam) - 300 PB+ / Year



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

Source: IDC, 2007

Source: IDC, 2007



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

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)			

Phillip B. Gibbons, Data-Intensive Computing Symposium

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 介面, 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

SaaS
Saas
Saas

Open Source for Private Cloud

建構私有雲端運算架構的自由軟體

應用軟體 Application

Social Computing, Enterprise, ISV, ...

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

程式語言 Programming

Web 2.0 介面, 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

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 介面, Mashups, Workflows, ...

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虛擬化 Virtualization
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硬體設施 Hardware
Infrastructure: Computer, Storage, Network

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 ”*

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

Database Virtualization

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
SeamlessRDP

OS-level Virtualization

Xen, KVM, OpenVZ

Network Virtualization

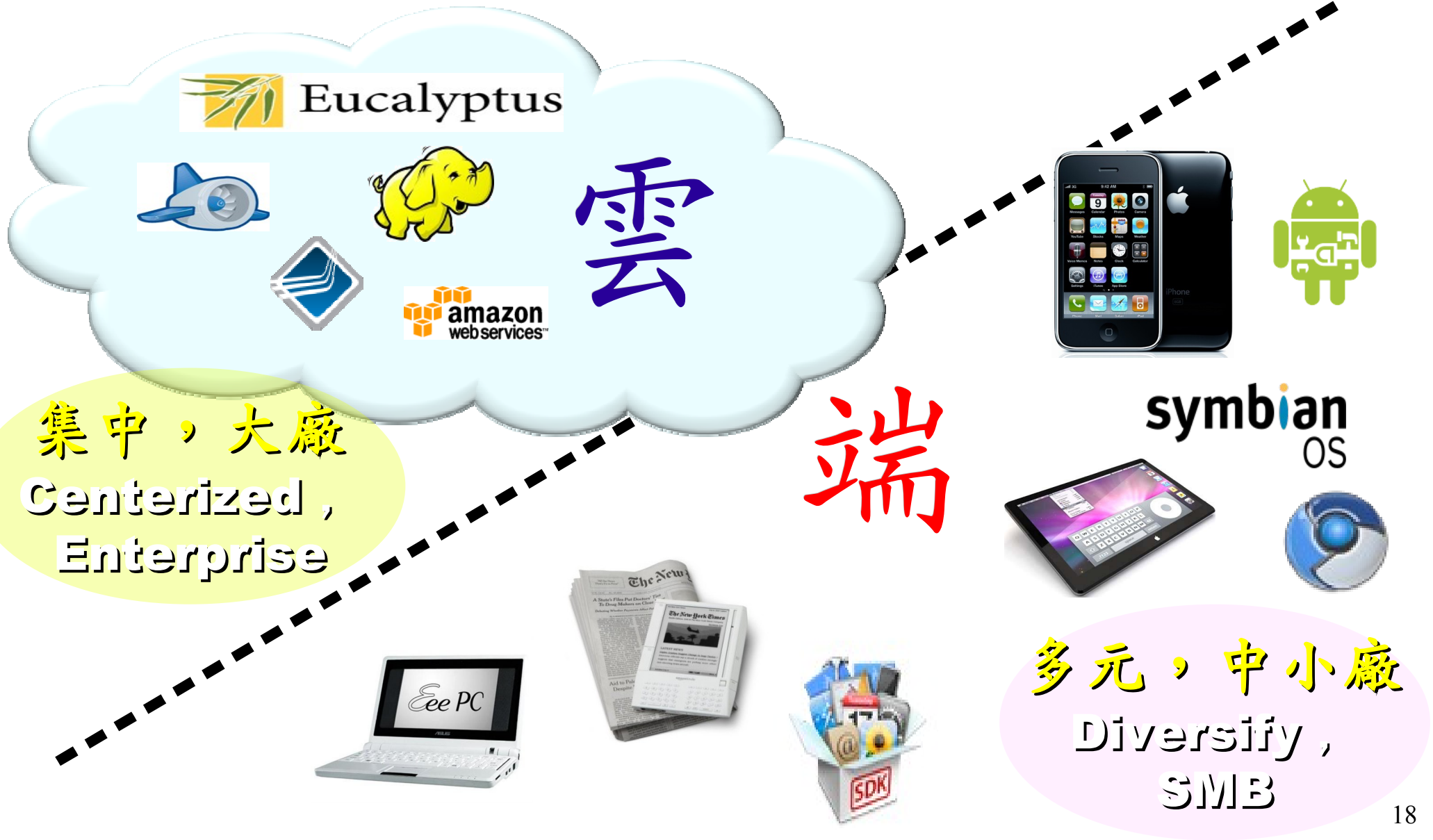
OpenFlow vSwitch

Storage Virtualization

Lessfs, SDFS

Virtualization for Embedded Device ?

虛擬化只用在「雲」嗎？那「端」呢？





淺談嵌入式虛擬化的新趨勢

Part 2 : Overview the trend of Embedded Virtualization

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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

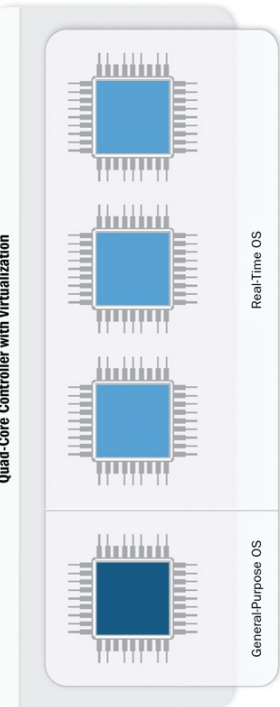
co-existence of different OS environment
on the same platform

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**

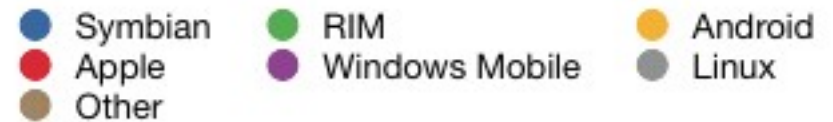
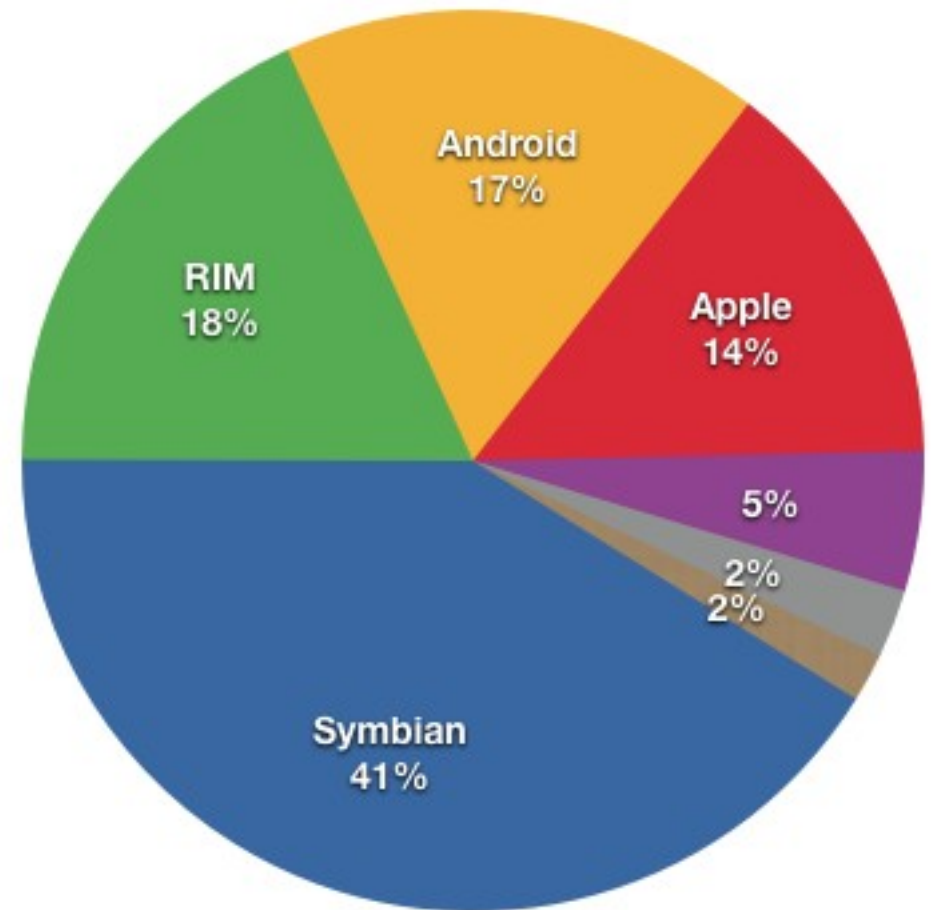
<http://www.eetimes.com/design/automotive-design/4016811/Embedded-systems-virtualization-Consider-a-Hypervisor>

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**

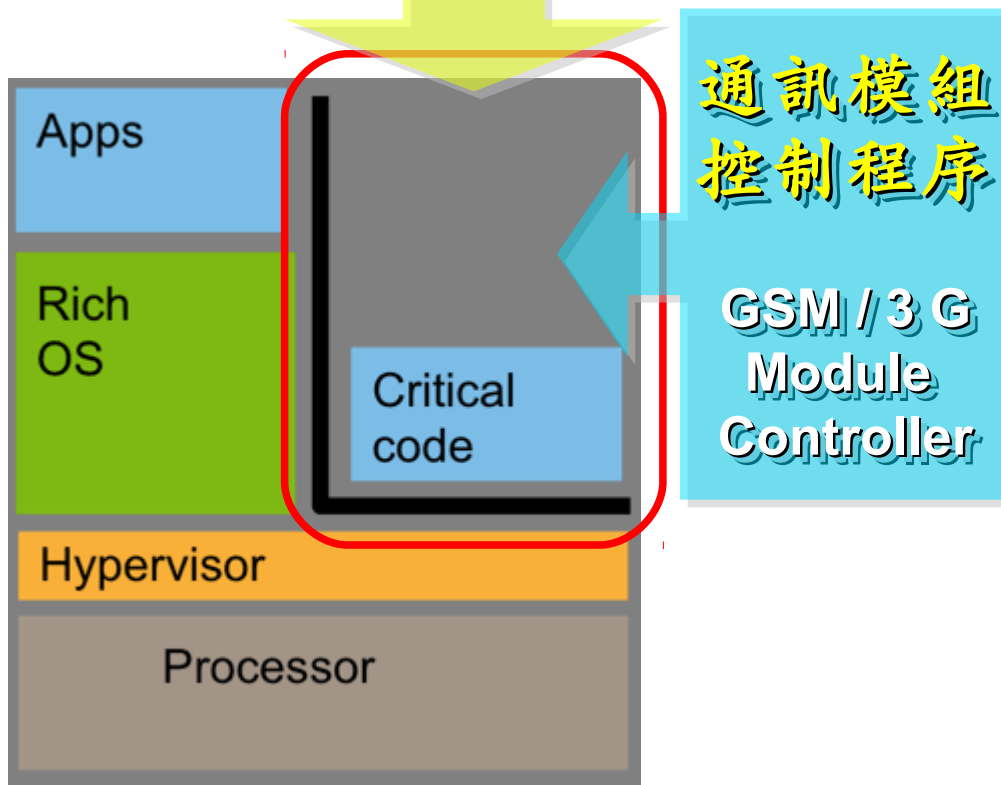
<http://www.redmondpie.com/how-to-dual-boot-windows-mobile-and-android-on-windows-phone-9140407/>

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

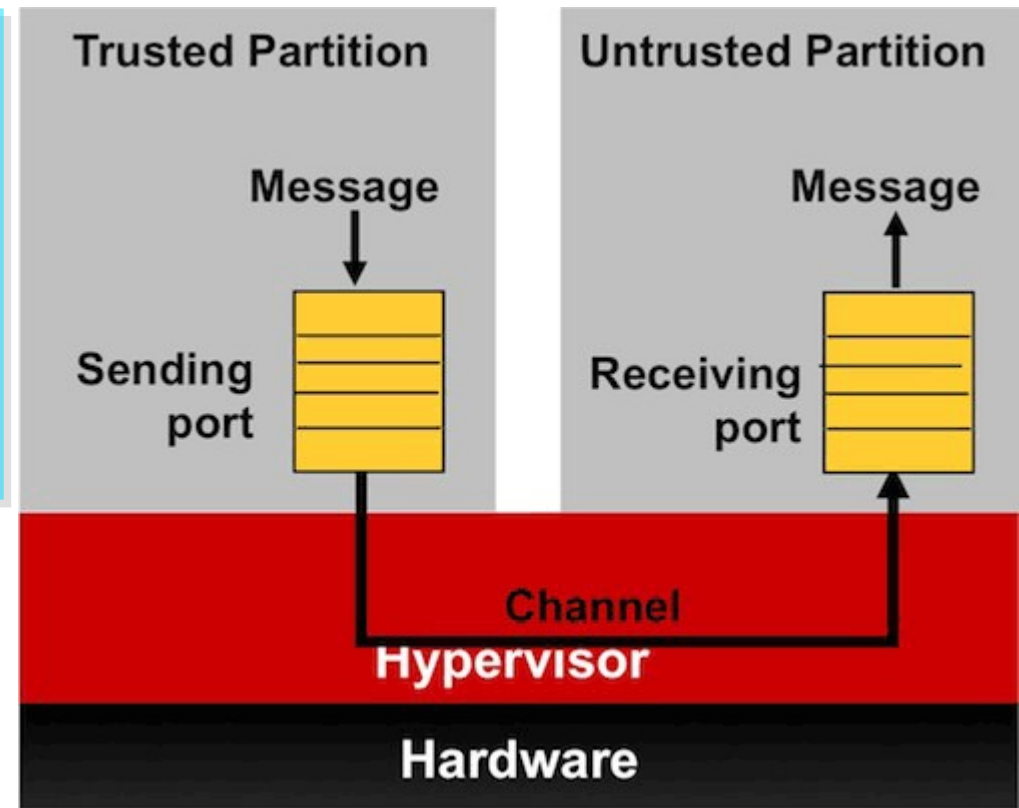
Virtualization for Embedded Security

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**

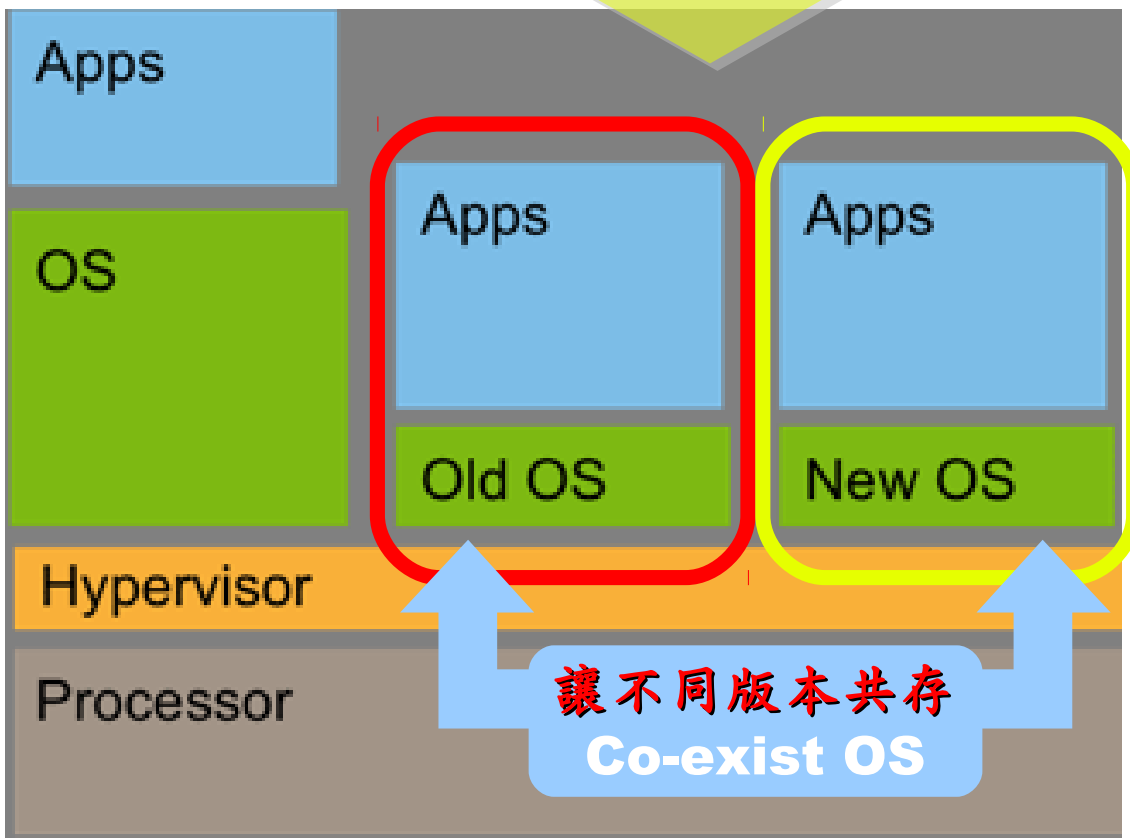
<http://embeddedinnovator.com/securing-smart-grid-devices>

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



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>

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](#)

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

image with
bedded

EDIT

[v project details](#)



雲端時代嵌入式裝置的安全問題

Part 3 : Security Issue of Embedded Devices in Cloud Era

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Scope of Cloud Security

雲端資安的四大範疇

用雲端
處理資安

**Dealing Security
issues using Cloud**

嵌入式裝置所
面臨的資安威脅

**Data Security
In the Cloud**

雲內部
的資安管制

雲端資料
安全性

**Security Issues
Inside the Cloud**

端本身
的資安威脅

**Security Threats
to Internet of Things**

以前你只有電腦需要防毒，現在.....

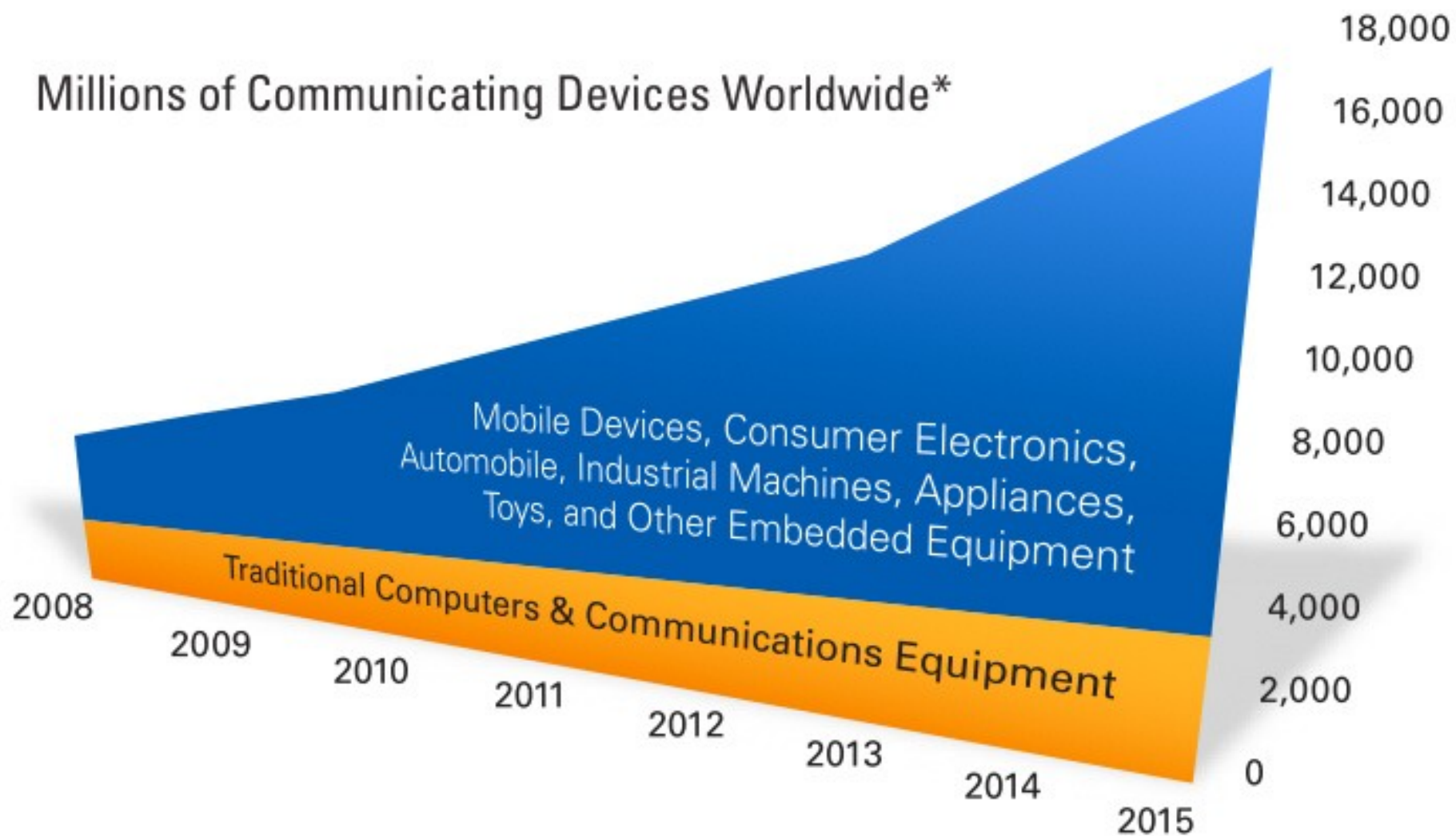


symbian
OS



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

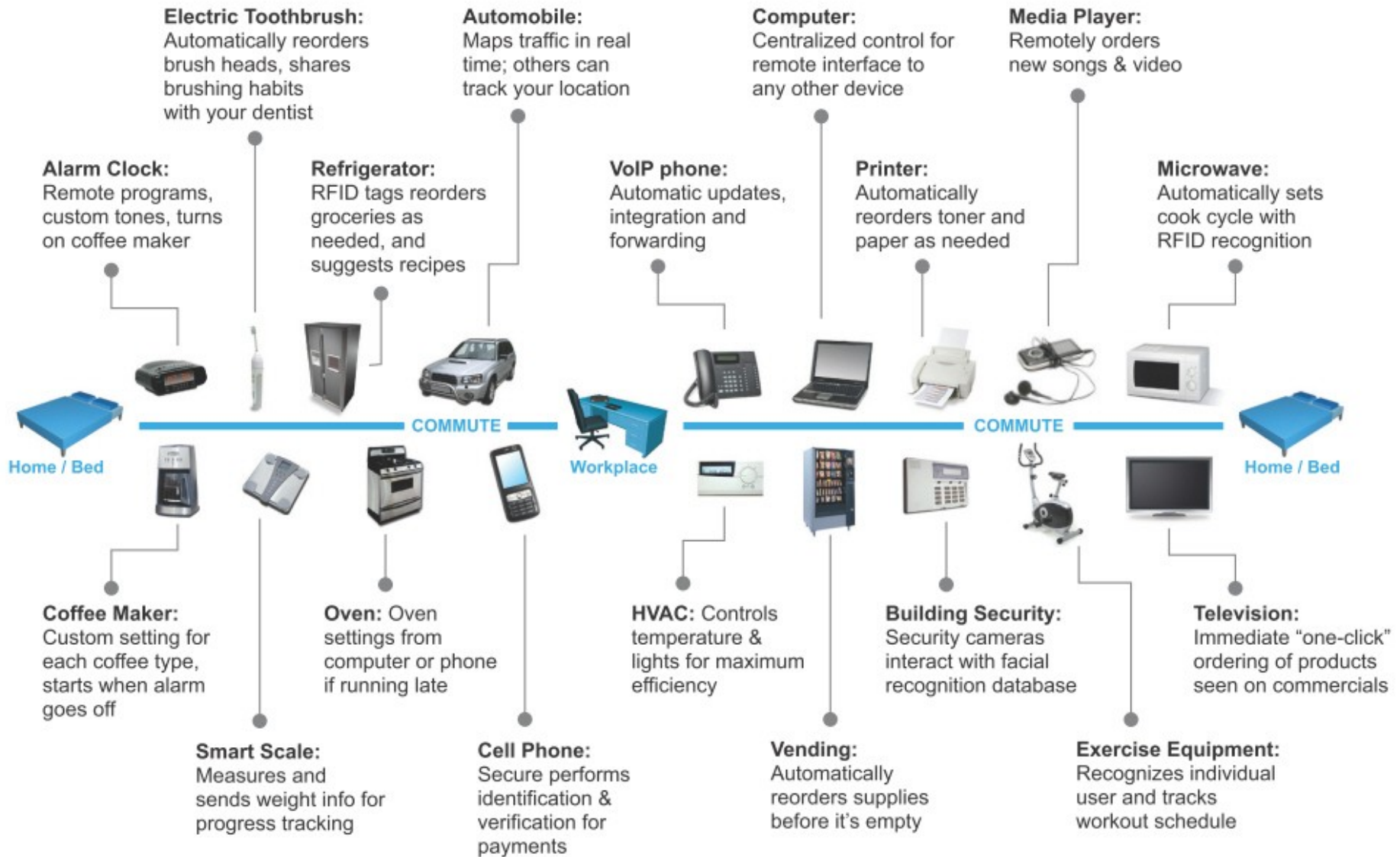
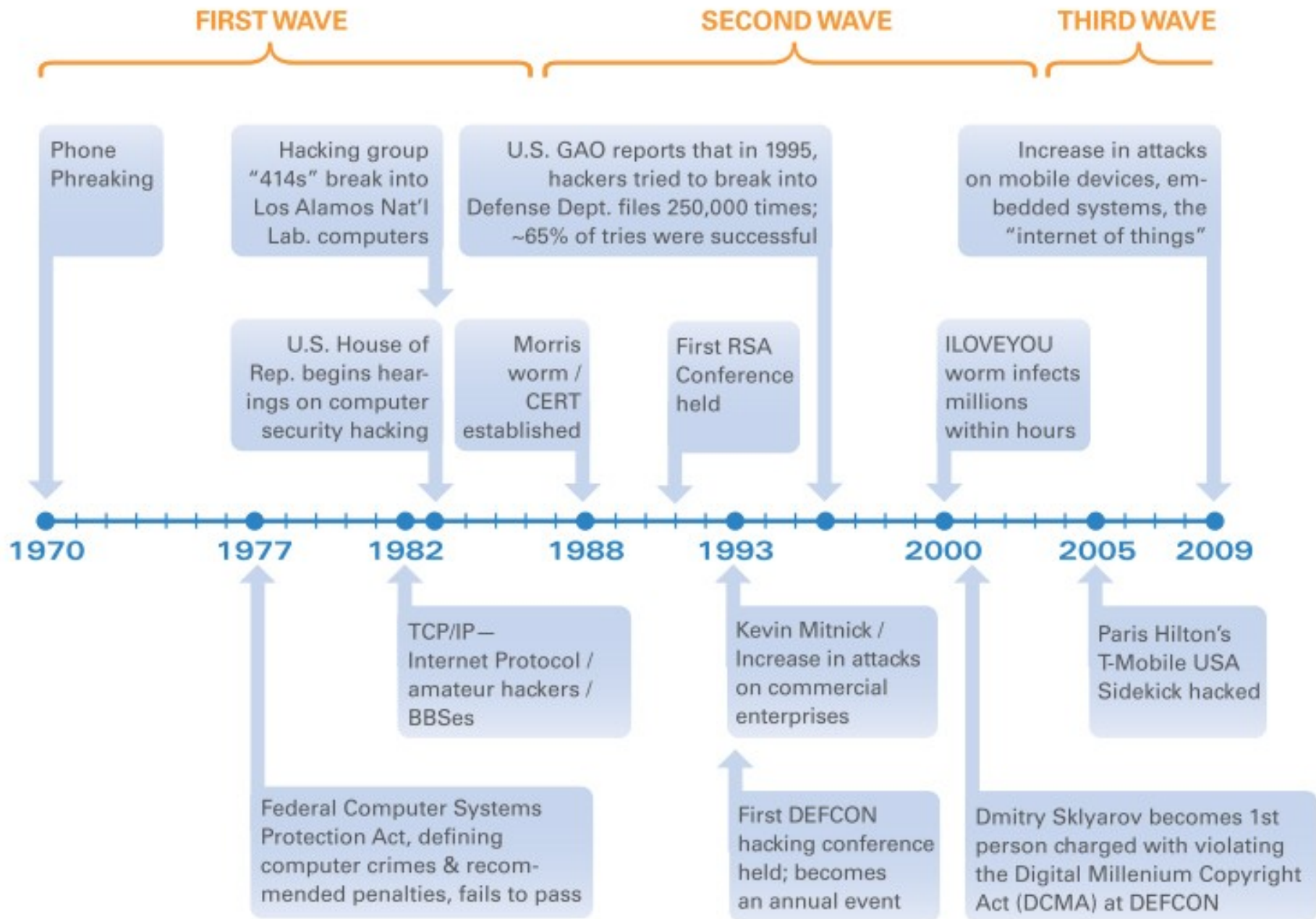


Figure 3. The Internet of Things

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

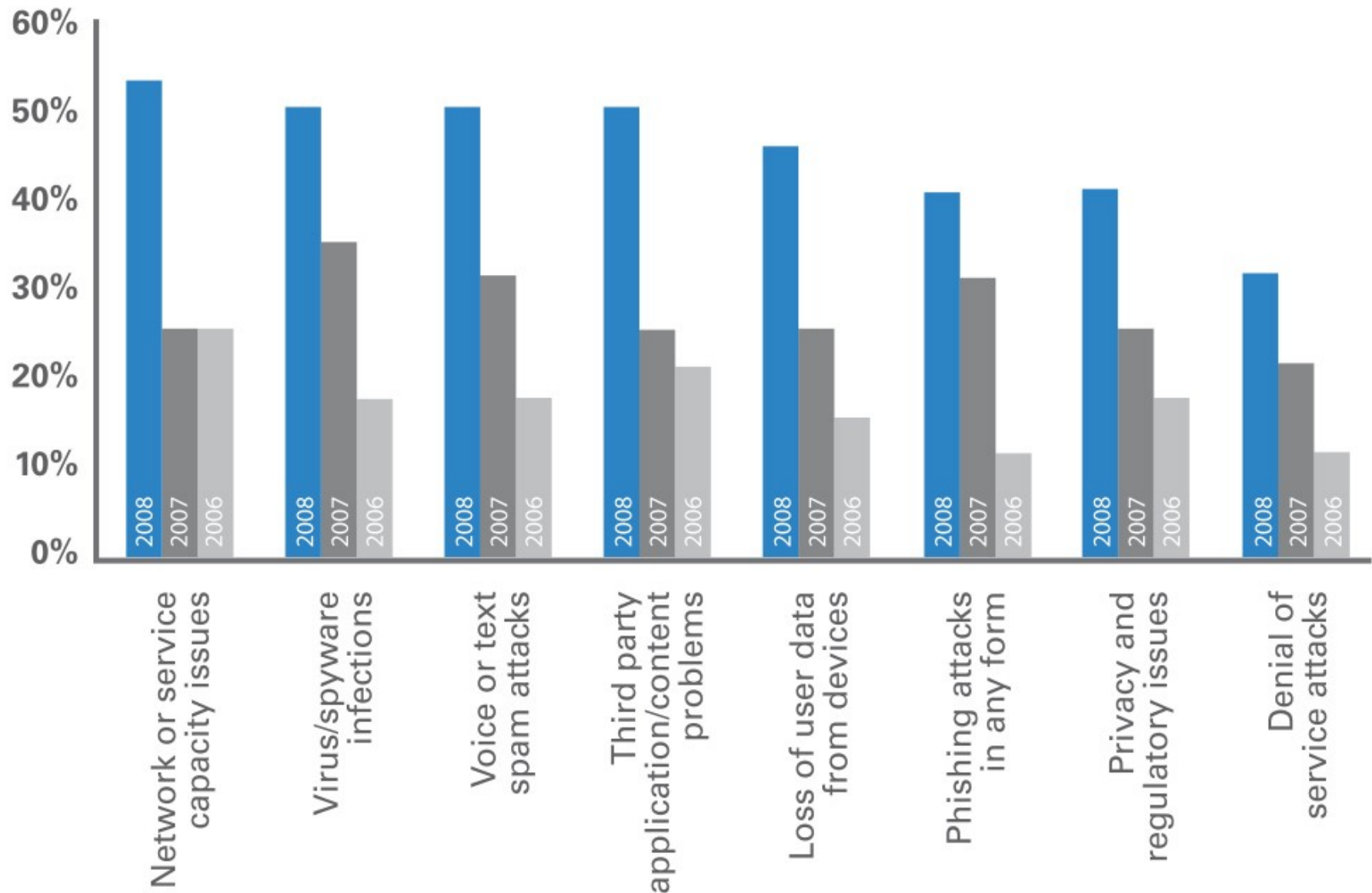
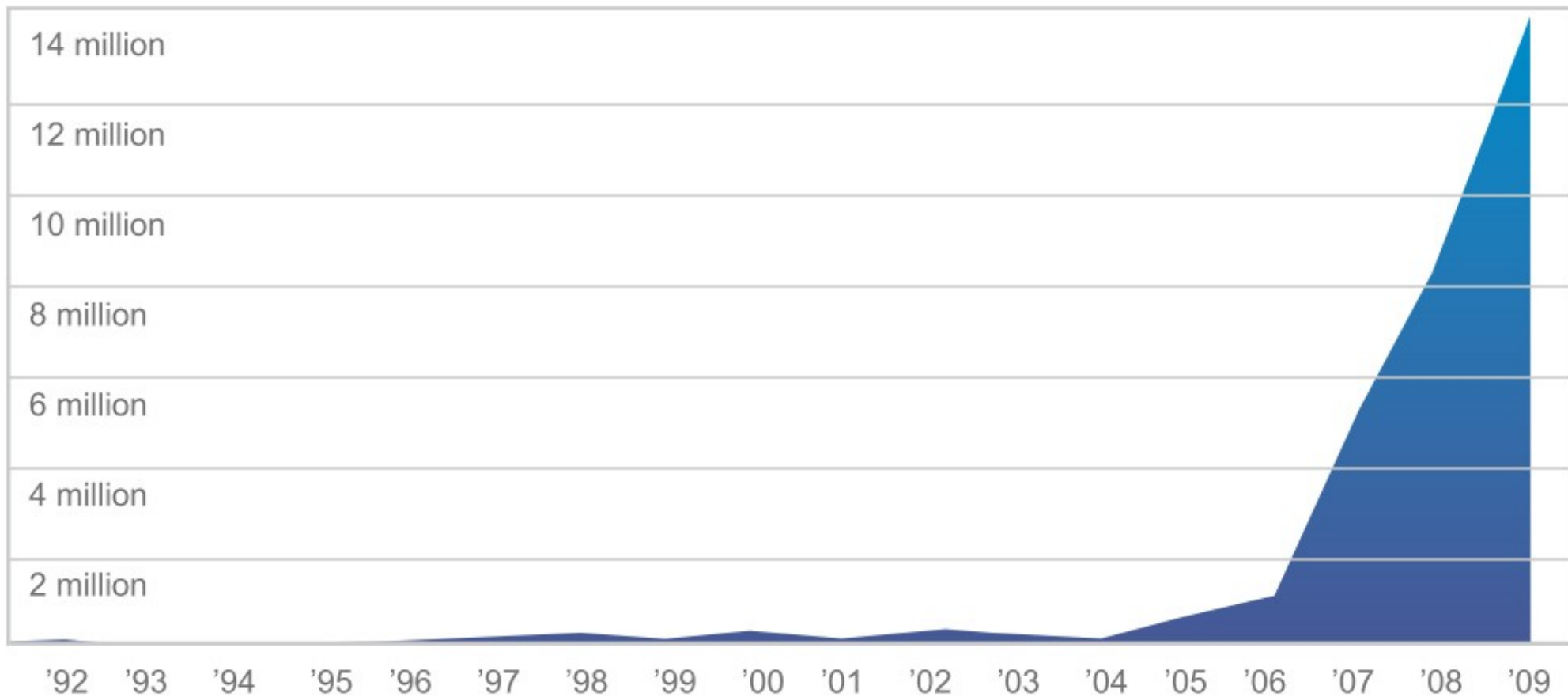


Figure 6. The increase in security issues experienced by mobile device users from 2006 to 2008; % of respondents. McAfee *Mobile Security Report 2009*

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

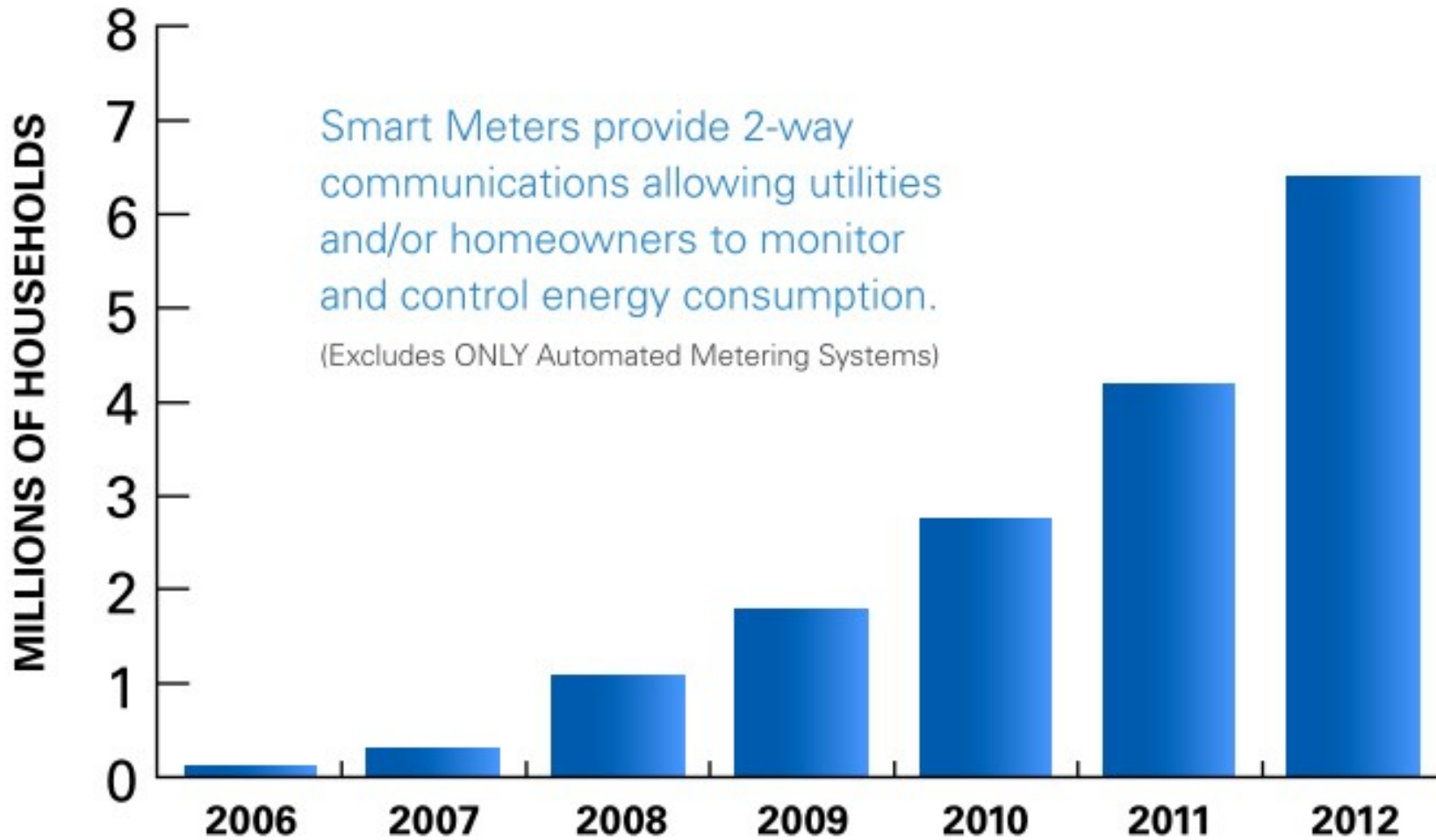
Malware detected by year



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

如果你家的智慧電錶被入侵會怎樣？

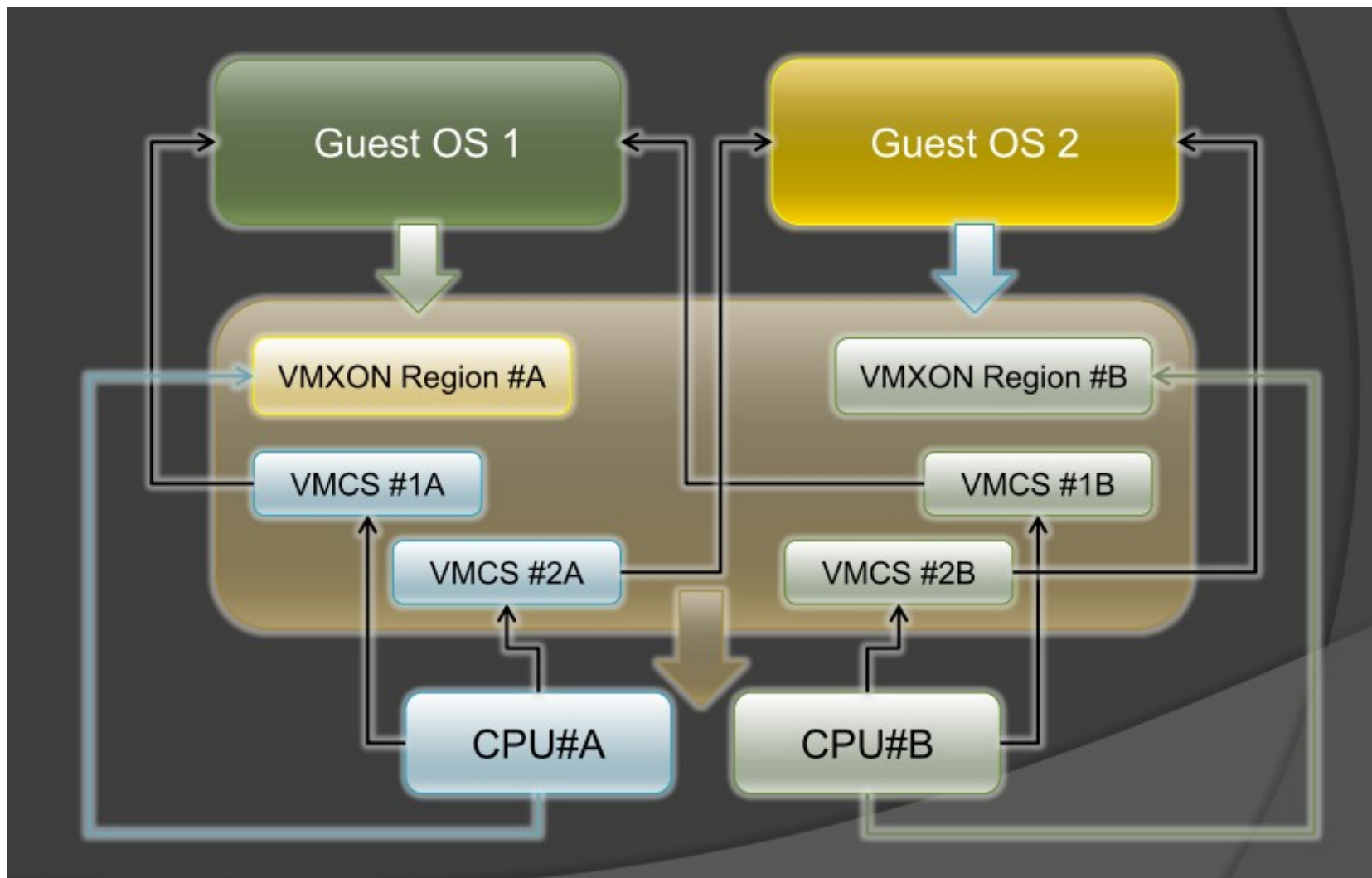
U.S. Households with Smart Meters



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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



Questions?

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

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