



.Net Micro Framework 在物聯網行業應用的前景

Vincent Chiang
vichiang@microsoft.com
Hardware Innovation Center
Microsoft Asia-Pacific R&D Group



IT產業趨勢



PC 時代 → Internet時代
(internet 3.0)



PC → PC+ (電話+家電+汽車)
PC → PC3 (通訊+計算+控制)



C/S → Client +Cloud (雲+端)



S → SW +Service (軟體+服務)



1B → 1B+ (中國+印度)

Internet 的發展

■ 0.0

- 1960s-90s
- ftp; 傳送資料

■ 1.0

- 1990s-00s
- www; 傳送資訊

■ 2.0

- 2000s-10s
- SNS; 互動式資訊共用

■ 3.0

- 2010s-20s
- cloud; 連接資訊, 設備和人
- 物聯網與雲端計算



我們進入了Internet 3.0 (2010s —)

■ 技術及應用

- 傳感技術；虛實結合
- 行動網路3G/4G
- 大量的數據流
- 智慧分散式軟體
- 自然使用者介面

■ Internet 3.0

- 物聯網與雲計算



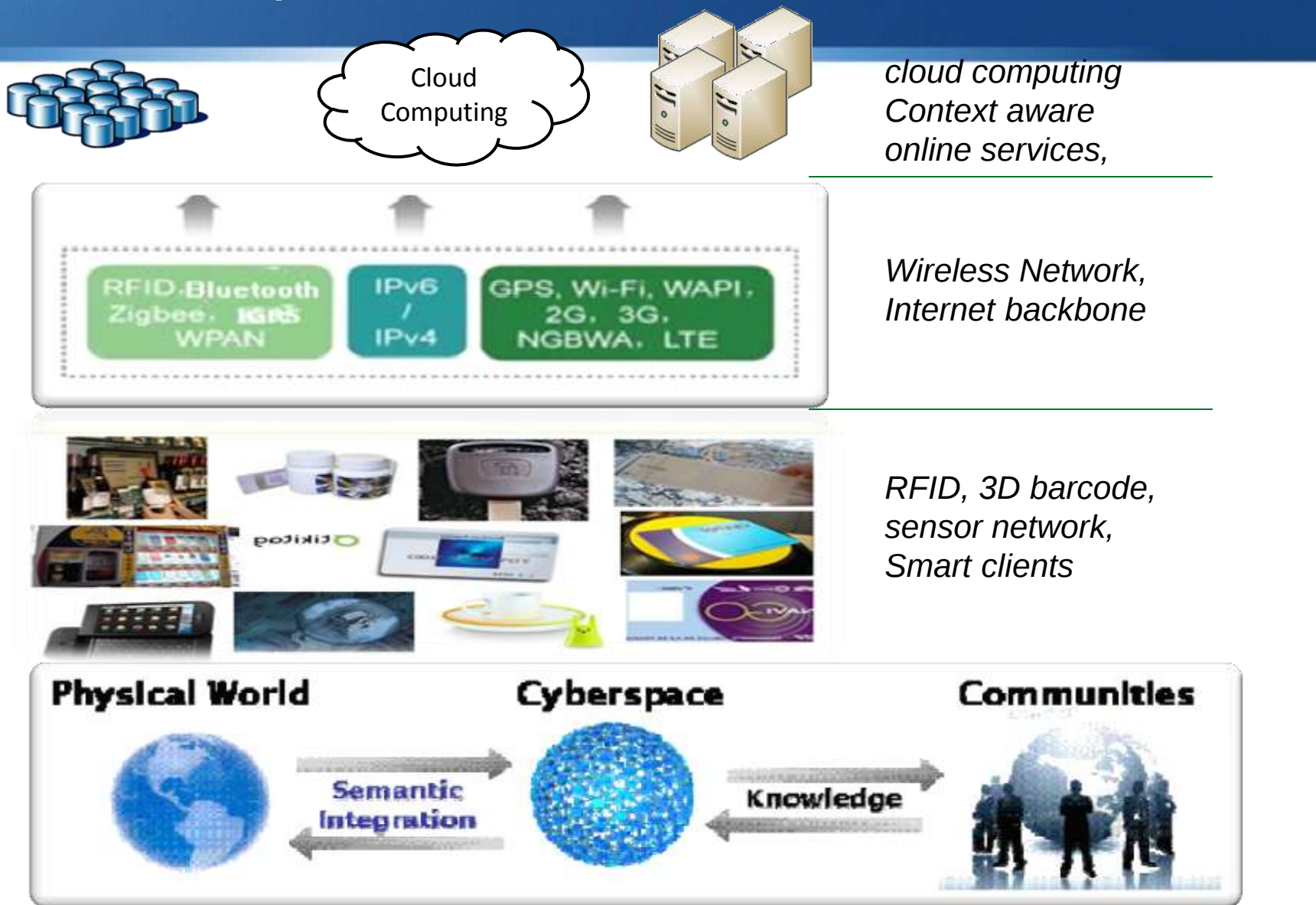
Internet of Things

WIKIPEDIA: a network of Internet-enabled objects, together with web services that interact with these objects.

ITU REPORT: *Machine-to-Machine communications and Person-to-Computer communications will be extended to things.*



IOT Concept



Key Components of IOT



物聯網裡的三層系統結構



應用層

遠端醫療

智慧交通

智能家居

物流監控

污染監控

智能電網/智慧電錶

網路層

雲端計算平臺

行動通訊網路

Internet

資訊中心
網管中心

感知層

RFID感測器

感測器閘道

接入閘道

RFID標籤

感測器節點

智慧終端

物聯網是垂直行業IT化的演進

物聯網不是明日科技

物聯網三個重要特徵：

- 全面感知

分散式採集I/O模組

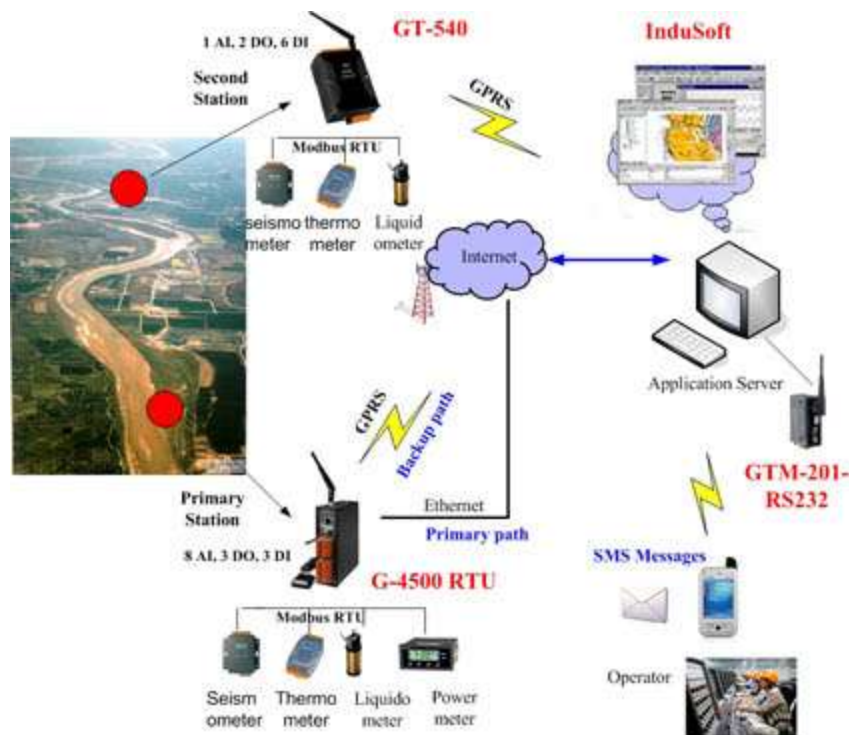
- 可靠傳遞

現場匯流排 工業通訊

- 智慧處理

可程式設計自動化控制器

物聯網的表現形式：M2M

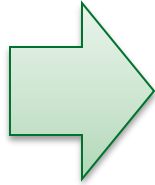


範例：傳統大樓緊急照明燈稽查的現況

偵測數以千計盞緊急照明燈的：光源狀況與電池狀況

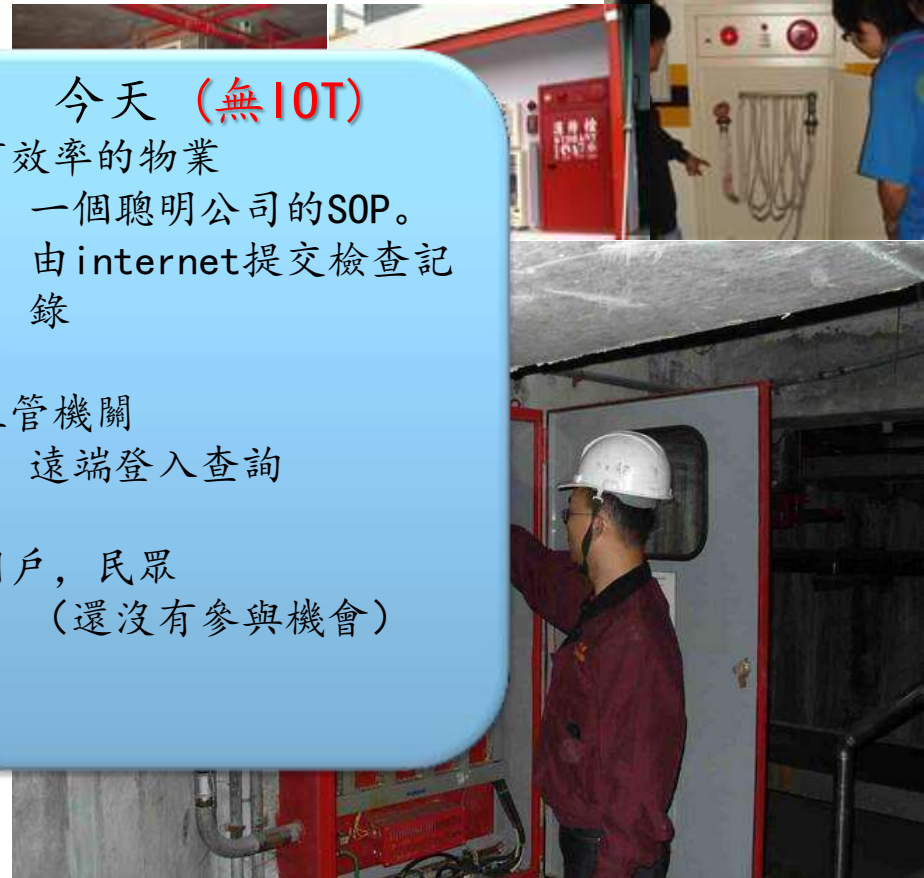
昨天（無IOT）

- 沒有效率物業
定時逐層巡邏，人工記錄，
隨機維修，叫修稽核資料
輸入，備查，提交
- 主管機關：
人工審核，分類，建檔
- 用戶，民眾
(還沒有參與機會)



今天（無IOT）

- 有效率的物業
一個聰明公司的SOP。
由internet提交檢查記錄
- 主管機關
遠端登入查詢
- 用戶，民眾
(還沒有參與機會)



範例：傳統大樓緊急照明燈稽查的現況

偵測數以千計盞緊急照明燈的：光源狀況與電池狀況

明天(IOT化)

➤物業：

透過無線傳感網路,節省運營成本與提升效率
狀態自動上傳,自動回報故障
對接派遣維修隊的ERP系統
運營記錄自動上傳

➤消防主管機構：

自動檢查,糾正
對接消防稽查機關記錄的系統,分類建檔
全區照明燈稽查記錄總結,彙報
自動生成公眾資訊並公告

➤民眾：

協助監督消防安全系統的運營狀況



中國三大IT領域的創新發展

2010 LiangHui* highlighted 3 IT focuses

Wikipedia: Lianghui means National People's Congress (NPC) and Chinese People's Political Consultative Conference (CPPCC) annual Plenary Session; It makes national-level political decision and sets priority



Green IT



Internet of Things



**Convergence of 3 Networks
(DTV, Internet, Telecom)**

微軟-工信部/CSIP 物聯網創新中心

微軟與中國工信部 CSIP聯合實驗室
四月在無錫宣布成立物聯網創新中心



RFID Interact with Zigbee



IOT Box (.NET M/F)



Application Layer

Transport Layer

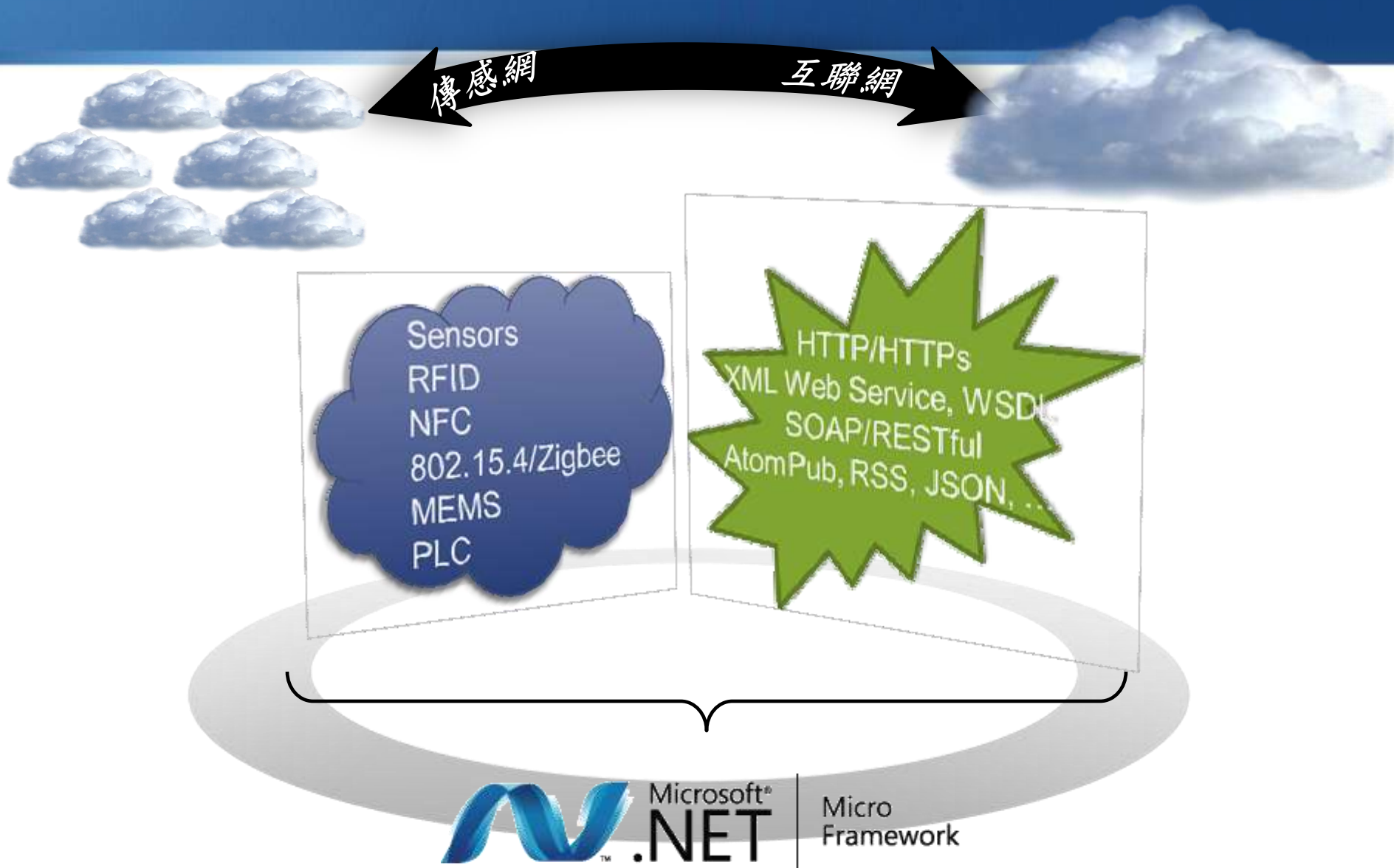
Internet Layer

Link Layer

Microsoft Confidential

Microsoft
.net Micro Framework

物聯網需要一個開放的嵌入式橋接平臺



.NET Micro Framework on smart devices

Trends for Devices



Devices are complementary to desktop and web applications

Devices are more and more connected and intelligent

Devices require a fast time-to-market turnaround

Fast growing business for 32 bits MCU/MPU

Highly innovative market

Trends for Devices



Application fields are diverse and require specific hardware programming skills

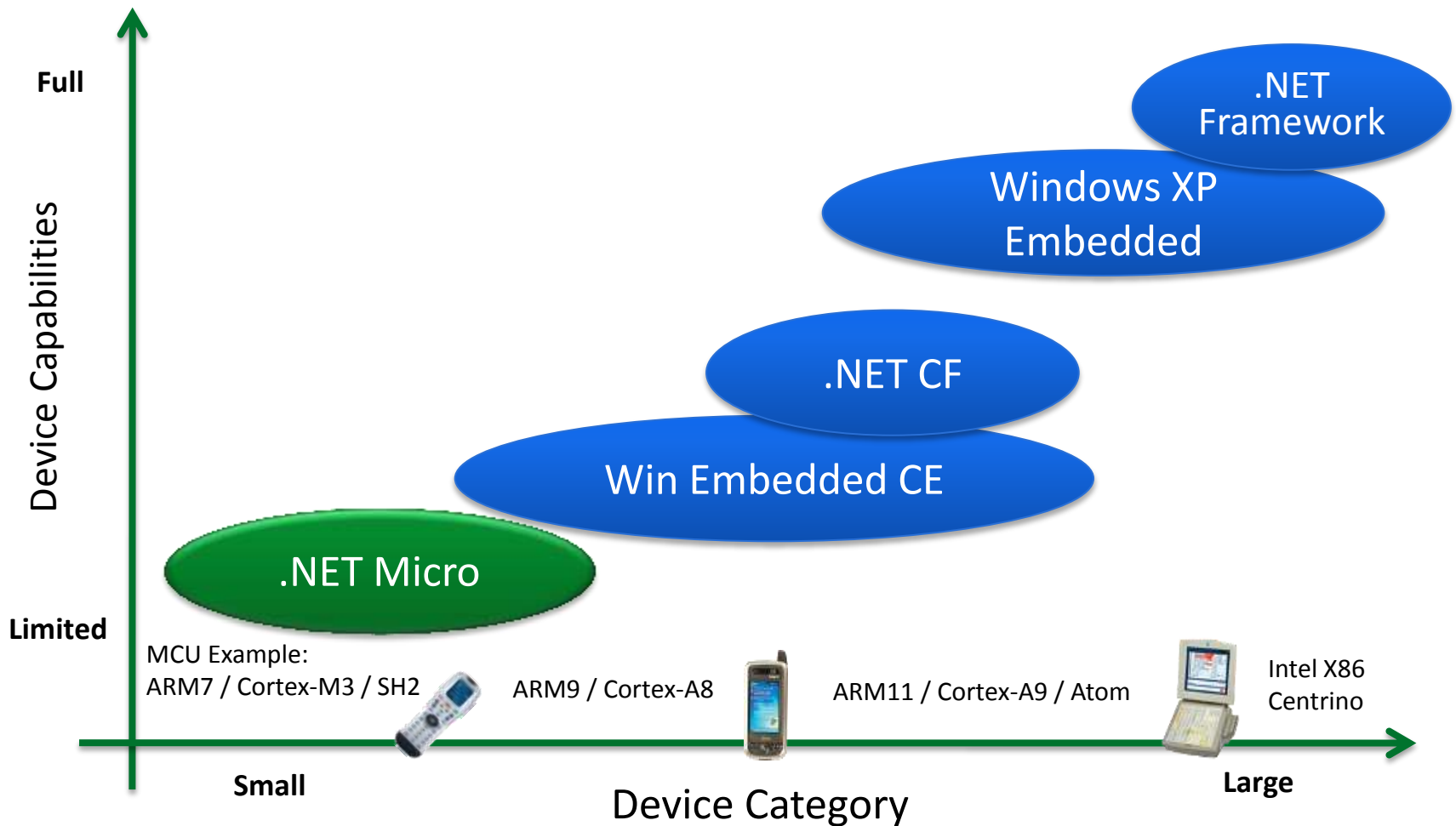
Connectivity must address peer devices, desktop and services transparently

Very diverse toolset, no standard programming model

Few standard communication protocols and little support

Code is generally difficult to port

The Devices Continuum



為智能終端提供最佳化的開發平臺與豐富統一的開發工具

微軟為PC、Web、伺服器、移動以及嵌入式各領域開發提供集成、端到端、統一的編程模式和開發工具。

 **Micro
.NET Framework**
*Bootable Runtime
for Embedded
Micro Devices*

 **Windows
Embedded CE**
*Real-Time OS for
Power Conscious
Small Devices*

 **Windows
Embedded**
for Point of Service
*Embedded OS for
Retail POS
Systems*

 **Windows^{XP}
Embedded**
*Componentized OS
Embedded
Optimized*

 **Microsoft
Visual Studio** **Microsoft
.net**

.NET Micro Framework 4.0

The .NET Micro Framework is a re-implementation of the desktop CLR for embedded devices that are unable to run a high-end embedded OS such as Linux/Android...

Very small memory footprint:

- Completely modularized by feature
- 512KB ROM / 256KB RAM for the full feature set
- WinCE and CF may require more than 10MB ROM / 10MB RAM

Supports all ARM MCU from ARM7 and up, Analog Devices Blackfin and Renesas SH2/SH2A MCU. No MMU restrictions

Entirely independent code base: this is not the Compact Framework

Bridging the Gap with Desktop Programming

The programming model is entirely managed code

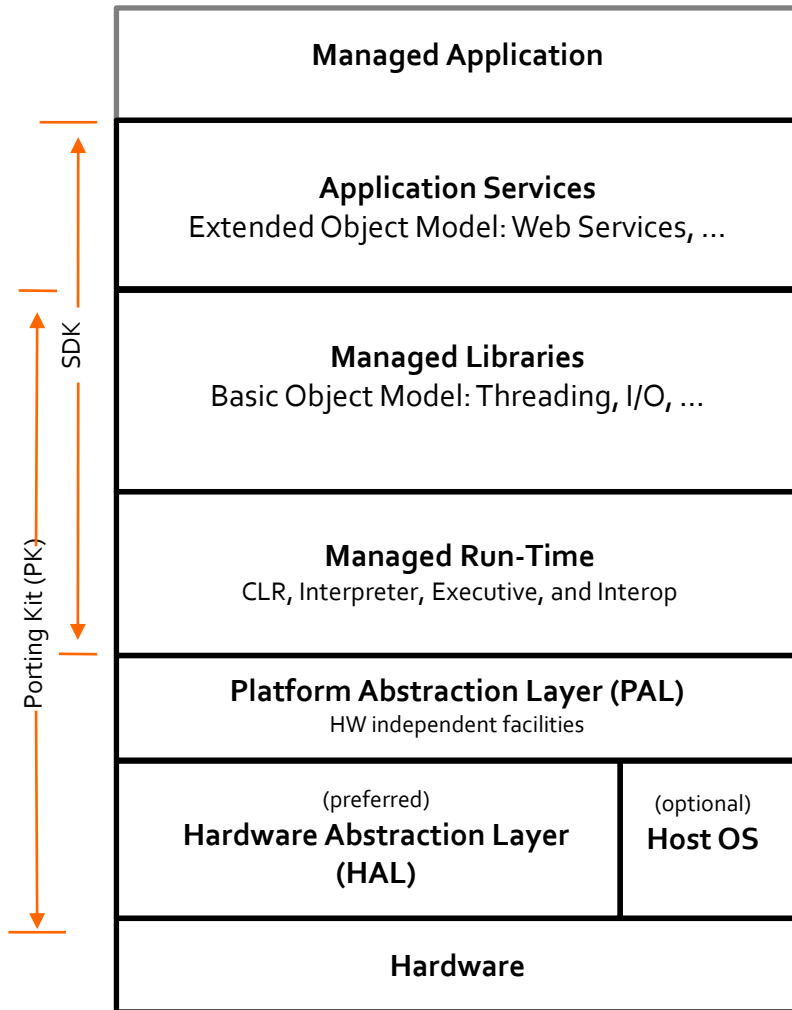
The programming environment is the latest VS2008 SP1

Interoperability is supported

Object Model offers a sub-set of the same namespaces of the .NET Framework for the desktop

Object Model is tailored for small embedded devices

Architecture and Tool Set



SDK enables:

- coding and deploying applications
- targeting any emulator or device
- extending the emulator
- leveraging full VS debug support
- using VS Express edition

PK enables:

- Coding drivers for the .NET MF
- Supporting additional processors
- Coding interoperability components
- Customizing the runtime and OM

.NET Micro Framework SDK

Contains everything you need to get started!

- Add-in installer for the latest VS 2008 SP1
- Post-processing of assemblies into the .NET MF compact format
- Project wizards
- Full .NET MF object model
- Standard emulator
- Deployment and debugging against the emulator or any device
- Samples
- Font editor tools
- Device Diagnostic tools
- Help (also available online at MSDN)
- Compatible with VS2008 Express Edition

.NET Micro Framework Porting Kit

Contains everything you need to port the MF onto any device!

With the Porting Kit you have full source code access to:

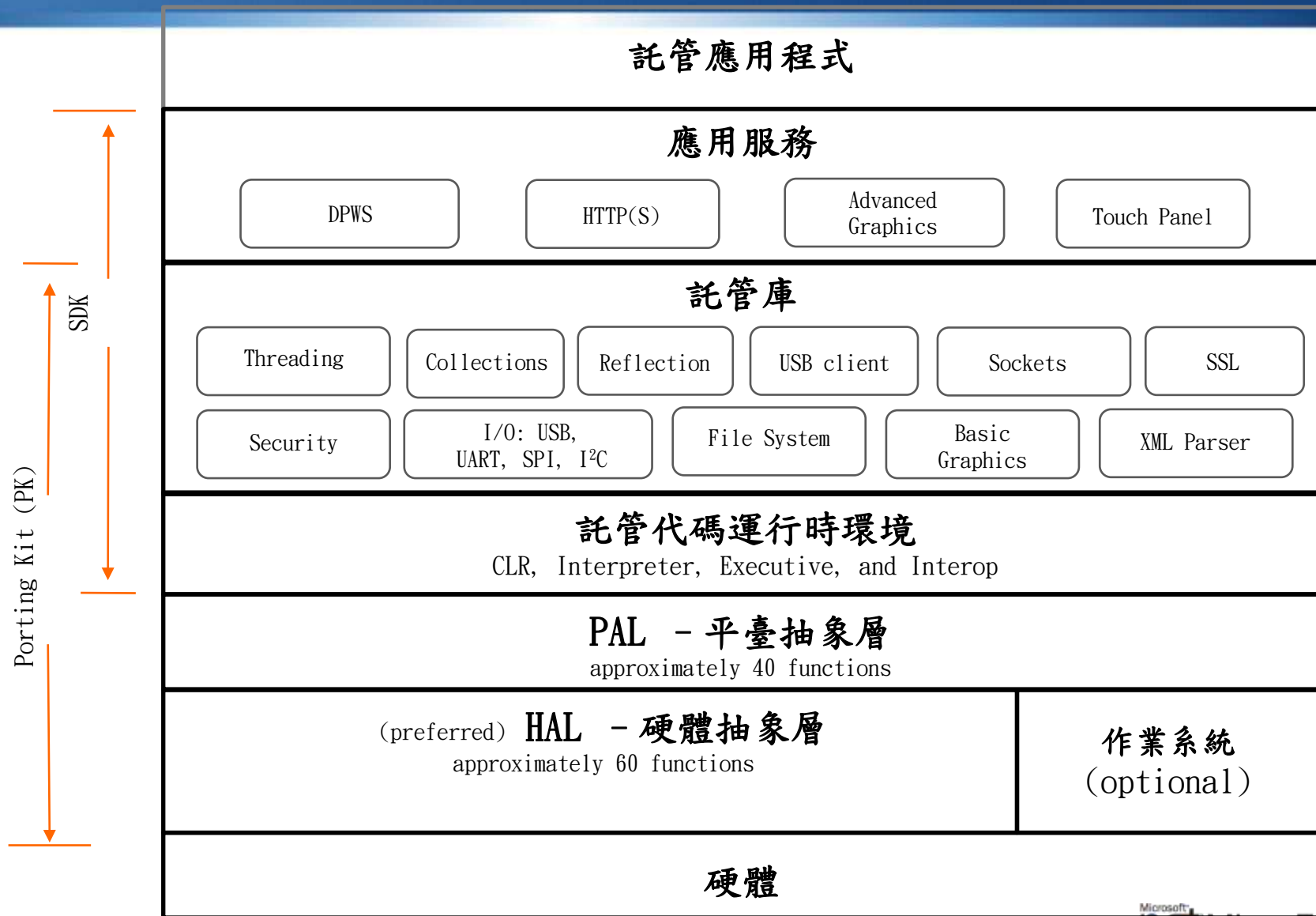
- Code and build device drivers for the .NET MF
- Code interoperability components and expose them to the OM
- Customize the runtime and object model for special needs
- Add support for additional instruction sets

Assisted creation of new drivers and processor support packages

Supports mainstream embedded tool chains such as ARM RVDS, Keil MDK, GCC, HEW, Visual DSP++

Includes extensive sample libraries coded by silicon vendors such as Atmel and NXP for mainstream MCUs

.NET Micro Framework物件模型



The Programming Model

Managed Code Device Drivers, abstracted I/O and virtualized input for maximum portability

Encourages event based programming and provides advanced sleep-on-HW-event support for maximum battery life

```
public static class BatterySaver
{
    public static void WaitOnSerialInput( SerialPort sp ) {
        sp.DataReceived += new SerialDataReceivedEventHandler( this.DataOnSerial
    );
        PowerState.Sleep(SleepLevel.DeepSleep, HardwareEvent.SerialIn);
    }

    private static void DataOnSerial(object sender, SerialDataReceivedEventArgs e) {
        ...
        ((SerialPort)sender).Read(...);
        ...
    }
}
```

.NET Micro Framework 4.0

Communication and messaging

HTTP(s)

- HttpWebRequest, HttpWebResponse and HttpListener
- Supports HTTP/1.1 with chunking and keep-alive
- Supports SSL with X.509 certificates

DPWS

- Supports WSDL 1.1, SOAP 1.2, WS-Addressing, WS-MetadataExchange, WS-Transfer, WS-Discovery, WS-Eventing
- Compatible with WCF Soap bindings
- Code generation tools to/from WSDL and assembly
- Code generation compatible and interoperable with desktop tools

Wired and Wireless

- Ethernet, Serial and USB
- 802.11 configuration support
- 802.15.4 stack available (not yet documented)

UI Support

Inspired to WPF, supports dynamic layout, rendering , and event dispatching

Basic types

- Application
- Windows

Basic layout controls

- StackPanel
- Canvas
- InkCanvas

Basic controls

- Text
- ScrollView
- ListBox

Event routing and input providers support

Integrated Touch Panel and Inking support



.Net MF4.0 新的商業模式

- ✓HTTP (S)
- ✓版本控制
- ✓更快的 XML解析器以及支持 System.Collections
- ✓更快的 Graphic/Touch/Inking組件
- ✓能耗控制
- ✓Flash 儲存裝置的損耗平衡
- ✓時間同步
- ✓任意的顯示尺寸
- ✓支持Atmel AT91SAM9RL64 ARM9處理器
- ✓支持NXP LPC2478 AR7
- ✓支持Renesas SH2/A SH7619

新的商業模式：

- ✓從11/16/2009起，.NET Micro Framework以 Apache 2.0 license下的**開放原始程式碼發佈**
- ✓包括CLR runtime環境，物件模型以及設備驅動在內的所有代碼都**免費**提供

.NET MF 技術論壇

既針對專業開發人員也針對業餘愛好者

論壇內協作開發

微軟與論壇領袖一起展望以及制定開發功能需求

論壇為基於 .NET MF 的元件和解決方案提供交流平臺

微軟將提供 .NET MF 的官方支持版本

歡迎任何人為 .NET MF 的擴展做出貢獻

www.netMF.com



以 .NET MF 實現的物聯網設備

範例：Leviton Vizia 射頻轉乙太網閘道



家居自動化 Z-Wave轉乙太網閘道

"Since .NET Micro Framework is basically C# code for embedded devices, it was easy to use Visual Studio Rapid Application Development tools to craft a 'working prototype' very quickly"

~ Chris Walker, President and Chief Technical Officer, Control Think.

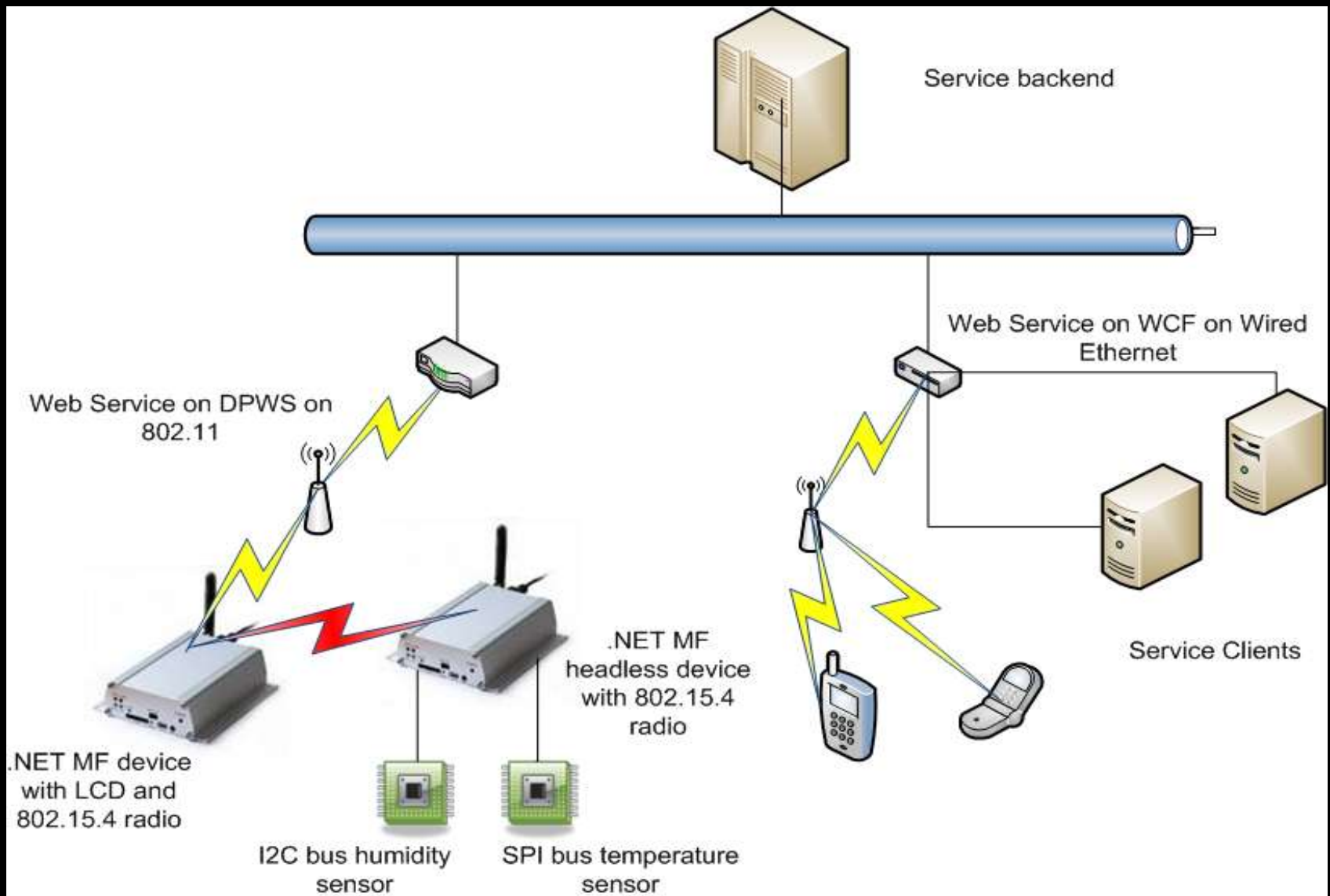
- 更快更好更經濟
- 技術性驗證
 - 3天
- 完成產品
 - 3個月
- 立即獲得高投資回報率！



"We've shown that you can reduce the time it takes to get your product to market with .NET Micro Framework. That really changes the game for embedded device designers and manufacturers."

John Leier, Product Manager for Embedded Solutions,
Digi International

.NET MF在IOT中的應用(一) Zigbee+WiFi雙模組



.NET MF在IOT的應用(二) 實際垃圾回收



Mr. Mario Rossi:
Via Monte Nero,
MESTRE

RFID badge with user data.

RFID badge reader installed within the bin.
No mechanical part shall be exposed to
avoid tampering of the system

Board with .NET Micro Framework installed
(IMOTE2 ?).
It manages the list of authorized users and
pilots the lock/unlock bin system.
A IEEE802.15.4 radio system allows short
range communication with external clients

基於MF以電池供電的
RFID檢測設備



- The truck is equipped with a .NET Micro Framework board featuring short range IEEE802.15.4 radio
- As soon as the truck approaches the bin, the latter will start transmitting the data stored since the previous grabage collection

Bin ID: 000001

01/06/2009; 08:45;
01/06/2009; 08:51;
02/06/2009; 15:34;

Mario Rossi
Paolo Bianchi
Giuseppe Verdi

微軟SQL
伺服器後端

在微軟創新中心幫助下為義大利威
尼斯市開發的垃圾回收系統

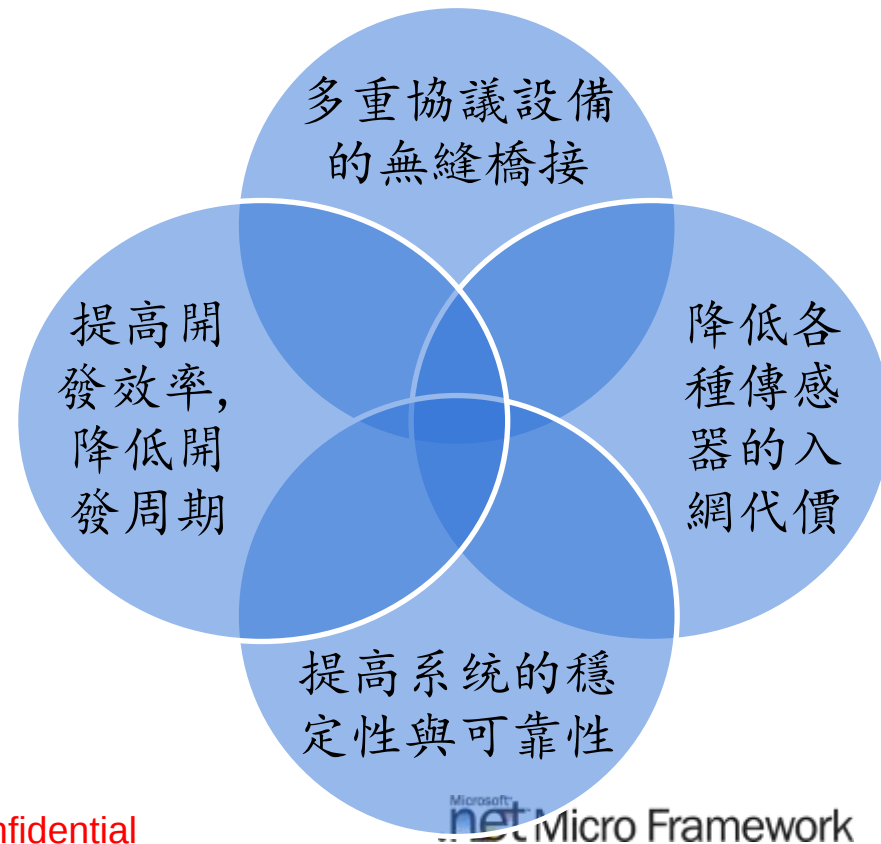


- The truck goes through a defined path (e.g., at the garbage collector or in the trucks garage) and upload all data into the central management system
- Once in the management system the loop is closed: the Municipality can track who is using bins and prepare bills accordingly

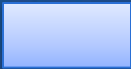
以 .Net MF 為依託構建羽量級嵌入式組態軟體 TinyIos

■ TinyIos，就是 **Tiny I/O Server** 的簡稱，在物聯網、雲計算時代，一切以數據資料為中心，不同的感測器通過不同的方式聯入網路，通過雲端計算的方式為不同的終端使用者提供服務。

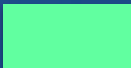
解決嵌入式技術和物聯網整合的四大關鍵



物聯網前端管理平臺



.NET MF



Tiny I0s



C#應用

應用服務

DPWS

高級圖形

SSL

XML解析

託管庫

Threading

Collections

Reflection

USB Device

Sockets

Security

I/O: USB,
UART, SPI, I²C

File System

Basic
Graphics

Touch
Screen

託管運行時

CLR, Interpreter, Executive, and Interop

Tiny I0s

數據
管理

狀態
診斷

設備
管理

策略
管理

I/O
驅動

匯流排
適配

PAL - 平臺抽象層

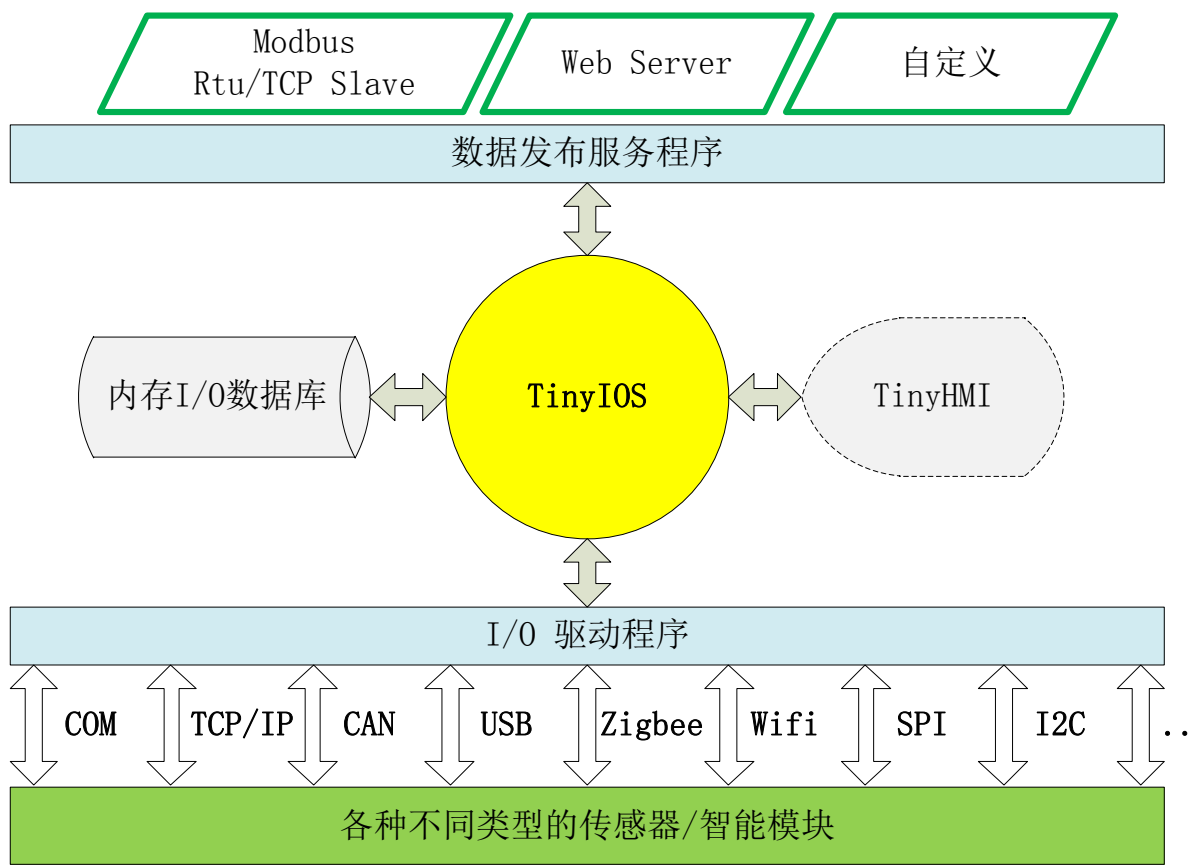
HAL -
硬體抽象層

(optional)
Host OS

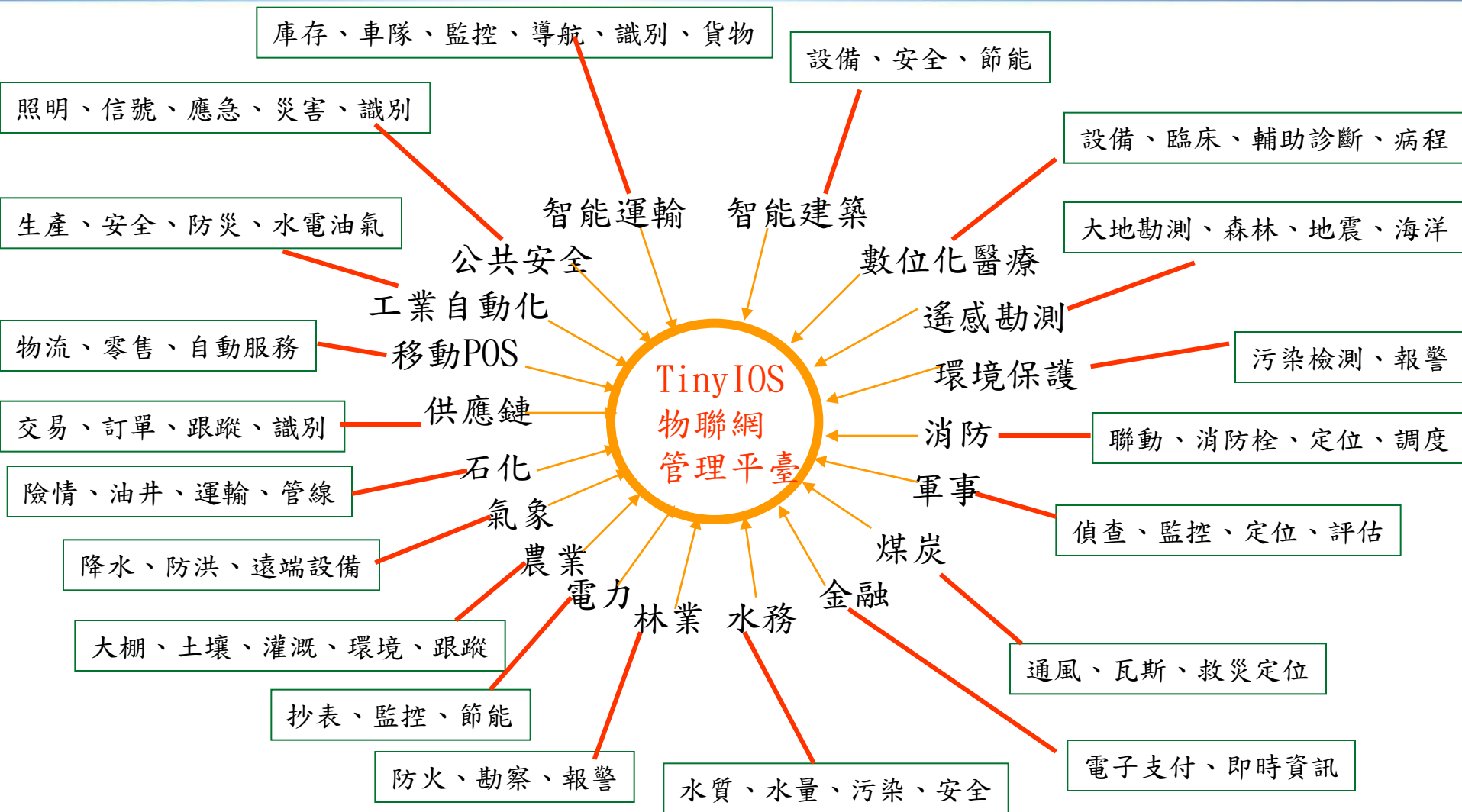
硬體

用戶關心的只是數據資料！

- 不管是什麼樣的感測器
- 不管是什麼樣的設備介面
- 不管是什麼樣的通訊協定
- 不管是什麼樣的網路拓撲
- TinyIos展現給用戶的就是標準的資料發佈



Tiny Ios 物聯網前端管理平臺

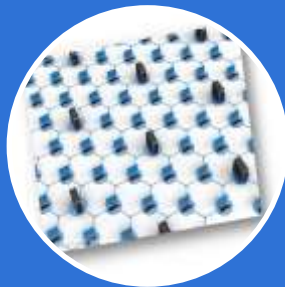


.NET & ARM Cortex M3 物聯網開發參考平臺



“實現感知”

- 匯集各種實用的傳感器, RFID識別功能, camera 圖像處理.



“互聯互通”

- 集成Ethernet, WiFi、藍芽、ZigBee、3G WWAN等通訊網路



“控制操作”

- 伺服器端的信息處理和控制

實現可感知、可管理、可控制、可用的真實物聯網世界

.NET & ARM Cortex M3 物聯網開發參考平臺

物联网技术支撑体系

通过数据融合、挖掘，信息处理，商业智能，GIS，GPS
等技术整合成具体的应用解决方案

应用层

WIFI、蓝牙、ZigBee、3G、网卡

网络层

RFID、传感器、智能卡、摄像头等数据采集和感知技术

感知层



.net Microframework

物聯網開發參考平臺——演示

- RFID與Zigbee互動, 透過物聯網雲計算伺服器的管理

