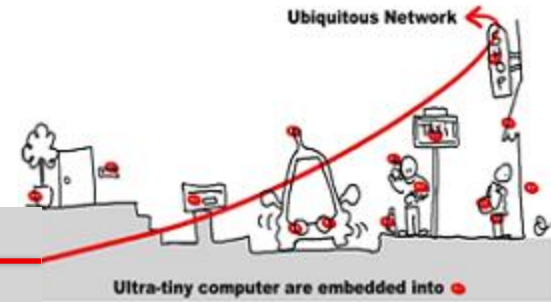


# .Net Micro Framework et .Net Gadgeteer

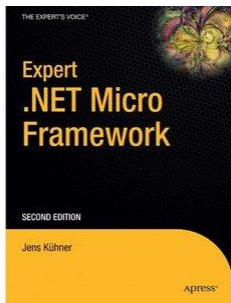


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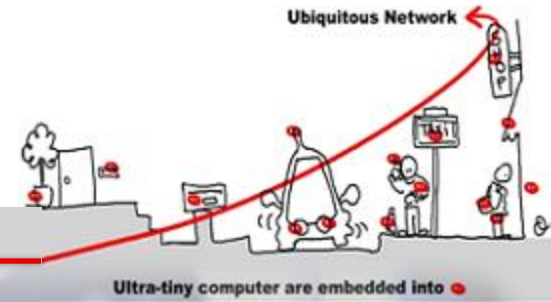


[http://www.windowsfordevices.com/files/misc/Kuhner.NETMicroFramework\\_Ch4\\_sample.pdf](http://www.windowsfordevices.com/files/misc/Kuhner.NETMicroFramework_Ch4_sample.pdf)

<http://www.thierry-lequeu.fr/data/Beginners-Guide-to-NETMF-French.pdf>

<http://www.tinyclr.com/support/>

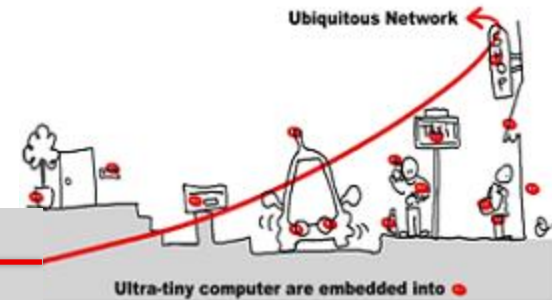
# .NET MicroFramework



- **Historique & état des lieux**
- **Architecture**
- **A l'intérieur du MicroFramework**



# Historique



- **2001 : Début de SPOT chez Microsoft Research (Smart Personal Object Technology)**
- **Produits déjà lancés:**
  - Smart Watches (2004)
  - Microsoft TV (2005) (maintenant sous CE)
- **En cours de lancement :**
  - Microsoft Windows Vista SideShow



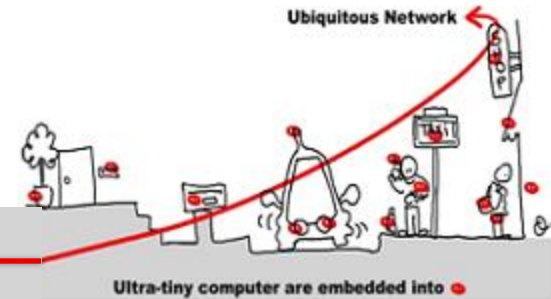
## Hardware

- PortalPlayer PP5024  
Dual-core ARM7
- USB connection to host PC
- Self-contained battery
- 320x240 QVGA TFT display
- WMA/MP3 Playback



# Motivation

## Ce que propose Microsoft ...



- **General**

- Microsoft Windows XP Embedded
- Microsoft Windows CE

- **Dérivés**

- Microsoft Windows Automotive 5.0
- Microsoft Windows Embedded for Point of Service

- **Taille de Windows CE**

- Le noyau de CE est > 600Ko selon les options
- Windows CE + .NET Compact Framework (CF)= 12Mo
- Windows CE a besoin d'une MMU

# S'ouvrir sur d'autres périphériques

## .NET Micro Framework



Wearable Devices



Auxiliary Displays



Health Monitoring



Remote Controls

## Windows CE



Windows Mobile Smartphone



Windows Mobile Pocket PC Phone



Portable Media Center



Windows Automotive



Mobile handhelds



VoIP phones



Set-top boxes



Gateways

## Windows XP Embedded



Retail Point-of-Sale



Windows-based terminals



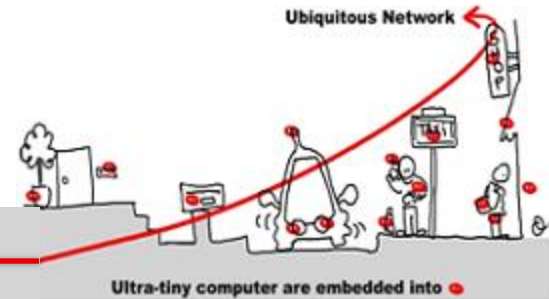
Medical devices



Entertainment devices

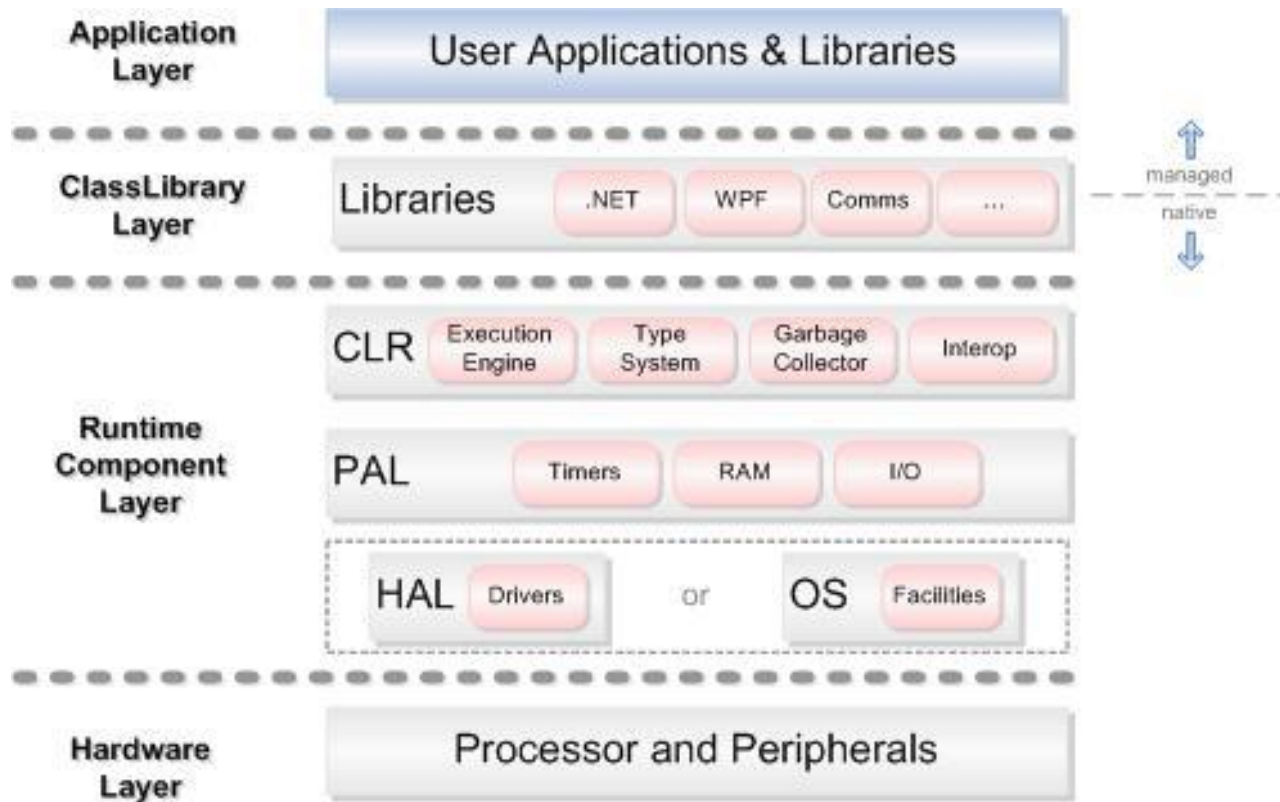
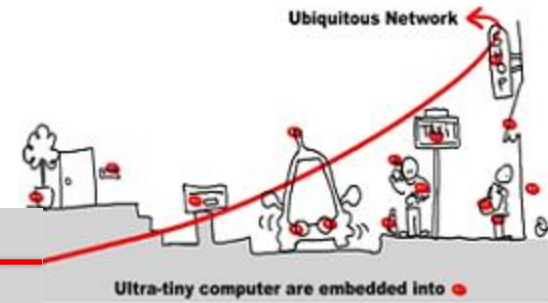
# Architecture

## Philosophie et buts



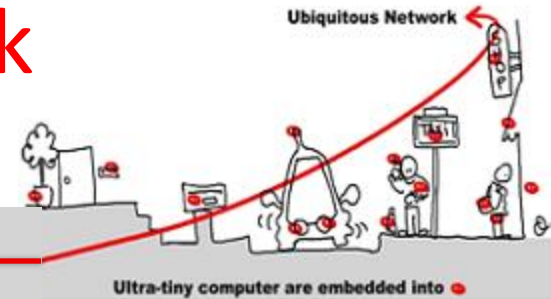
- **Bootable .NET**
  - Bénéfices du code managé, proche du hard
- **Créer la plus petite plateforme compatible .Net pour les périphériques ayant peu de ressources (CPU, mémoire, alimentation)**
- **Compromis**
  - Empreinte mémoire réduite, options de boot avancées et BSP (Board Support Package)
  - CLR runtime
  - Librairies essentielles (mscorlib, graphics, HW, Net)
  - Librairies sous forme de composants pour étendre des périphériques particuliers

# Architecture





# A l'intérieur du MicroFramework

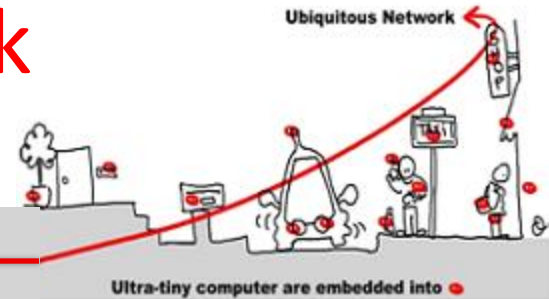


- **Chipsets supportés**
  - ARM
    - ARM7TDMI, 25Mhz, 384Kb RAM, 1/2Mb FLASH, 8Kb D/I cache
    - ARM920T, 96Mhz, 4Mb RAM, 2Mb FLASH, 16Kb D/I cache
    - ARM Cortex M3 (en cours de développement)
- **Plateformes supportées (en tant qu'hôte pour le CLR)**
  - M68k
  - Win Embedded XP
- **Porter vers un nouveau hardware : ~80-100 fonctions**
- **Porter vers une nouvelle plateforme : ~20-30 fonctions**
- **Un kit pour porter le micro framework vers un nouveau hardware est disponible**



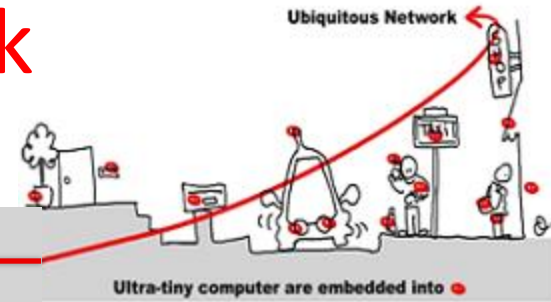
# A l'intérieur du MicroFramework

## HAL + PAL



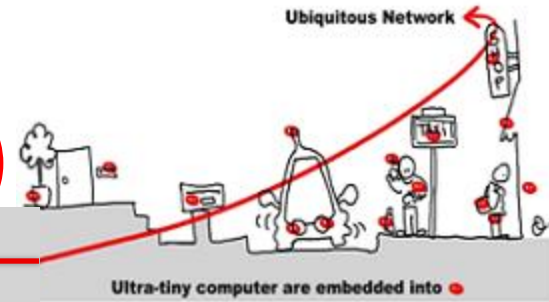
- **Conçus pour .NET Micro Framework**
  - Bootstrap
  - Abstraction du matériel
  - Mécanisme de report d'appel de procédure ( Deferred Procedure Call (DPC) )
    - Priorités des appels de fonction
    - Gestion des appels asynchrones ( entrées/sorties)
    - Forme de multitâche coopératif
- **Simple**
  - Ni scheduler ou gestion de mémoire
  - Blocage minimum (seulement les ISRs)
  - Seul le CLR est exécuté

# A l'intérieur du MicroFramework HAL + PAL



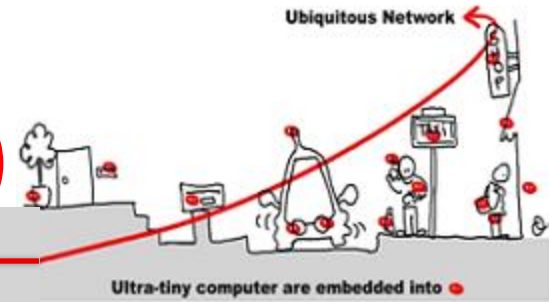
- **Petit**
  - 40Ko (avec les drivers principaux)
- **Execution du CLR**
  - Directement sur le HW (via HAL, Hardware Abstract Layer)  
ou
  - En tant que tâche d'un RTOS (via PAL, Physics Abstraction Layer)
- **PAL est une surcouche de HAL**

# A l'intérieur du MicroFramework Common Language Runtime (CLR)



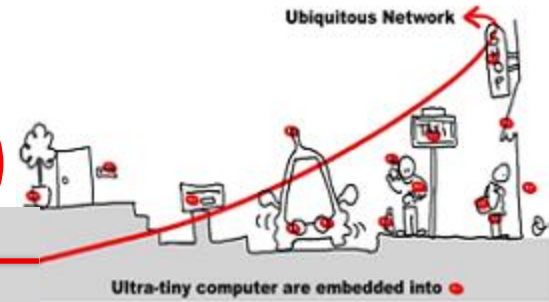
- **Dérivé du standard ECMA (CLI)**
  - CLS/CTS/VES (common language specification, common type system, Virtual Execution System)
  - Aucun appel unsafe
  - Quelques extensions spécifiques à l'environnement embarqué
- **Taille très réduite**
  - runtime + framework library: ~200 KB
  - <500KB toutes options (UI, XML, ...)

# A l'intérieur du MicroFramework Common Language Runtime (CLR)



- **Gestion mémoire**
  - Garbage collector
  - Support pour de la mémoire non-volatile
  - Optimisé pour le ratio size/performance
- **Moteur d'exécution**
  - Charge et exécute le code managé (MSIL)
  - MSIL interprété
    - Execution avec une faible granularité
    - Code plus petit
  - Multi-threads
  - Gestion des exceptions

# A l'intérieur du MicroFramework Common Language Runtime (CLR)



- **Moteur de sérialisation**
  - Optimisé pour la mémoire non-volatile
- **RPC**
  - Communication bi-directionnelle
  - Au travers de différents types de liens (Bluetooth, USB,...)
- **Réseau**
  - Drivers 802.15.4 (Chipcon cc2420) et BT (Promi-SD)
  - Bientôt une stack TCP/IP (System.Net.Sockets)
- **Drivers managés**
  - GPIO, PWM, VTU32, I2C, SPI, USART

# .NET Framework

Ubiquitous Network

## System.Web

- Services
  - Description
  - Discovery
  - Protocols
- UI
  - HTML controls
  - Web controls

Cache

Security

Configuration

Session state

## System.Data

ADO.NET

SQL Client

Design

SQL ServerCE

## System

Collections

IO

Security

Net

Text

Reflection

Globalization

Resources

## System.Windows.Forms

Design

Component model

## System.Drawing

Drawing 2D

Printing

Imaging

Text

## System.XML

XML Document

Serialization

Xslt/XPath

Reader/writers

Configuration

Service process

Diagnostics

Threading

• Runtime

- Interop services
- Remoting
- Serialization



# .NET Compact Framework

Ubiquitous Network

## System.Web

### • Services

- Description
- Discovery
- Protocols

### • UI

- HTML controls
- Web controls

Cache

Security

Configuration

Session state

## System.Windows.Forms

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# .NET MicroFramework

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# .NET MicroFramework

Ubiquitous Network

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- UI
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  - ...

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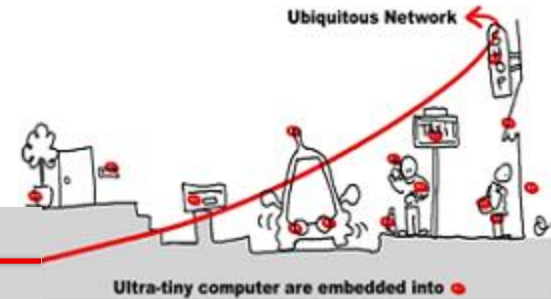
Threading

• Serialization

**OPEN SOURCE  
Cf. Codeplex**

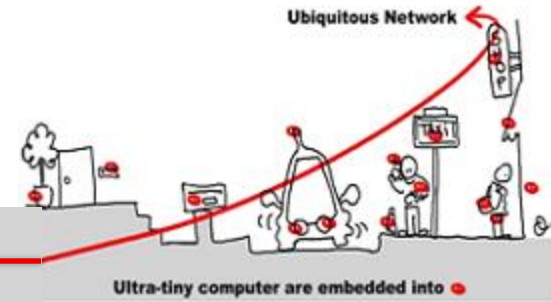


# Le SDK et les APIs : .Net MF et WPF



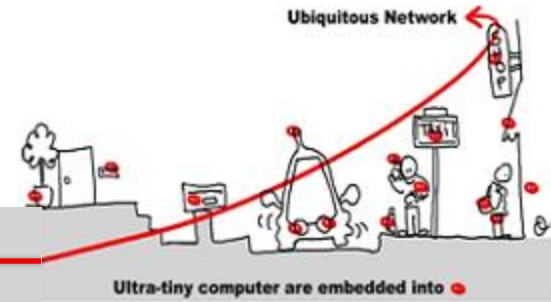
Namespace	Description
<a href="#">Microsoft.SPOT.Input</a>	Contains tools for collecting and managing user input.
<a href="#">Microsoft.SPOT.Presentation</a>	Provides the ability to design and control the layout and display of graphical user interface elements.
<a href="#">Microsoft.SPOT.Presentation.Controls</a>	Enables your program to create elements (known as controls) that make it possible for users to interact with the programs. This namespace also provides support for displaying text.
<a href="#">Microsoft.SPOT.Presentation.Media</a>	Gives your applications the tools required to draw and manipulate bitmapped images.
<a href="#">Microsoft.SPOT.Presentation.Shapes</a>	Provides tools that enable your programs to draw two-dimensional (2-D) geometric shapes.

# Exemples .Net MF et WPF

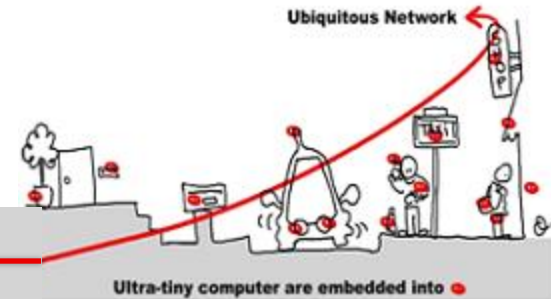


- <http://www.christec.co.nz/blog/archives/174>

# Exemples .Net MF and Inputs



# Environnement de développement



- Visual C# express 2012 ou 2013
- <http://www.microsoft.com/express/vcsharp/>
- .NET Micro Framework 4.1 ou supérieur SDK  
<http://www.microsoft.com/downloads/details.aspx?displaylang=en&FamilyID=cff5a7b7-c21c-4127-ac65-5516384da3a0>, si le lien ci-dessus ne fonctionne pas, cherchez “.NET Micro Framework 4.1 SDK”
- SDK GHI NETMF. <http://www.tinyclr.com/dl/>