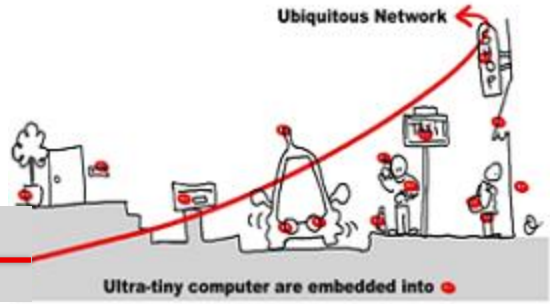

Component based middleware and service composition for ubiquitous computing

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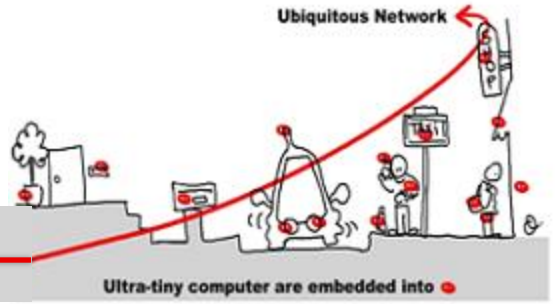
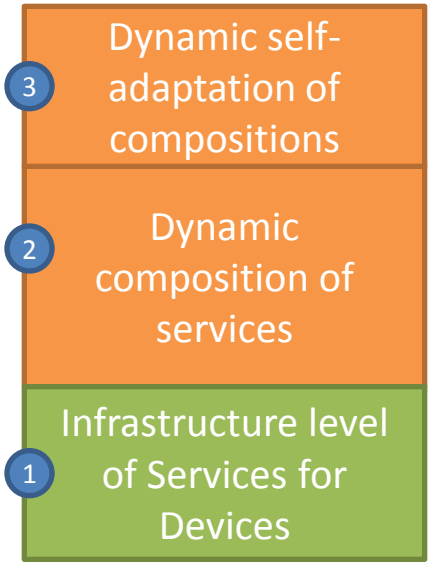
Ref : Component-based Software Engineering Ivica Crnkovic



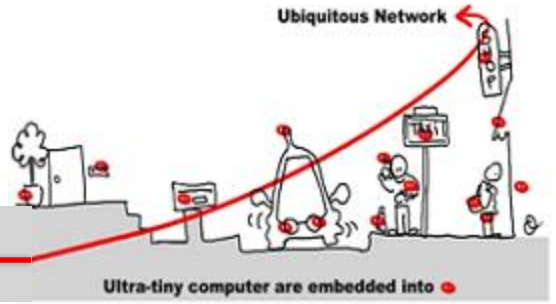
Next Step ….

1. Infrastructure : based on Web services for Device
2. Composition : based on CBSE
3. Self-Adaptation : using Aspects of Assembly (AA)



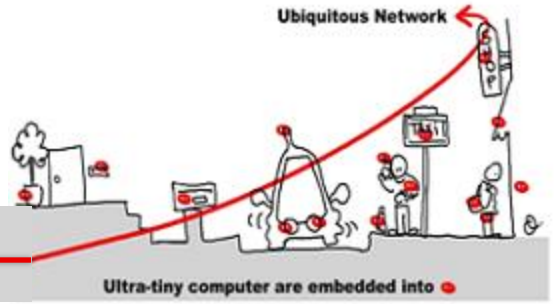
MASTER_INFO_CORTE_IAM_2013 component_based_middleware Jean-Yves tigli -

Overview



- Introduction
- ACME Architectural Description Language
- Java Bean Component Model
- LCA (Wcomp) Component Model, for ubiquituous computing

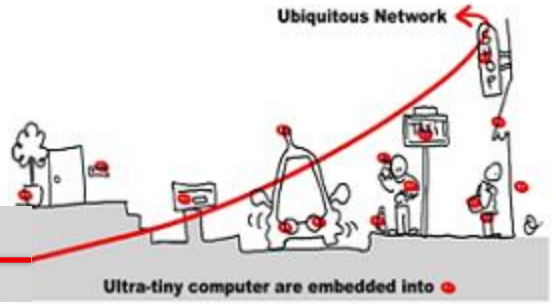
What is a Component?



- *"A software component is a software element that conforms to a component model, and can be independently deployed and composed without modification according to a composition standard."*
- Component Model
  - Interaction Standards
    - Clearly Defined Interface
  - Composition Standards
    - Describe how components can be composed into larger structures
    - Substitutions

[1],[2]

CBSE Definition

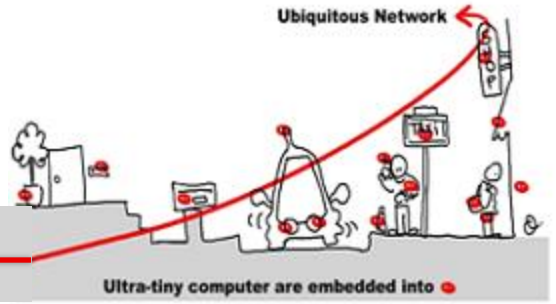


- Developing new software from pre-built components.
- Attempt to make an association between SE and other engineering disciplines.

Advantages of CBSE

- Management of Complexity
- Reduce Development Time
- Increased Productivity
- Improved Quality

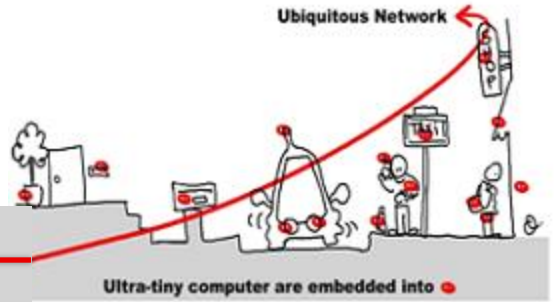
More on Trust



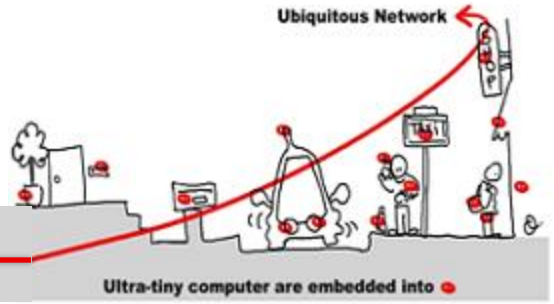
- Components come in several forms
  - Binary
  - Source Code
- Need a Certification Standard
  - Tests
  - Environments

- => Formal Validation and Model Checking is a way to do that (SCADE and synchronous programming)

Disadvantages of CBSE



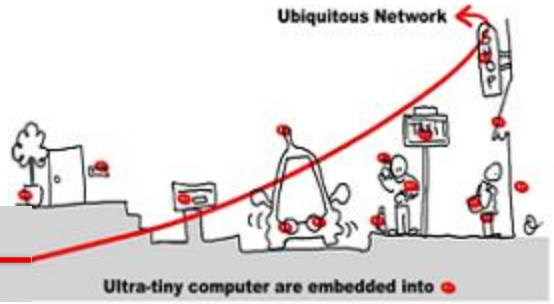
- Development of Components
- Lack of Components
- Component Maintenance Costs
- Sensitivity to changes
- Trust



General Model of CBSE

ADL - ACME

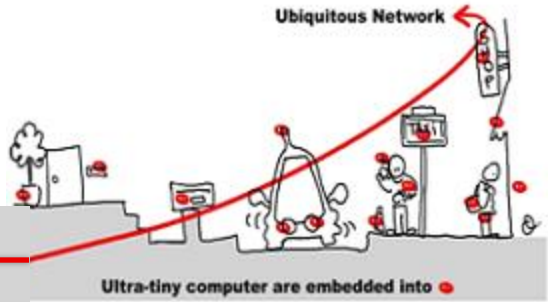
Architecture Definition Languages



- ADLs primarily address the issues related to the early phases of software engineering
  - Design
  - Analysis

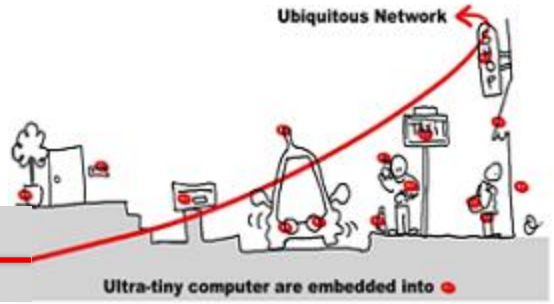
- They identify a number of concepts, such as:
  - Architecture, configurations, connectors, bindings, properties, hierarchical models, style, static analysis and behavior.

ACME Architectural Description Language

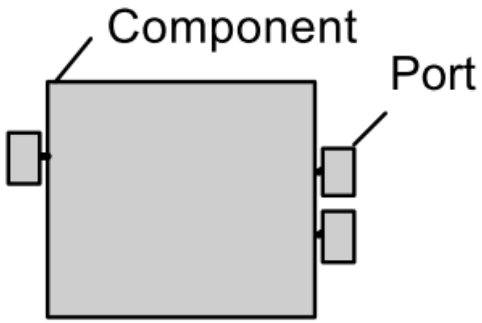


- Components and Ports
- Connectors and Roles
- Systems and Attachments
- Representations and Bindings

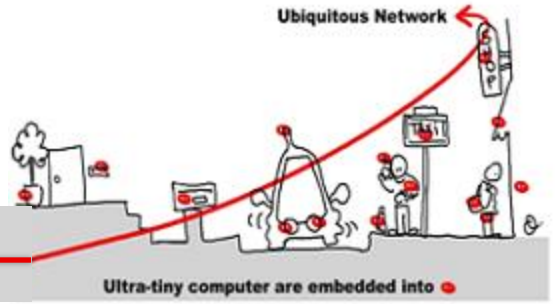
Components and Ports



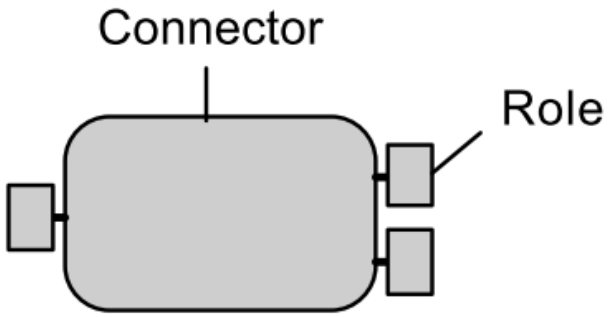
- Components
  - Represent the computational elements and data stores of a system.
- Ports
  - Are the points of interaction between a component and its environment.



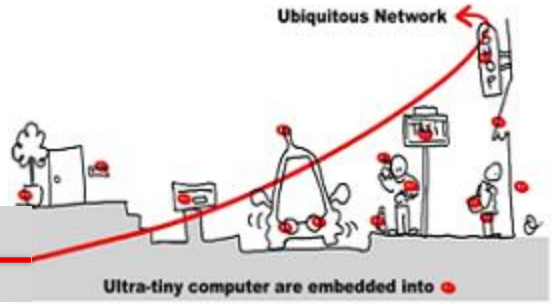
Connectors and Roles



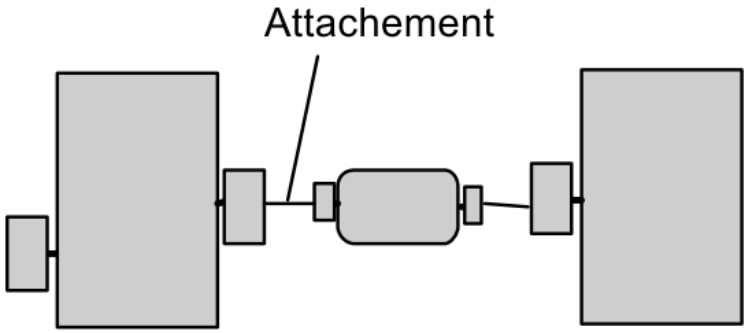
- Connectors
  - Represent interactions between components such as method calls or an SQL connection between a client and a database server.
- The interface of a connector is defined as a set of roles



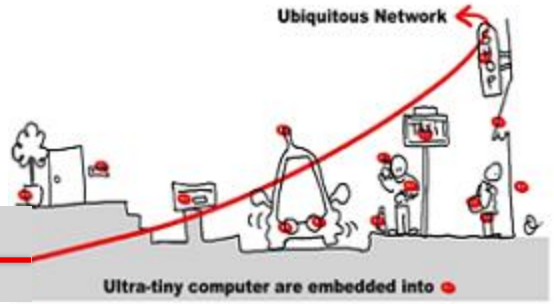
Systems and Attachments

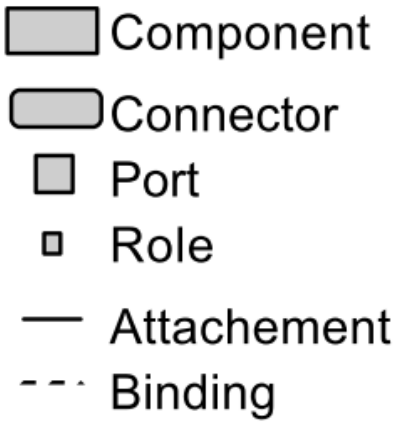


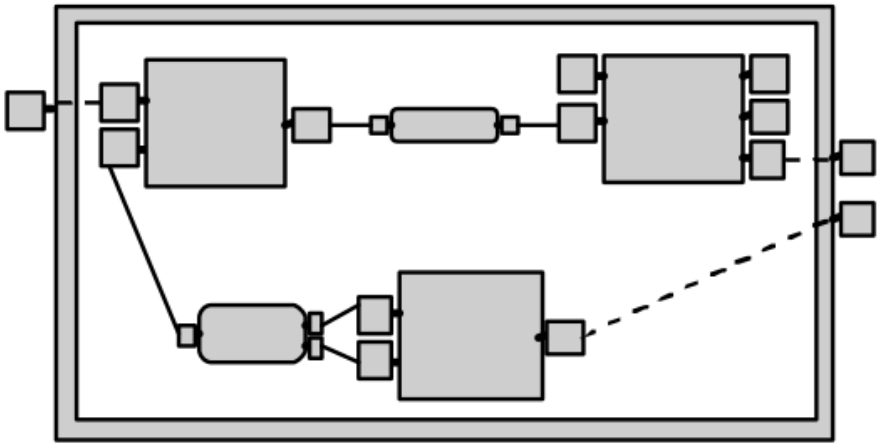
- The structure of a system is specified by a set of components, a set of connectors, and a set of attachments.
- Attachment
  - Links a component port to a connector role.

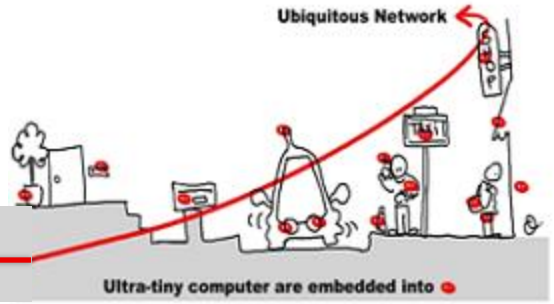


Representations and Bindings





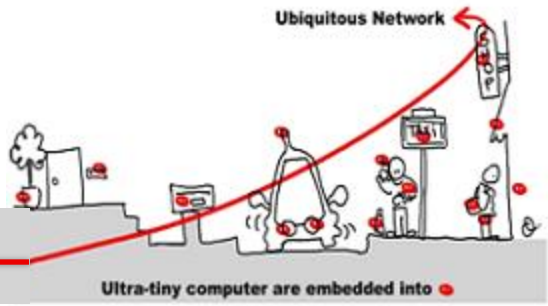




Fine grained Component

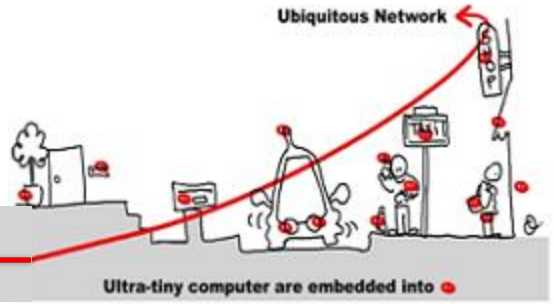
Or local Component

Fine-grained Component
Ex. JavaBean Model and Key Features

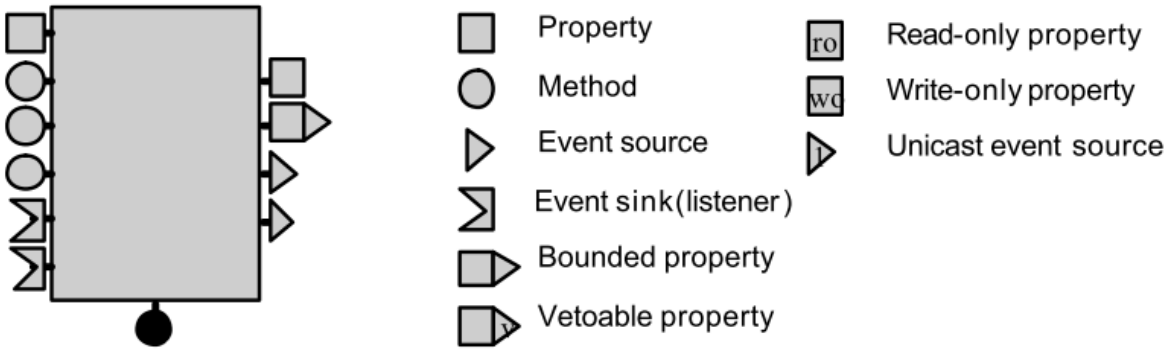


- "A Java Bean is a reusable software component that can be manipulated visually in a builder tool ”.
- The Java Bean was designed for the construction of graphical user interface (GUI).
- Explicitly tailored to interact in two different contexts:
  - At composition time, within the builder tool.
  - At execution time, with the runtime environment.
- Any Java class that adheres to certain conventions regarding property and event interface definitions can be a JavaBean.
- Beans are Java classes that can be manipulated in a visual builder tool and composed into applications.

Interface of a Component

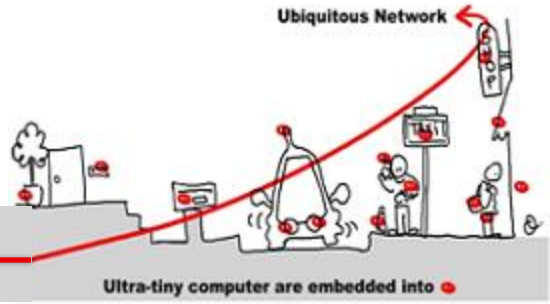


- This model defines four types of port:
  - methods,
  - properties,
  - event sources (generate an event)
  - event sinks called listeners (they receive event)

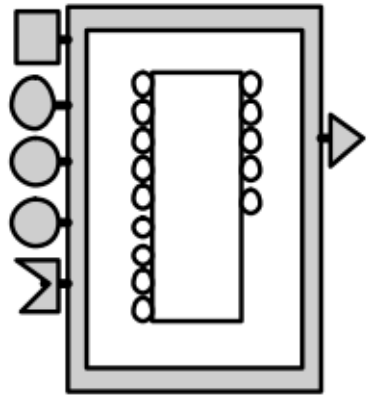


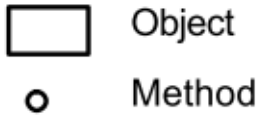
Ports

Implementation of a Component



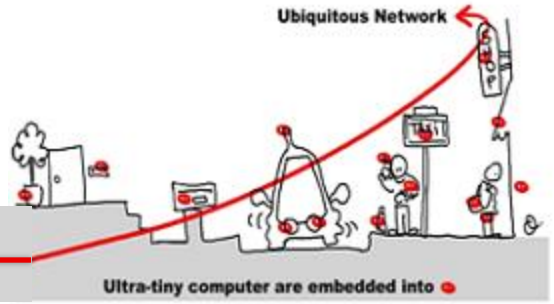
- Most bean components are implemented by a simple object and naming convention
- A component factory is a class





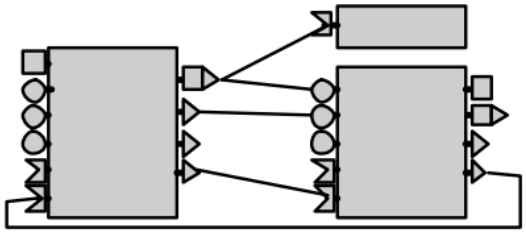
A simple implementation

Components Assembly

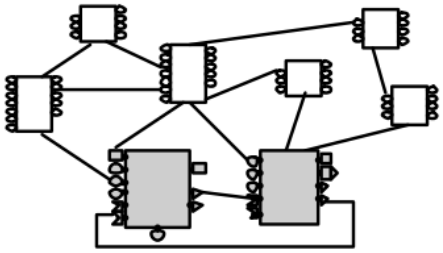


- Assembly is one of the key features of Bean.
  - Composition tools (Bean Box)

- Different ways of assembling components are supplied.

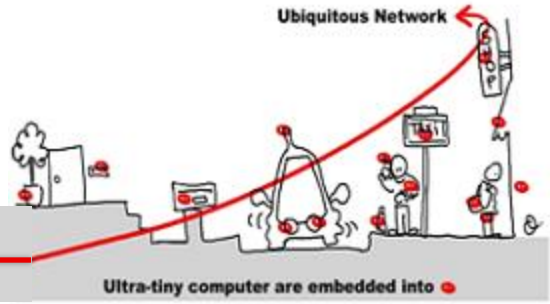


Component-based assembly

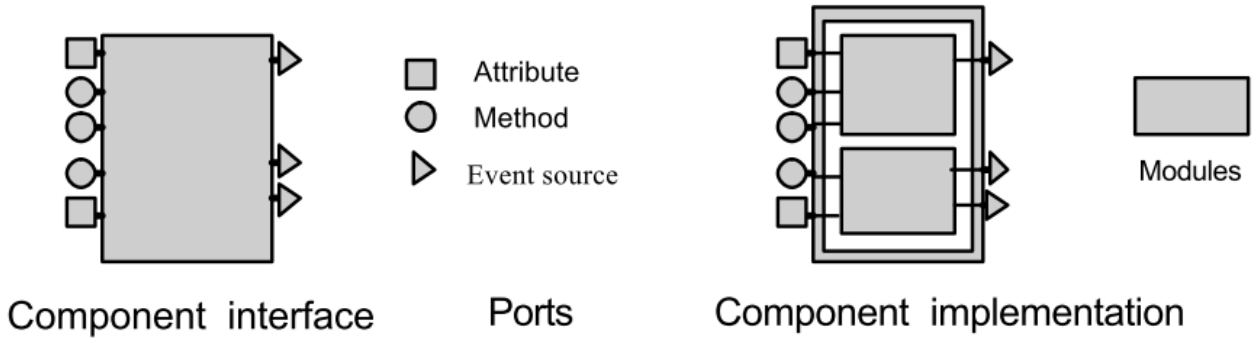


Heterogeneous assembly

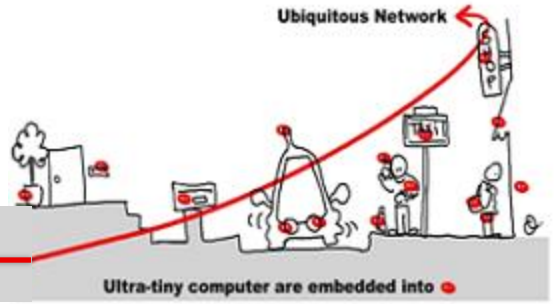
Fine grained Component
ex. .NET Model – Implementation



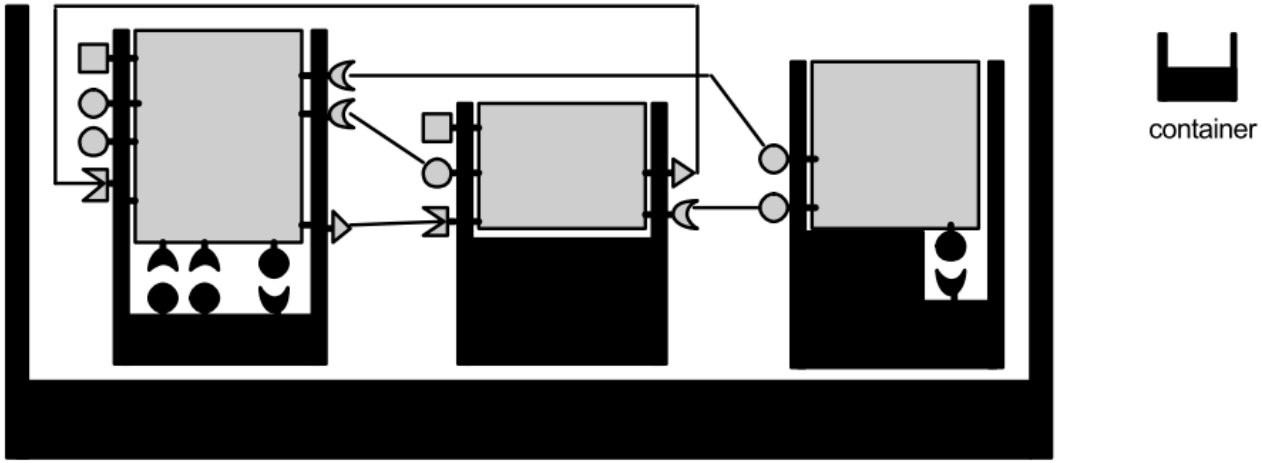
- A component (assembly) is made of modules, which are traditional executable files (DLL).
- Modules cannot be assemblies, thus the .NET model is not hierarchical.

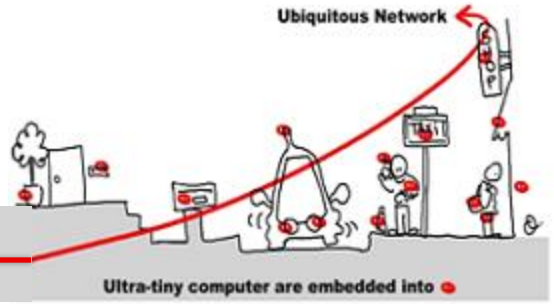


Framework : The Container Approach



- Framework – a set of containers. Containers contains components and provides a set of standard services (security, events, persistence, life -cycle support)

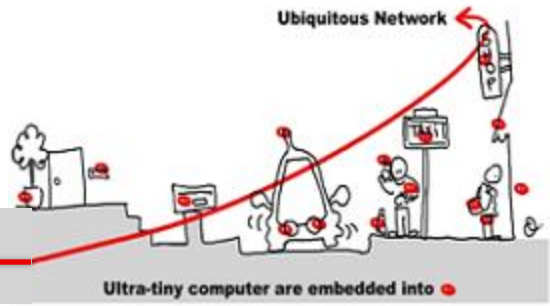




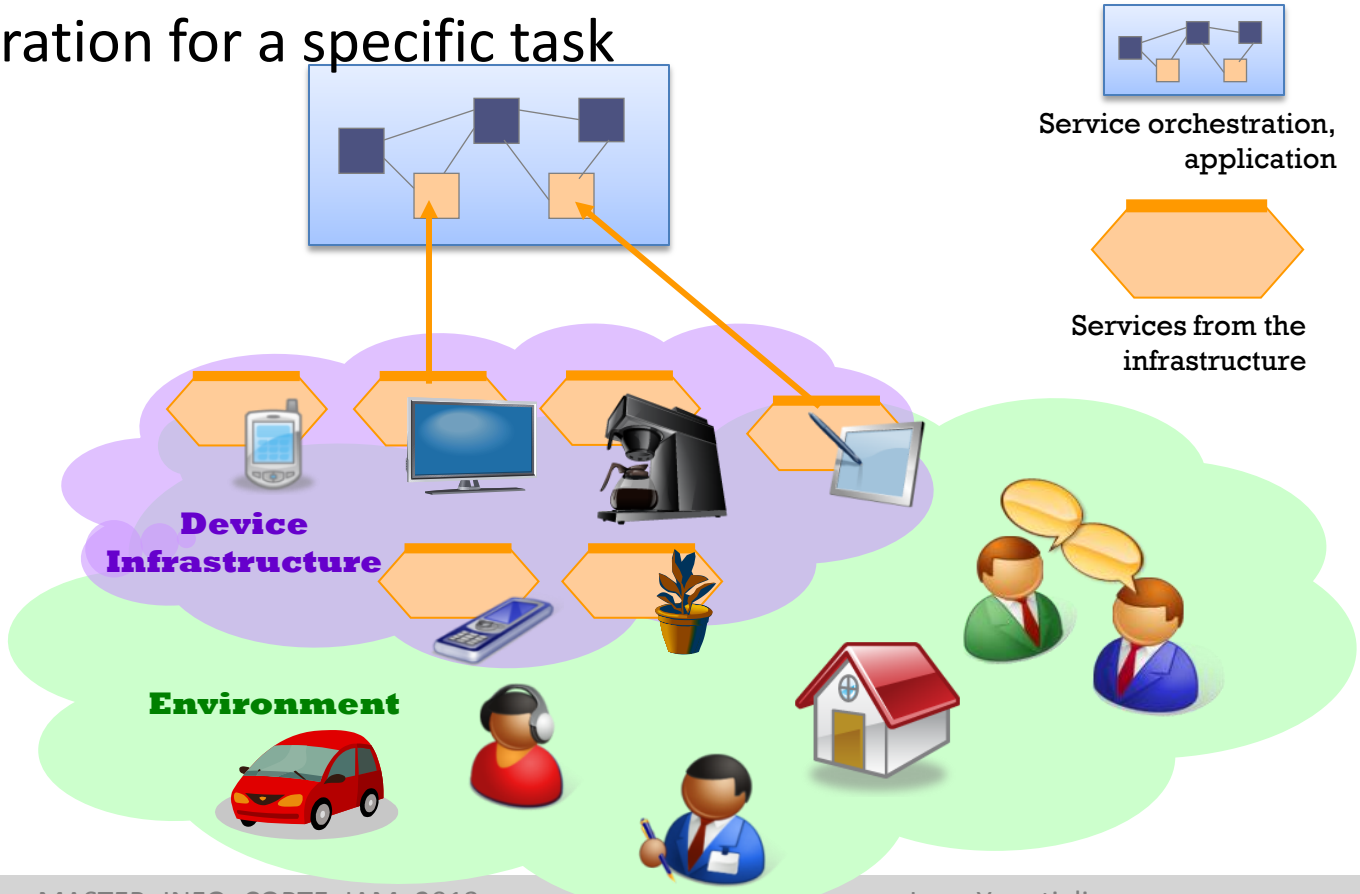
A way to dynamicaly compose services

SLCA Model

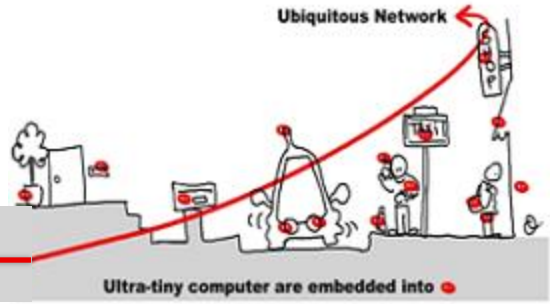
LCA to compose services for Devices



- Lightweight Component Architecture to create service-based orchestration for a specific task

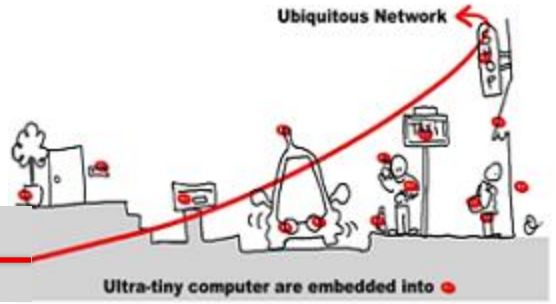


WComp and Local Composition (LCA)



- Main requirements for ubiquituous computing :
  - Composition must be event based
  - At runtime ….
- Solution :
  - Event based Local Composition : LCA (Lightweight Component Model) for each application execution node.

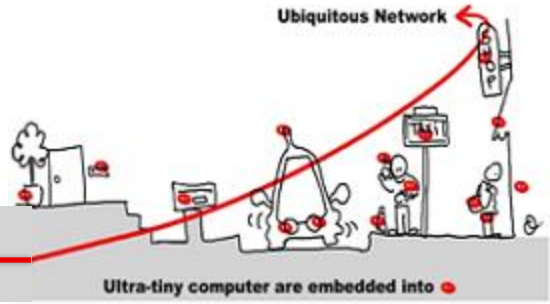
Main Features of LCA Model :



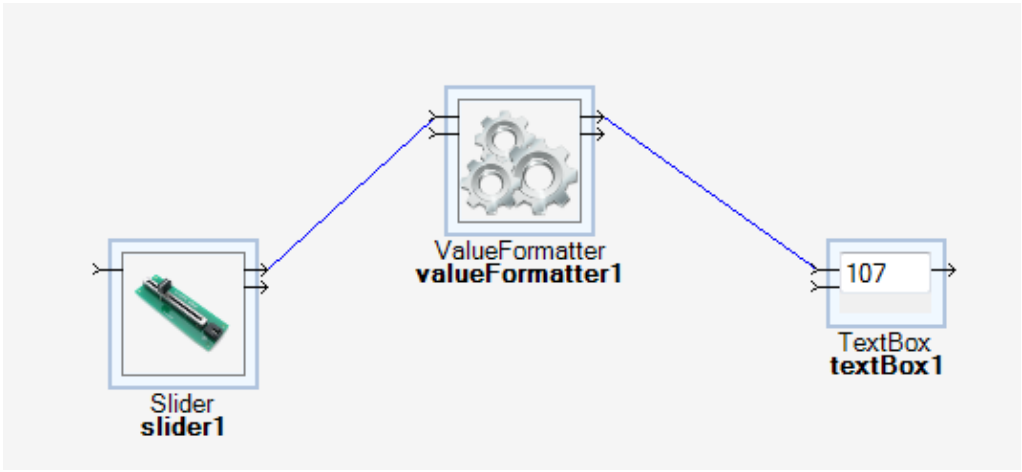
- Goal :
  - Allow to compose Services for Device between them towards a multiple devices ubiquitous application.

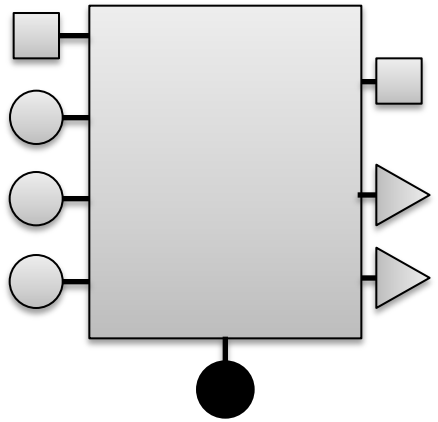
- Principles
  - LightWeight Components Approach :
    - Like OpenCom, JavaBeans, PicoContainer
  - On the same execution node
  - For each execution node, a container dynamically manage the assembly of components
  - Event-based interaction between components
  - Blackbox LightWeight Components

LCA, Bean WComp and ports



- Demo



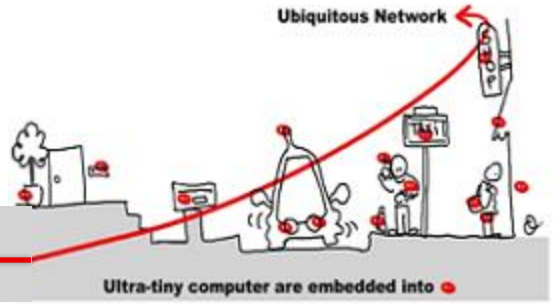


Property

Method

Event source

BeanWComp .Net template



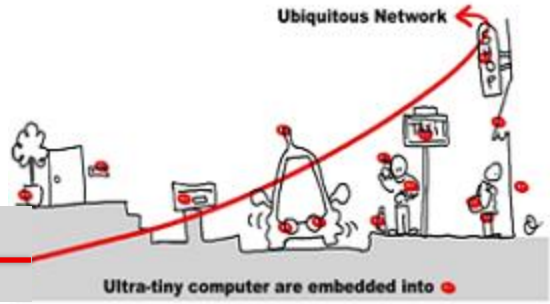
- Events are based on « delegate » model (in C#)

Category

Event

```
using System;
using System.ComponentModel;
using WComp.Beans;

namespace Bean4
{
    /// <summary>
    /// Description rsume de Class1.
    /// </summary>
   [Bean(Category="MyCategory")]

    public class Class1
    {

// delegate implicite de void EventHandler(object sender, EventArgs e)

public event EventHandler MyEvent;

// graphiquement ce qui sera fait  :
// MyEvent += new EventHandler(func)
// avec private void func(object sender, EventArgs e)
```

BeanWComp .Net template

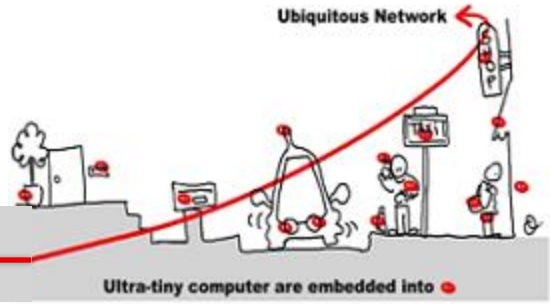


- Propriétés

Property

```
…

// Nom de la propriété avec minuscule

// variable de sauvegarde propriété

      protected int myprop = 1;

            //meta donnée : valeur par défaut propriété
            [DefaultValue(1)]

// déclaration propriété : public <type> Nom
            public int Myprop
            {
                  get
                  {
                        return myprop;
                  }

                  set
                  {
                        if (myprop < 1)
                        {
                              throw new ArgumentException("positif !");
                        }
                        // mot clef value
                        myprop = value;
                  }
            }
…
```

BeanWComp .Net template

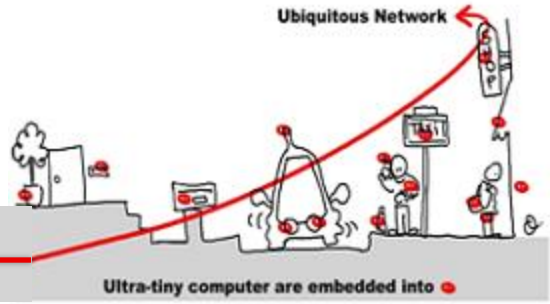


- Méthodes

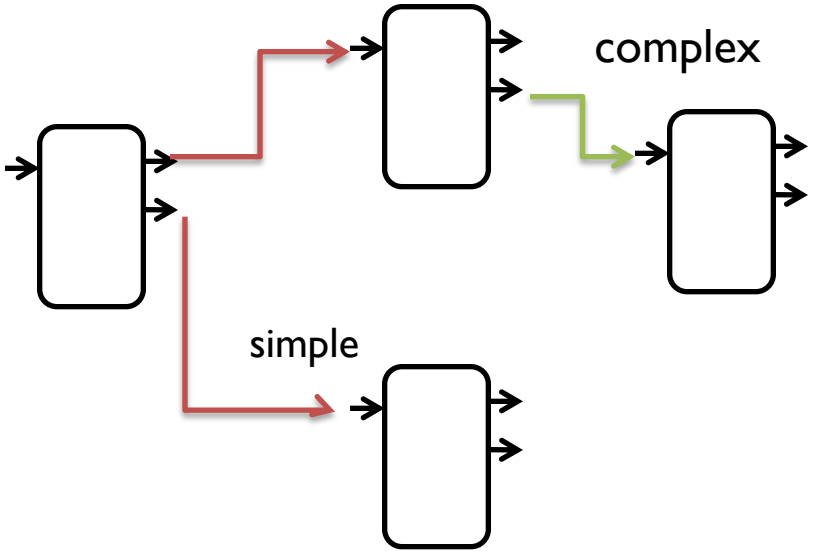
Method

```
// méthodes

            public void MyStep(int val1, int val2)
            {
                  if (myprop >= max)
                  {
                        myprop=1;
                        MyEvent(this, null);
                  }
                  else
                        myprop++;
      }
```

LCA, connectors



- Demo
- (Generated source code)



Connectors

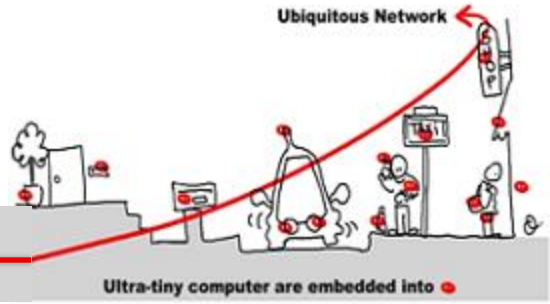
Simple Event based Connector

C1.Event (param) → C2.Method (param)

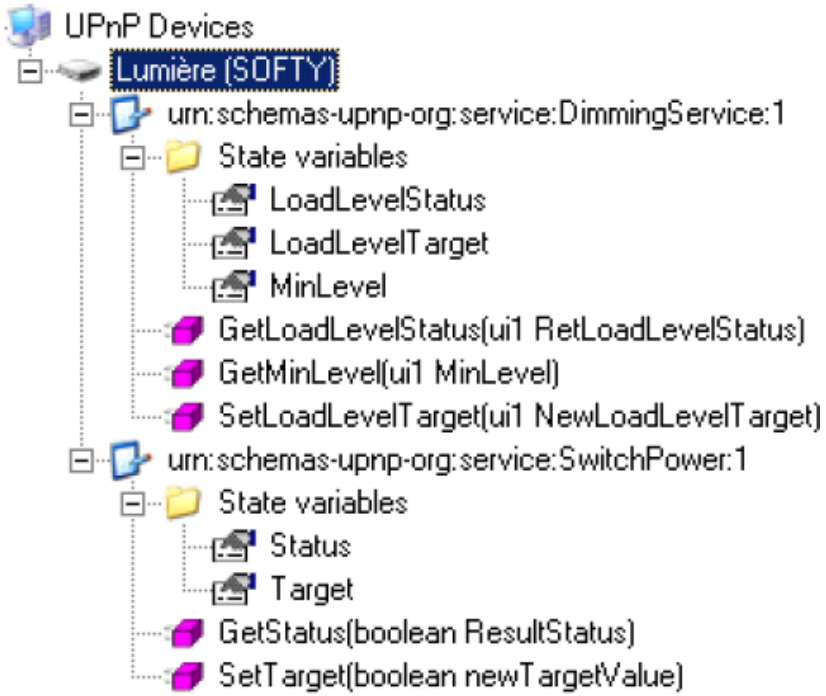
Complex Event based Connector

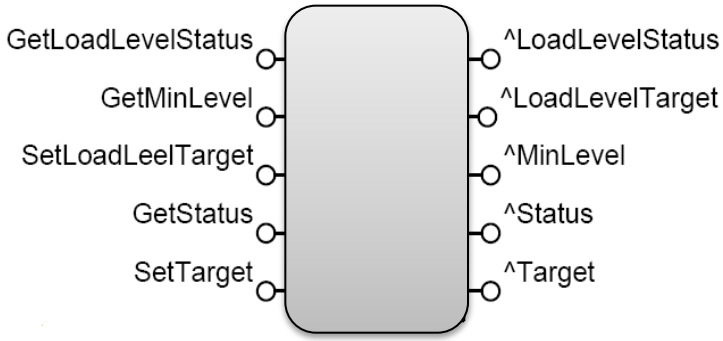
C1.Event (param) → C2.Method (C1.GetAProperty())

LCA Proxy components to access to Services for Devices

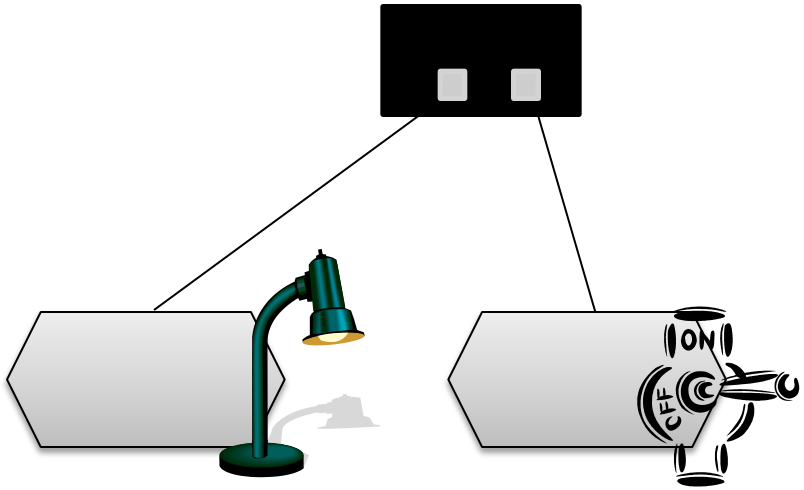


- Demo

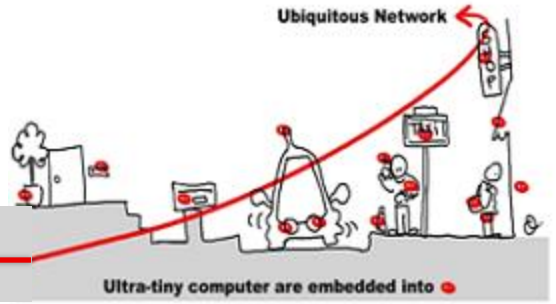




Proxy Component



Service for Device

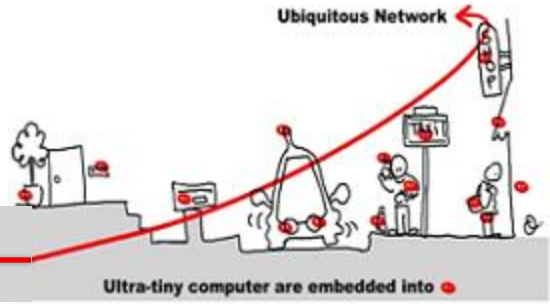


CNS 3260

C# .NET Software Development

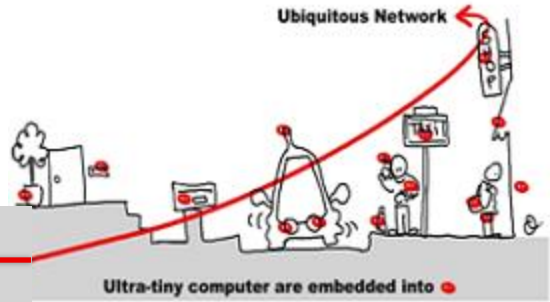
ANNEX DELEGATES AND EVENTS IN C#

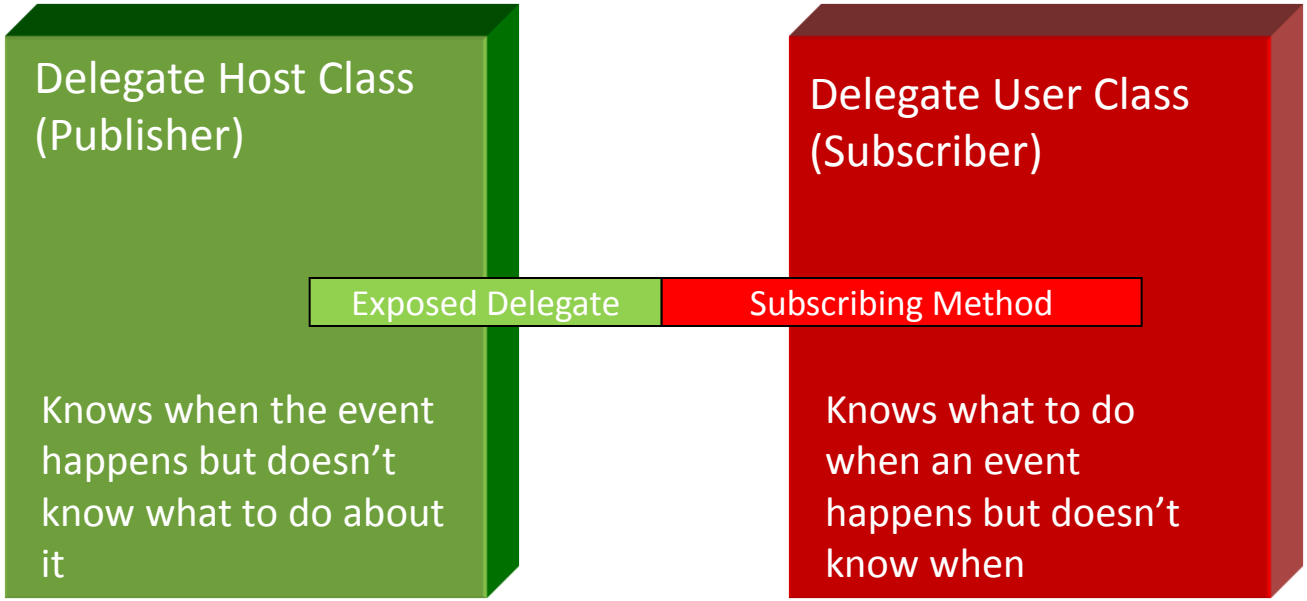
Delegate types



- A delegate declaration defines a new type
- Delegates are similar to function pointers
- Delegate types are derived from System.MulticastDelegate

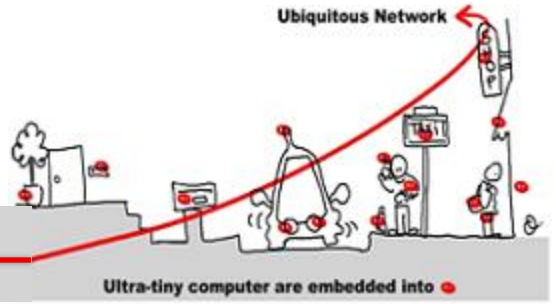
Simple Delegate Command Pattern





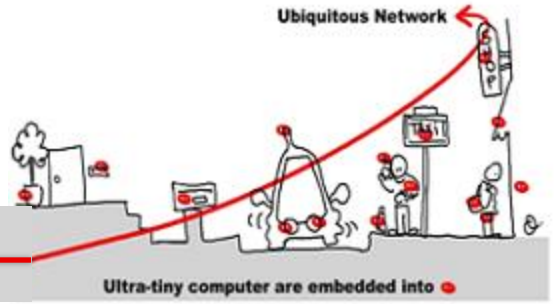
The Observer Pattern or .NET Event Model

Two reasons to use Delegates



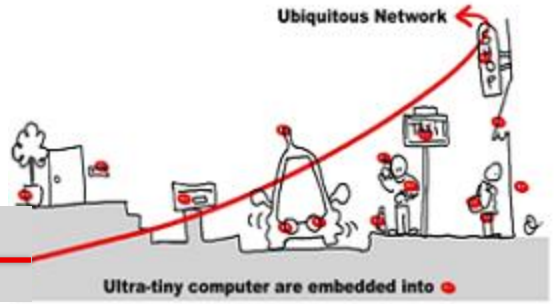
- When you're not sure what should happen when an event occurs
  - GUI events
  - Threading situations
  - Callbacks
  - Command Pattern
- To keep your interface clean
  - Looser coupling

Defining and using Delegates



- three steps:
  - Declaration
  - Instantiation
  - Invocation

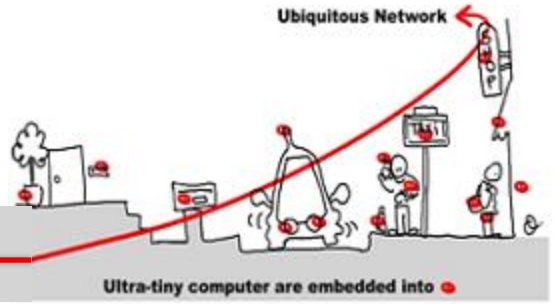
Delegate Declaration



- namespace some_namespace
- {
- delegate void MyDelegate(int x, int y);

Delegate Type Name

Delegate Instantiation

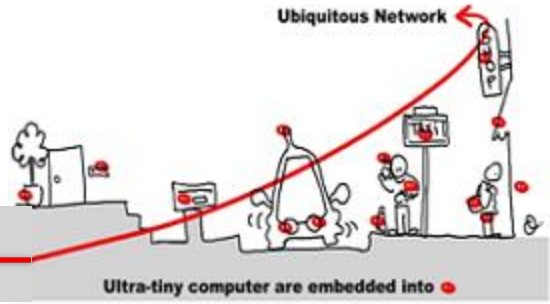



```
delegate void MyDelegate(int x, int y);

class MyClass
{
  private MyDelegate myDelegate = new MyDelegate( SomeFun );

  public static void SomeFun(int dx, int dy)
  {
  }
}
```

Invocation Method

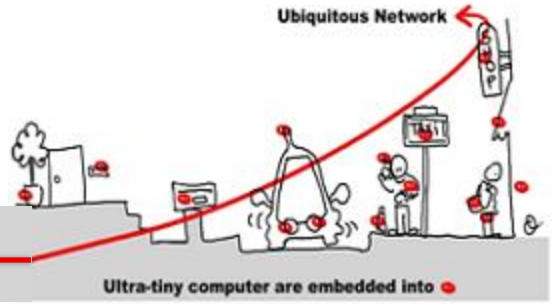
Invocation Method name (no params or perens)

Delegate-Method Compatibility



- A Method is compatible with a Delegate if
  - They have the same parameters
  - They have the same return type

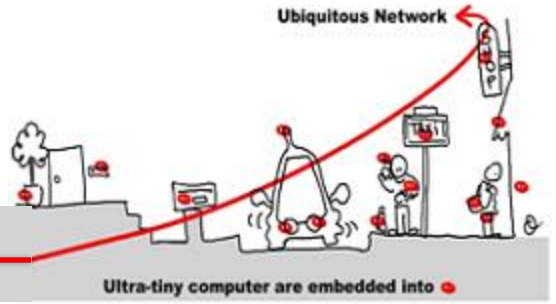
Delegate Invocation




```
class MyClass
{
   private MyDelegate myDelegate;

   public MyClass(MyDelegate myDelegate)
   {
      this.MyDelegate = myDelegate;
   }

   private void WorkerMethod()
   {
      int x = 500, y = 1450;

      if(myDelegate != null)
         myDelegate(x, y);
   }
}
```

Attempting to invoke a delegate instance whose value is null results in an exception of type *System.NullReferenceException*.

Delegate's "Multicast" Nature



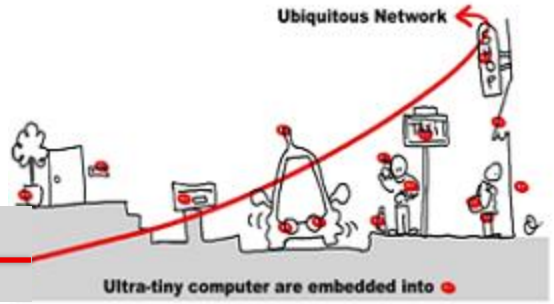
- Delegate is really an array of function pointers

```
mc.MyDelegate += new MyDelegate( mc.Method1 );
mc.MyDelegate += new MyDelegate( mc.Method2 );
mc.MyDelegate = mc.MyDelegate + new MyDelegate( mc.Method3 );
```

- Now when Invoked, mc.MyDelegate will execute all three Methods

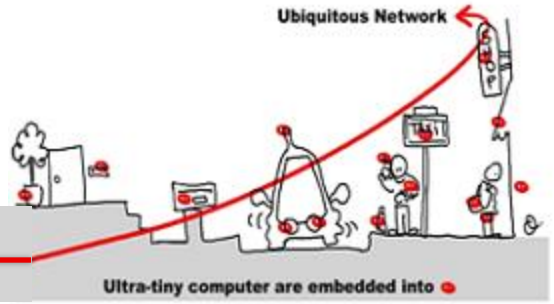
- Notice that you don't have to instantiate the delegate before using +=
  - The compiler does it for you when calling +=

The Invocation List



- Methods are executed in the order they are added
- Add methods with + and +=
- Remove methods with - and -=
  - Attempting to remove a method that does not exist is not an error
- Return value is whatever the last method returns
- A delegate may be present in the invocation list more than once
  - The delegate is executed as many times as it appears (in the appropriate order)
  - Removing a delegate that is present more than once removes only the last occurrence

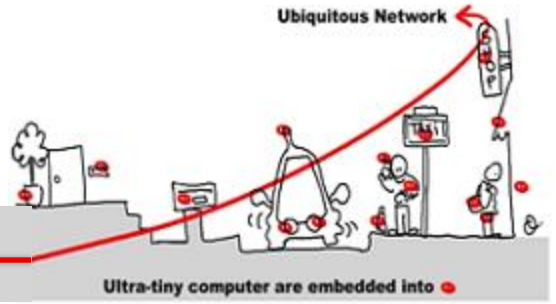
Multicast example




```
mc.MyDelegate = new MyDelegate( mc.Method1 );
mc.MyDelegate += new MyDelegate( mc.Method2 );
mc.MyDelegate = mc.MyDelegate + new MyDelegate( mc.Method3 );


// The call to:
mc.MyDelegate(0, 0);
// executes:

// mc.Method1
// mc.Method2
// mc.Method3
```

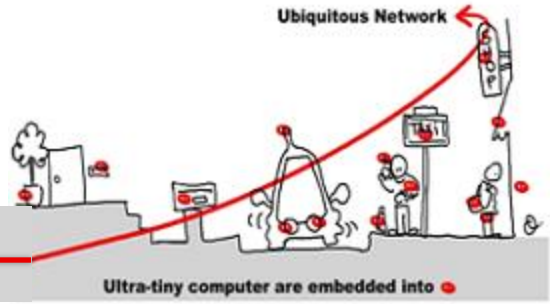
(See Delegates Demo)

Events



- Events are “safe” delegates
  - But they are delegates
- Restricts use of the delegate (event) to the target of a += or -= operation
  - No assignment
  - No invocation
  - No access of delegate members (like GetInvocation List)
- Allow for their own Exposure
  - Event Accessors

Event Accessors

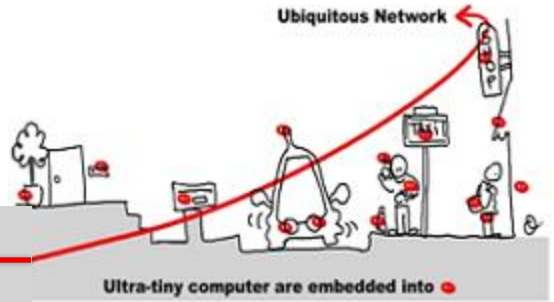



```
public delegate void FireThisEvent();
class MyEventWrapper
{
   private event FireThisEvent fireThisEvent;

   public void OnSomethingHappens()
   {
      if(fireThisEvent != null)
         fireThisEvent();
   }

   public event FireThisEvent FireThisEvent
   {
      add { fireThisEvent += value; }
      remove { fireThisEvent -= value; }
   }
}
```

add and remove keywords

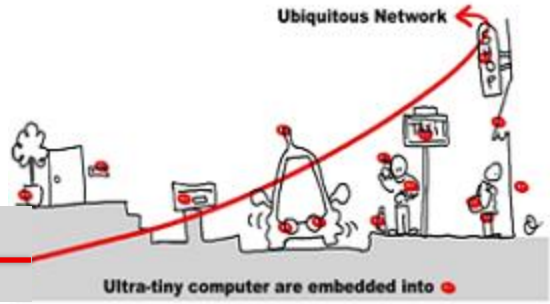
(See Event Demo)

Library Delegates



- ThreadStart
- TimerCallback
- ASyncCallback
- EventHandler
- KeyPressEventHandler
- KeyEventHandler
- etc.

References



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