Introduction to the .NET Micro Framework

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Julie Trygstad

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- BSc Computer Science, University of Durham, UK
- CompTIA Certified Technical Trainer
- Over 15 years of embedded software engineering experience
- TrygTech
  - High Performance Designs
  - Fast Time-To-Market
  - Low Development Costs
Renesas Technology & Solution Portfolio
Agenda

- Introduction
- Architecture
- Tools
- CLR
- User Interface
- Event Handling
- Features
- Lab Time
- Summary
Introduction - .NET Micro Framework

- VAVE50 Universal Remote Control
  - Controls up to 24 A/V devices
  - Learning
  - Large library of codes
  - Macros
  - Favorite Channels
  - Iconic
Local/Remote and Secured Web Access to the Streetlight Monitoring Web Applications

Administrator Web Portal providing Web applications for configuration
End-user web portal for monitoring, analysis, control, and remote commands

Data Collect and Web Services
Aggregate, filter, calculate, and store meaningful information in an open database (MySQL, Oracle, MS SQL Server)

Server Level
- Alarms
- Third-party Applications

Street Level
- SECURED VPN NETWORK
- GPRS, ADSL, WI-FI, or WIMAX

Streetlight Central Database

Hundreds of Streetlight Segment Controllers
- LONWORKS-compatible
- in each streetlight (max 150 per Segment Controller)
- driving Electronic Dimmable Ballasts or Magnetic Ballast
- Astro clock
- Schedulers
- Alarms
- Data sending
- Get/Set points
- Groups

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Innovation

- Use intelligence from the smart grid and home sensors to:
  - Take advantage of “time-of-use” pricing
  - Lower overall energy demand
  - Integrate green energy sources
.NET Micro Framework

- Embedded applications using Visual Studio and C#
- Large pool of existing .NET developers
- Rapid Prototyping
- Focused on being small and efficient while in a managed code environment
Architecture

Application Layer

User Applications & Libraries

ClassLibrary Layer

Libraries

Managed

CLR

Execution Engine
Type System
Garbage Collector
Interop

Native

Runtime Component Layer

PAL

Timers
RAM
I/O

Hardware Layer

HAL

Drivers

or

OS

Facilities

Processor & Peripherals
Architecture

User Code

System Libraries
Architecture

User Code

System Libraries

WPF

CLR

TinyCLR

HAL
Trying .NET MF is as easy as....

1. Download SDK
2. Get hardware
3. Get porting kit
Tools and Development Environment

- Visual Studio 2010
- .NETMF SDK
- The .NETMF Porting Kit
- HEW Tools
Using the CLR

- Numeric Types
- Class Types
- Value Types
- Arrays
- Delegates
- Events
- References
- Weak References
User Interface

- WPF
- Input
- Presentation
- Presentation.Controls
- Presentation.Media
- Presentation.Shapes
User Interface Controls

- StackPanel
- Canvas
- Brushes
- Borders
- Shapes
- Text
Button Handling

- UIElement virtual methods:
  - OnButtonUp
  - OnButtonDown
- e.Handled = true;
Porting Kit

- TinyBoofter
- PortBoofter
- NativeSample
- TinyCLR
Porting Kit

**Application Layer**

**User Applications & Libraries**

**ClassLibrary Layer**

**Libraries**
- .NET
- WPF
- Comms
- ...

**CLR**
- Execution Engine
- Type System
- Garbage Collector
- Interop

**Runtime Component Layer**

**PAL**
- Timers
- RAM
- I/O

**HAL**
- Drivers

**Hardware Layer**

**Processor & Peripherals**

**Managed**

**Native**

**OS**
- Facilities
MSBuild

- <Assemblyname>.PE
- <SPOClient>Solutions\SH7264_RSK.settings
- Dotnetmf.proj
- <AssemblyName>.FeatureProj
HEW Tools

- High-performance Embedded Workshop
- GUI-based development environment
- E10A-USB Emulator support
.NET Micro Framework Features

- Networking
- Wireless
- Two TCP/IP stacks:
  - RTIP
  - lwIP
- XML
DPWS

- Messaging
- Discovery
- Description
- Eventing
Renesas

- SH7264 RSK
- Ethernet
- VGA
- Touch screen
Lab Time!

- Please refer to the Lab Handout and let’s get started!

**LAB PROCEDURE**

**Introduction to the .NET Micro Framework**

**Description:** The .NET Micro Framework (NETMF) extends the .NET programming model to embedded devices. This allows embedded developers to take advantage of desktop application tools and enables current .NET developers to now work on devices.

This lab introduces the .NET Micro Framework concepts and shows examples of working at both the application level and the hardware level.

**Skill Level**
1. Intermediate
2. You should have some familiarity with the Microsoft .NET Framework and Visual Studio environment
3. Programming experience with C++, C# or other object oriented language

**Lab Materials**
- Please verify you have the following materials at your lab station
  - Microsoft Visual Studio 2010 Professional Edition
  - .NET Micro Framework Platform SDK
  - .NET Micro Framework Porting Kit
  - Renesas High-performance Embedded Workshop
  - SH72x4
  - Power Cord
  - Serial Cable
  - Ethernet Cable

**Time to Complete Lab**
4 hours
Summary

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- Architecture
- Tools
- CLR
- User Interface
- Event Handling
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- Lab Time
- Summary
Further Reading

- **Expert .NET Micro Framework**, Jens Kühner
  - ISBN: 1430223870

- **Embedded Programming with the Microsoft .NET Micro Framework**, Donald Thompson
  - ISBN: 0735623651
Websites

- http://www.netmf.com
- http://renesasrulz.com
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