A Flexible and Testable Software Architecture

PCaPAC 2012, Kolkata, India

Andreas Beckmann

European XFEL GmbH

andreas.beckmann@xfel.eu

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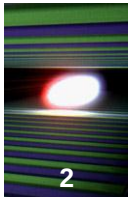
Outline



- Motivation
- Applying Presenter First
  - Technical Background
  - Presenter First
  - Example: Device Server
  - First Experience
- Summary

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Motivation

- Testability
  - System level tests are problematic
    - → Require complete system environment
    - → Difficult to test corner cases
    - → Testing is a manual task
  - Unit level tests are better
    - → Require simple test environment
    - → Easy to generate all kind of stimuli
    - → Testing is automated
- Flexibility
  - Allow integration into any machine control system
  - Allow exchange of message layer

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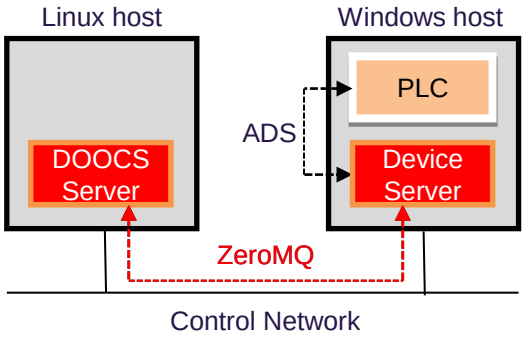
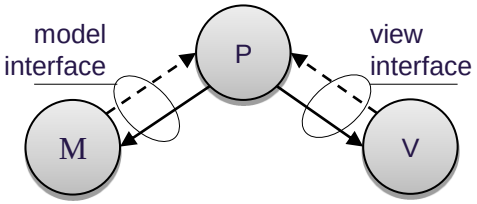
Technical Background

- DOOCS Server
  - Interfaces to machine control
  - Runs on a Linux host
- Device Server
  - Interfaces to PLC
  - Runs on a Windows host
- Data Exchange with ZeroMQ messages
  - More convenient to use than plain sockets
  - Two schemes:
    - Exchange on request (request/response scheme)
    - Exchange on value change (publish/subscribe scheme)

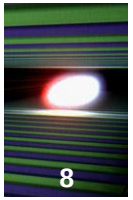


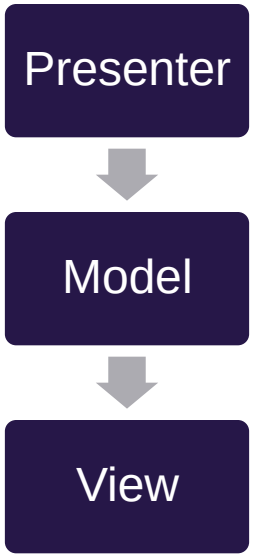
Presenter First



- Pattern
  - Presented in 2006 by Atomic Objects
  - Variant of MVP design pattern
    - MVP invented by Taligent as a generalized MVC
  - Components:
    - **M**odel: manages application data and logic
    - **V**iew: interacts with the environment
    - **P**resenter: represents the behaviour of the application
  - Communication over defined interfaces
    - Essential for unit testing => Testability
  - No connection between model and view (!)
    - Simplifies exchange of view => Flexibility

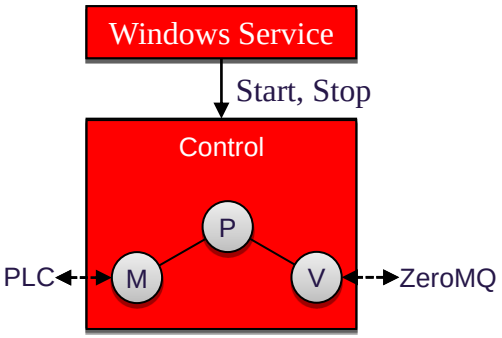
Presenter First (contd.)





- Process
  - Start with implementing the Presenter
    - Remember: "*Presenter represents the behaviour*"
    - Analyse the functional requirements
    - Define model and view interfaces
    - Unit test the presenter
  - Implement Model and View afterwards
    - Simply implement according to the just defined interfaces
    - Unit test the model
    - View is not unit testable, since it requires an environment

Example: Device Server



- Software Architecture
  - C# application run as a Windows Service
  - 2 main modules
    - ➔ Windows Service module
      - Integrates the Device Server into Windows Service Manager
      - Simply starts and stops the Control module
    - ➔ Control module
      - Instances MVP
      - Presenter waits on events from Model and View
        - » Model sends events when PLC variables change their value
        - » View sends events when ZeroMQ messages arrive

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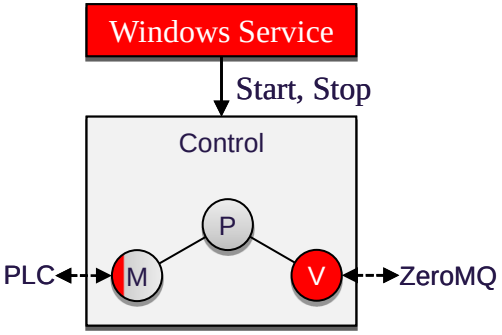
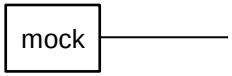
Example: Device Server (contd.)

- Applying Presenter First
  - Select a requirement
    - ➔ “The server shall respond to request messages received at the message interface”
  - Analyse the requirement
    - ➔ What is the impact on Model and View?
      - View indicates incoming message to Presenter
      - Presenter reads message from View
      - Presenter sends the message to the Model to process it
      - Model returns a response message
      - Presenter sends the response message to the View
    - ➔ Define interface events and methods

Example: Device Server (contd.)

- Testing
  - Unit level tests
    - Some parts cannot be unit tested
      - Windows Service module, View, part of Model
      - *Approx. 20% of the code due to complex View*
    - Testing the Presenter
      - Replace Model and View with mocks
      - Mocks verify interface methods calls
    - Testing the Model
      - Wrap (untestable) PLC interface into an adapter
      - Replace adapter with mock





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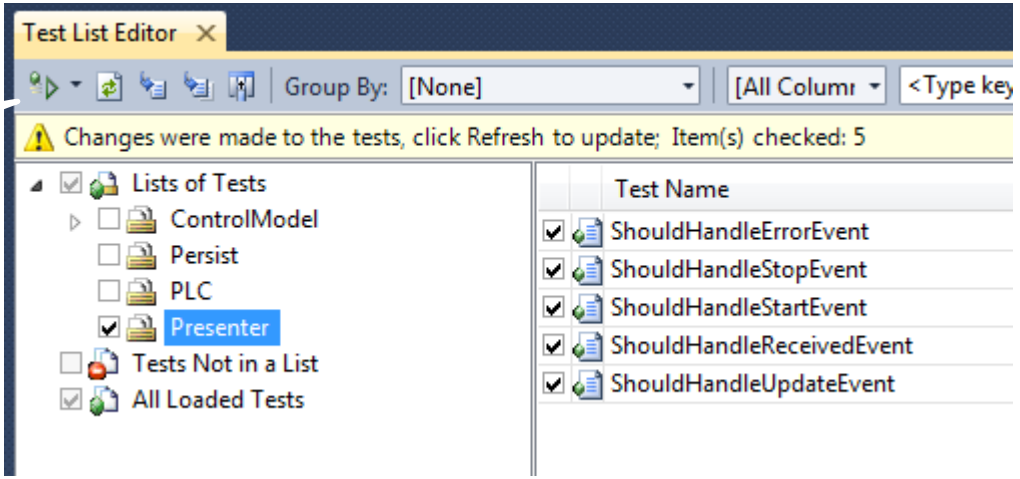
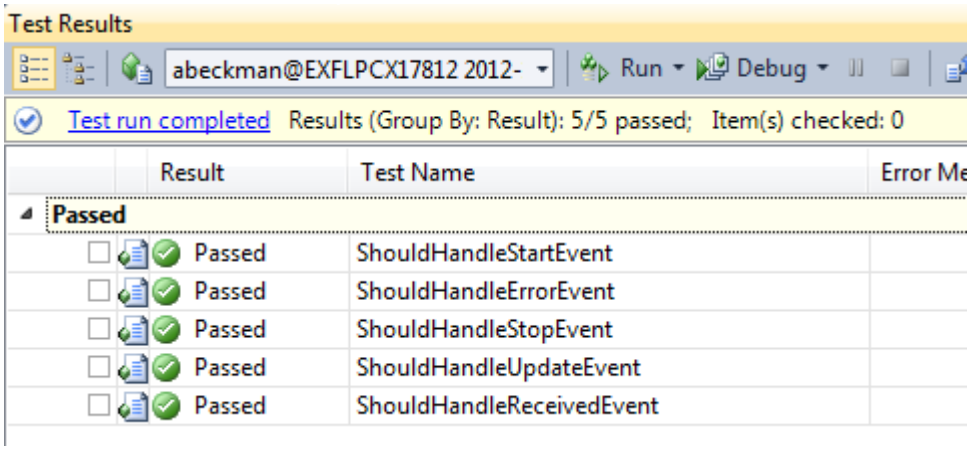
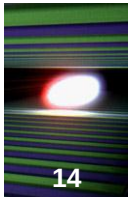
Example: Device Server (contd.)

- Testing (contd.)
  - Screenshots





Example: Device Server (contd.)



- Testing (contd.)
  - System Level tests
    - Install Device Server
    - Start Device Server
    - Test the system interactively using a DOOCS client
      - doocsput -t 2 -c XFEL/SASE1/UND01/GAP.SET -d 10.5
      - doocsget -c XFEL/SASE1/UND01/GAP
      - rpc_test

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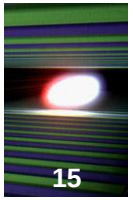
First Experience



- Initial effort to set up unit test environment
  - Required for test driven development
  - Essential for refactoring
- Reduced effort for commissioning
  - No extensive debugging on system level necessary
  - In principle “*just install and run*”
- Stable operation
  - Server runs for long time without failures
  - Reliable communication with DOOCS Server

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Summary

By using Presenter First, we got:

- Testable Software
  - Comprehensive use of unit level tests
    - ➔ Find bugs early
  - Implementation follows behaviour requirements
    - ➔ Reduce code complexity
- Flexible Software
  - Message layer code decoupled from application logic
    - ➔ Simplify exchange of message layer
  - *Device Server separated from DOOCS Server*
    - ➔ *Allow use of other machine control servers*

Thank you for your attention