Tutorial

Methodologies for Test-Driven Development of OSGi enabled Embedded Devices

Or .....

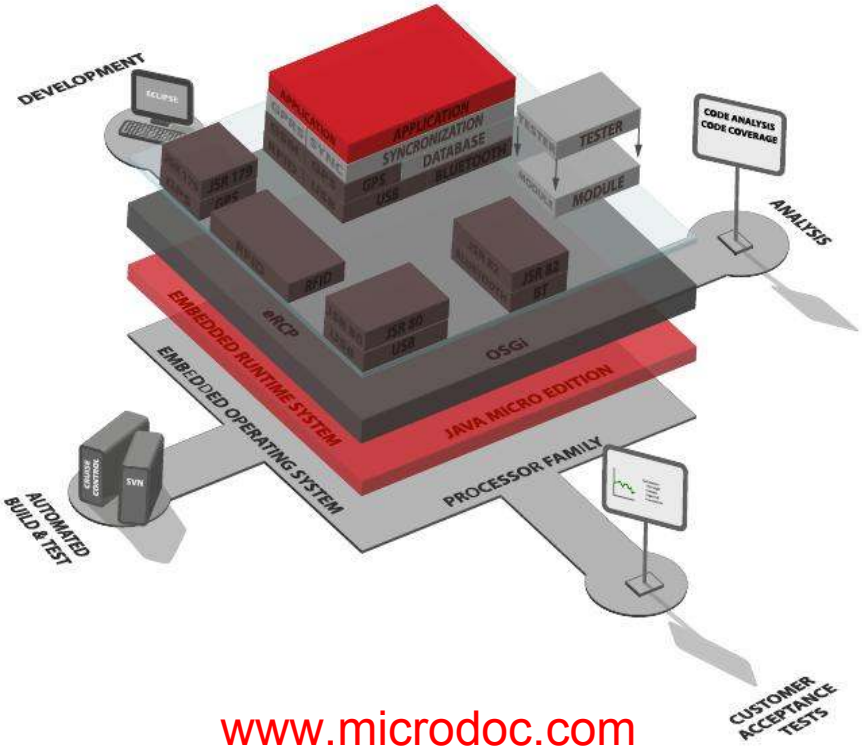
"How Fit is Your Device ?"

About the Tutorial

- The tutorial includes an overview, some real life examples, demos and hands-on excercises
- Requirements
  - Notebook
  - Java ME
  - Eclipse 3.3
  - Eclipse FitNesse Plug-In
- We provide the contents of the tutorial on CD-ROM and USB stick
  - Slides
  - PDF-Article
  - eFitNesse software

About us – **MicroDoc**

- Located in **Munich – Germany**
- **Test Driven Process Model** using Java and OSGi
- **Cross industry expertise**
  - Financial
  - Airline
  - Automation
  - Automotive
  - Logistics
  - IT
- First european business partner for **IBM's embedded Java platform**
  - Customized platform ports
  - Distribution and licensing for the IBM embedded product range.
- Active member of the
  - **Eclipse Foundation**
  - **Open Source Business Foundation**



www.microdoc.com

About our **partners** and **projects** in the embedded space

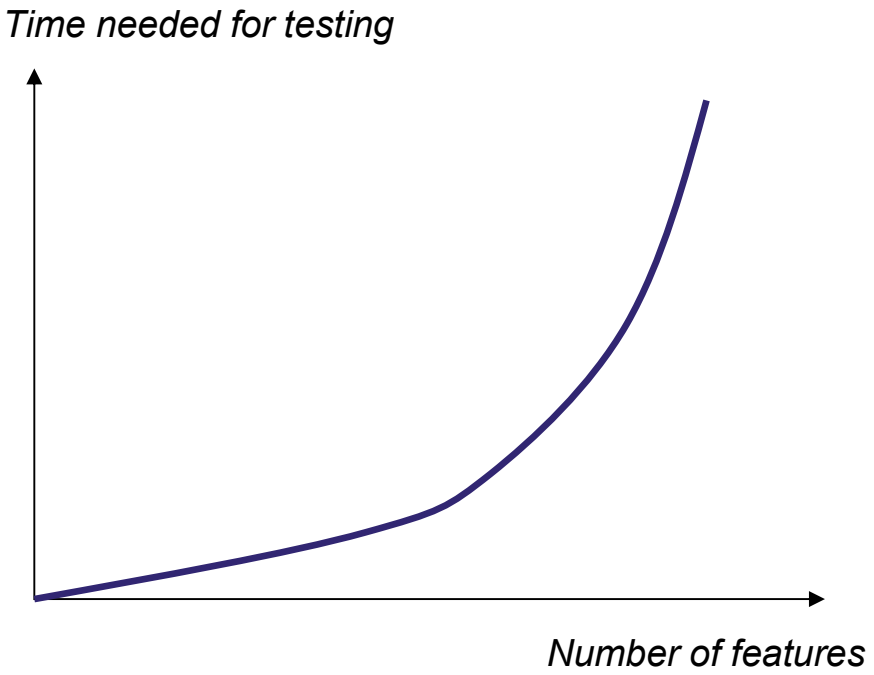
- IBM Business Partner
- AMD
- SKIDATA AG
- Daimler Fleetboard
- Lufthansa
- Trolltech
- Emlix
- Feig Electronic
- Banksys
- Gumstix

Challenges in Embedded Development

- Development environment versus runtime environment
- Device unit costs versus software development costs
- High end user expectations
- Bug fixing
  - much more complicated and expensive
  - no or minimal access to customer devices
- Requirements
  - High stablility and quality
  - Advanced requirements for recovery strategies
  - Remote update possibilities
  - Remote analyzing features

Our experiences in real-life projects

- Testing and Features
  - Exponential relation if testing is done manually
  - A lot of tests are performed manually on the embedded device.
  - Customers complain about time-consuming quality assurance
  - Customers tend to reduce full test coverage
  - Software quality suffers



Another experience in a real-life project

- Legacy Systems
  - Customer with a long-running embedded system in the area of access control systems
  - Grown legacy software with all known problems:
    - Hard to maintain/ extend
    - No testing possibilities besides manual testing
    - Each change leads to a quality risk
- Customer Decision
  - New software architecture → open source, OSGi
  - Focus on → changeability, maintainability, extendibility, testability
  - Introduction of → Agile methods, test-driven development

Need for a testing framework

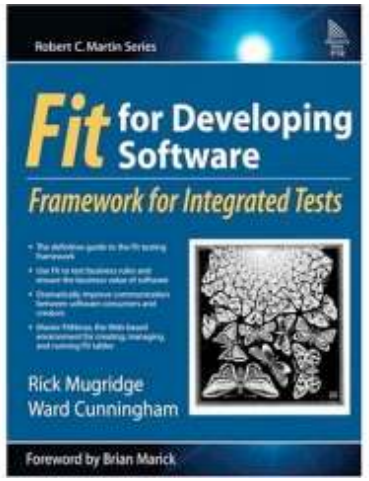
- Ideally usable for all testing layers
- Tests deployable and runnable on the target device
- Communication basis with the customer
  - Requirement specification (acceptance tests)
  - Bug reporting
  - Better understanding of business use cases
- Test automation support
  - Less manual test effort
  - Continuous testing
- Tests as application documentation
- Reduce time to market

Our Solution

- Story Tests / Acceptance Tests
  - Encourage your customer to define expectations and requirements as story tests
  - Clear communication through concrete examples
  - Business rules as executable tests
  - Implement story-driven / test-driven
  - Acceptance procedure = test verification
- Continuous Testing
  - Reduce Risk / Improve Software Quality
  - Test from a business perspective
  - Integration in a Continuous Build process
  - Test on the target platform / on the embedded device

FIT/FitNesse

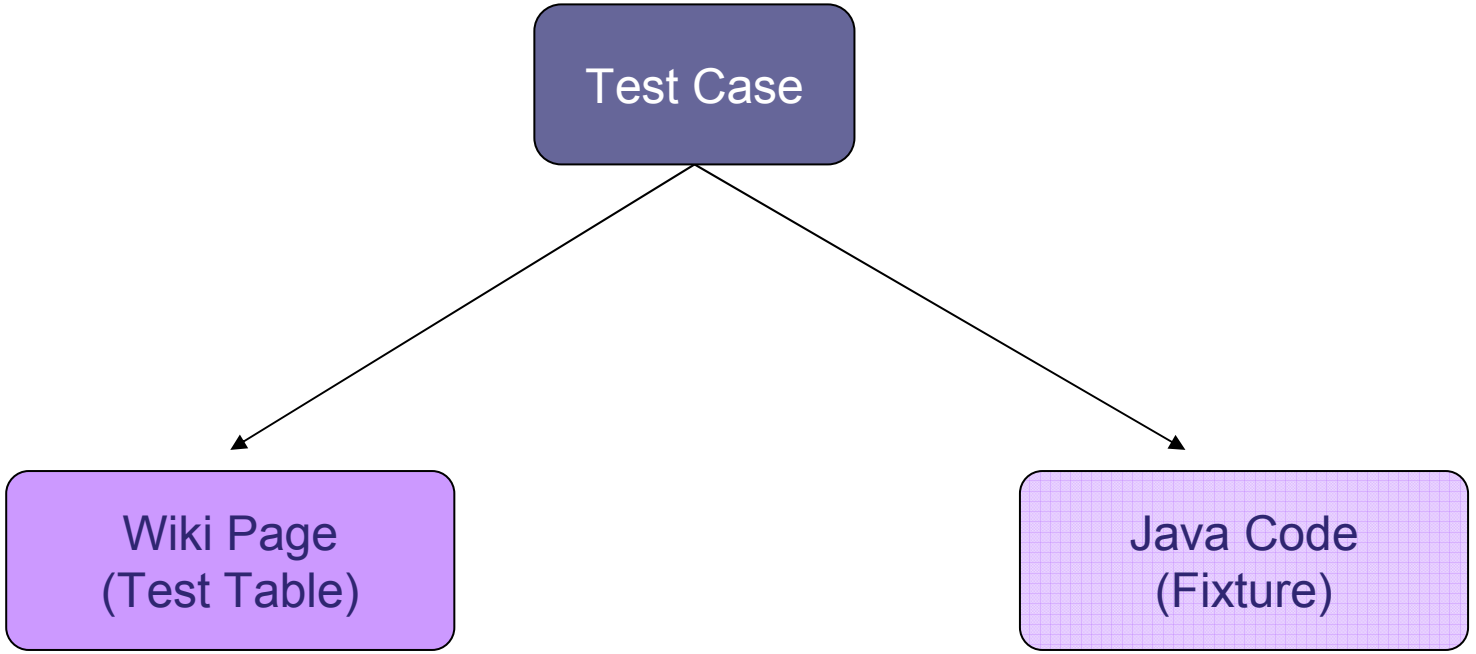
- FIT - Framework for Integrated Tests
  - captures business rules in a simple table format
- FitNesse
  - Collaborative Wiki for building and executing tests
  - Runs tests by reading HTML files, looks for tables, uses data in the tables to execute tests and compare results to expectations
  - Easy to learn Markup Language
- Business rules fall into two broad categories
  - Rules that calculate something or make decisions
  - Business process or workflow specification on how something gets done and what the outcomes should be



FitNesse – **Two Minute Example**

- **Test Case**
  - Test division of calculator application
  - Tests are expressed as table of:
    - **Input**
    - **Expected Output**
  - Input: numerator, denominator
  - Expected output: quotient
  - 10 : 2 = 5

FitNesse – **Two Minute Example**



FitNesse – **Two Minute Example**

- **Eclipse Setup**
  - Install BandXI FitNesse Plug-In
    - Eclipse Update Site: http://www.bandxi.com/fitnesse/
  - Create a new Project
  - Create source folder called "`src`"
    - Add FitNesse to project class path (right click -> FitNesse)
  - Create a wiki folder called "`FitnesseRoot`"
  - Configure the root directory of the FitNesse plugin
    - point to your "`FitNesseRoot`"
  - Start FitNesse Plug-In

FitNesse – **Two Minute Example**

- **Wiki page**
  - Edit wiki page and enter test table
  - Set page properties to “test”

FitNesse – **Two Minute Example**

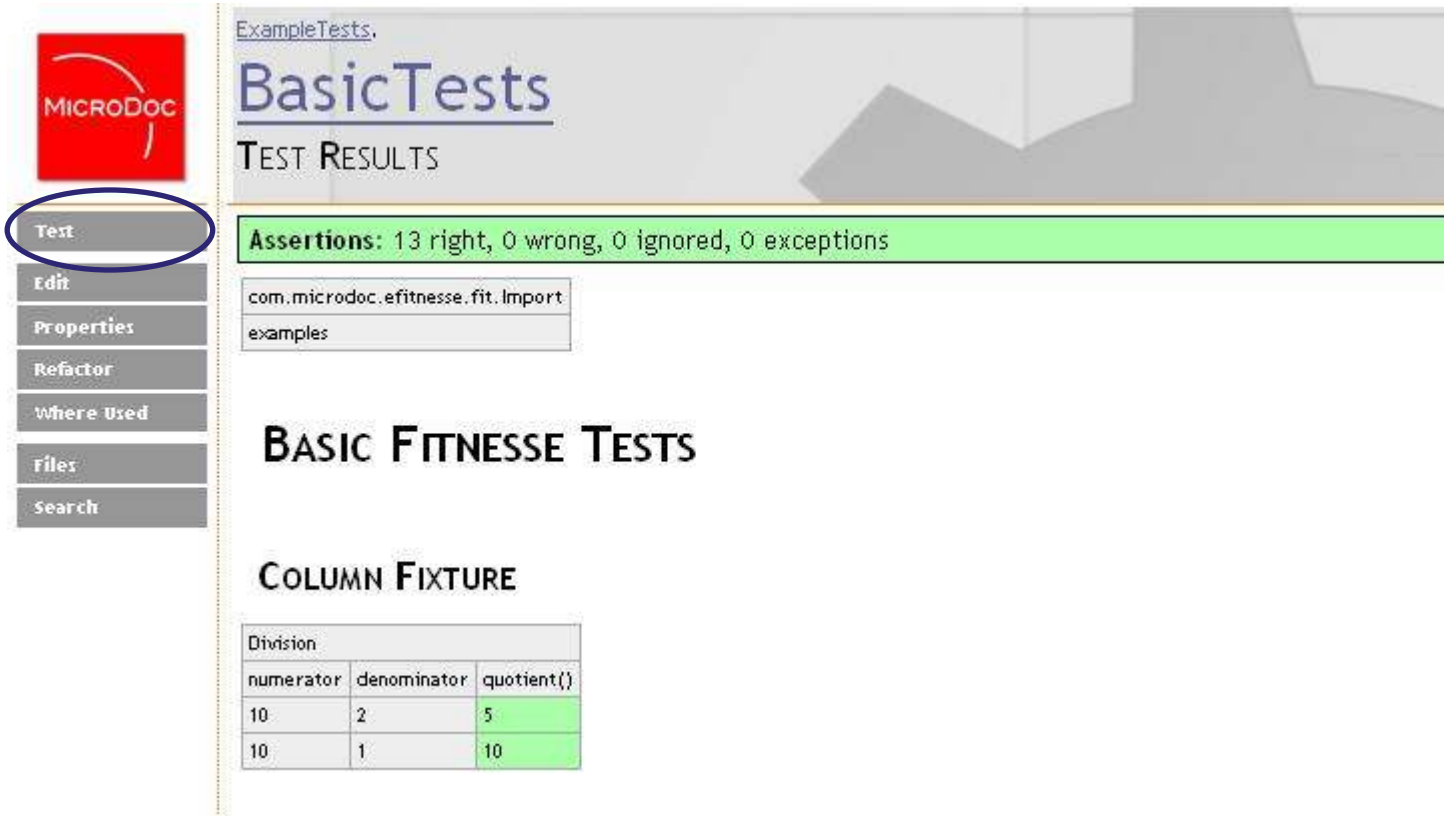
```
|examples.Division|
|numerator|denominator|quotient()|
|10|2|5|
|10|1|10|
```

Wiki Page
(Test Table)

```
package examples;
import com.microdoc.efitnesse.fit.ColumnFixture;

public class Division extends ColumnFixture {

  public double numerator, denominator;

  public double quotient() {
    return numerator/denominator;
  }
}
```

Java Code
(Fixture)

FitNesse – **Two Minute Example**



FitNesse – Wiki Pages

- Wikis, SubWikis
  - Page Properties, Refactoring Pages
  - PageHeader, PageFooter
  - SetUp, TearDown
- Useful built-in support
  - Index of contained subwiki pages: !contents
  - Include other pages: !include
  - Collapsable sections: !*****>
  - Variables: !define
  - Keyword support: null, blank, error

FitNesse – Basic Fixture Types

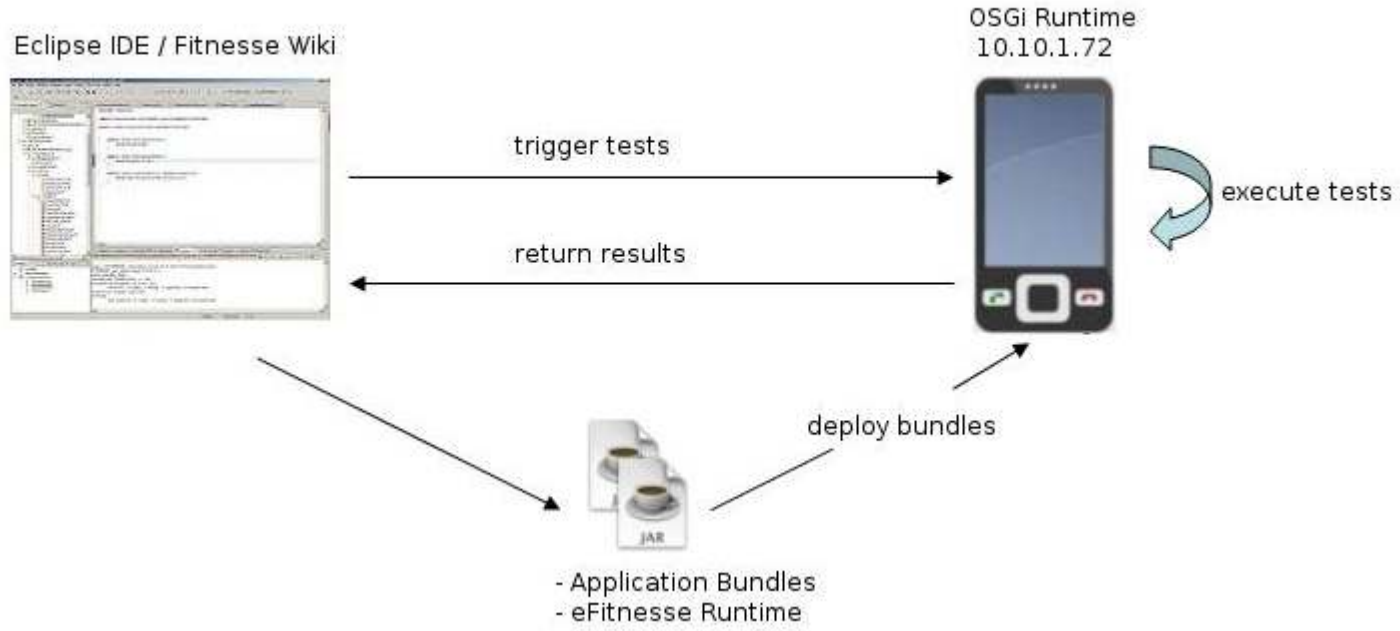
- ColumnFixture
  - Rows of data represent inputs and expected outputs — execute(), reset()
- RowFixture
  - Check the exact set of result objects of a query — missing / surplus-marker
- ActionFixture
  - Useful for emulating a series of events — start(), press(), check()

- Additional support in fixtures
  - Standard Java data types, Arrays
  - Parameters
  - Comparison expressions in numeric table cells

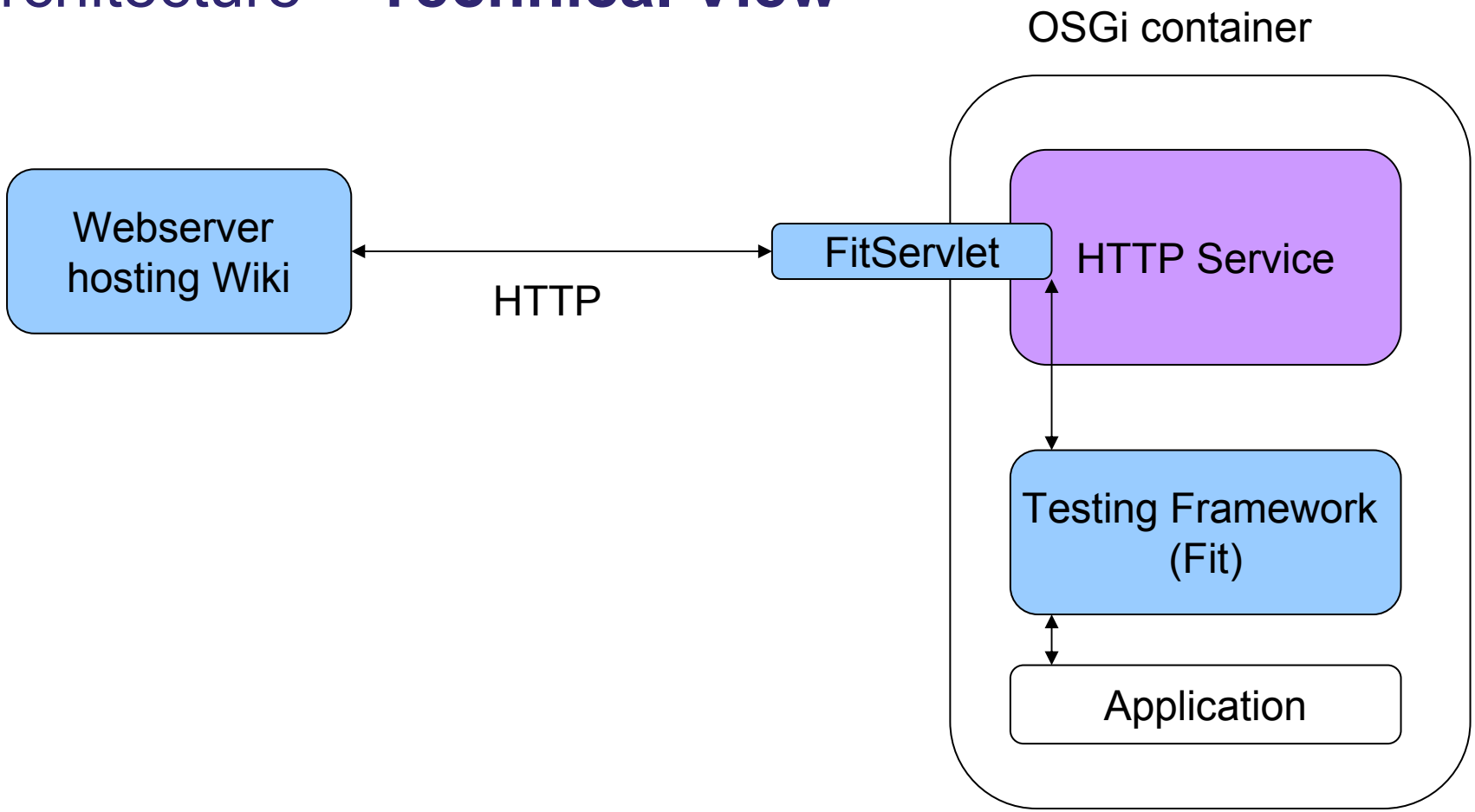
- Java Micro Edition
- OSGi Applications
- Remote Test Execution
- Remote Debugging

- System Analysis
- JUnit Test Cases
- Timeout behaviour

Architecture – **Developer‘s View**



Architecture – **Technical View**



Extended Features – **QueryRowFixture**

- Extended RowFixture
  - Assertion mode (default behaviour)
  - Query/Analyze mode (argument „query“)
- Fixtures already available for analysis of
  - OSGi bundles
  - OSGi services
  - System properties

com.microdoc.efitnesse.fitnesse.fixtures.analyze.bundles.ListFrameworkBundles		
id()	description()	state()
0	org.eclipse.osgi	ACTIVE
1	org.eclipse.osgi.services	ACTIVE
3	org.eclipse.equinox.http.servlet	ACTIVE
4	javax.servlet	ACTIVE
5	org.eclipse.equinox.http	ACTIVE
6	com.microdoc.eFitnesse	ACTIVE

Extended Feature – **JUnitFixture**

- Generic fixture to run JUnit Tests within FitNesse
- Advantage:
  - One user interface for different test levels

com.microdoc.efitnesse.fitnesse.fixtures.junit.JUnitFixture	examples.SimpleTestCase	
getTestCase()	getFailures()	getErrors()
testSimpleTrue	-	-
testException *failed*	-	testException(examples.SimpleTestCase): My Exception
testSimpleFalse *failed*	testSimpleFalse(examples.SimpleTestCase): expected:<77> but was:<88>	-

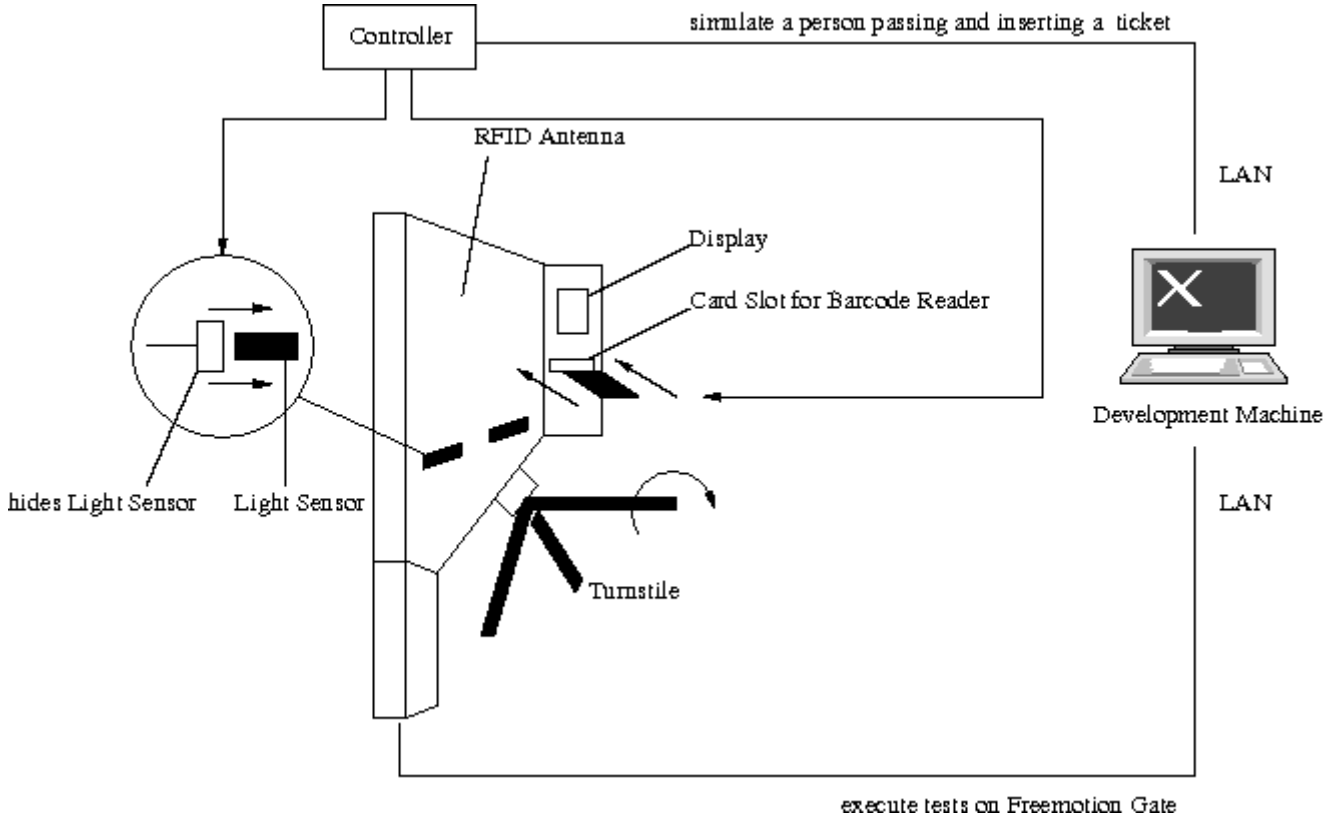
Extended Feature – **TimeoutColumnFixture**

- Extends ColumnFixture
- Abstract superclass for userdefined fixtures
  - Waits for the expected results within a distinct timeout interval without canceling the test
  - Redos assertion of the results until the assertion is passed or the max timeout is reached
  - The interval between two assertions is configurable
- Useful for
  - Asynchronous operations
  - Slow devices
  - Device specific delays

Demo 1: **Automated Tests**

- **SKIDATA AG** www.skidata.com
- Access Control Systems
  - Several thousands of access transactions per day
- Methodology was adopted within the customer‘s QA department
- Used for automated regression tests

Demo 1: **Automated Tests (cont'd)**



Demo 2: **GUI Testing**

- FleetBoard DispoPilot http://www.fleetboard.com
- Automatic GUI Testing
  - GUI Fixtures with timeout behaviour
    - Edit
    - Button-Cick
    - Hardkey-Click
    - Select
    - Assert Pages, Dialogs
  - Test Recorder Tool
  - GUI Analyze Feature

Demo 3: **Hands-On**

- Embedded Devices
  - Gumstix device
  - Windows Mobile Smartphone
- Software
  - eFitNesse including runtime, documentation, wiki, and examples

Outlook

- Continuous Build Integration
- Wiki improvements
  - Extended Keywords
  - Embedded HTML, PHP
  - Flash

Useful Links

- **Technical Paper – eFitnesse**
  - http://www.microdoc.com/efitnesse
- **FitNesse Testing Framework**
  - http://fitnesse.org
- **Patang Testing Framework**
  - http://patang.sourceforge.net
- **Eclipse FitNesse Plug-In**
  - http://www.bandxi.com/fitnesse/index.html
- **General information about embedded Java and OSGi**
  - http://www.microdoc.com/
- **Custom Embedded Java Virtual Machines**
  - **http://www.microdoc.com/microdoc/products**

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