Model-based Testing @ Telekom. Lessons learned from a R&D transfer project.

MBTUC Keynote, Berlin, October 2011.
Introduction – IT Deutschland & T-Labs.
Operating Segment Germany.

Operating Segment Germany

- Integrated market approach with fixed line and mobile

Facts

Employees Q1 2010: 80,729

Customers / Partners

- Over 26M fixed line connections
- Over 11M broadband connections
- Market leader in mobile: Over 39M cell phone customers
- Market share in the DSL new customer business in Germany: 45%
- Over 1 million Entertain Packages marketed
- Revenue from mobile data: Near €1B

Highlights

- IPTV offering with over 120 channels, 10,000 items in TV archive and online video store – a thousand of them in HD quality
- LIGA total! – all games of German Bundesliga in HD
- Mobile TV
- Exclusive partner of Apple iPhone
- Market launch of 1st Android-Phone T-Mobile G1
- Deutschland LAN: comprehensive communication solution for connect worked in the office and on the road

IT Deutschland in Numbers.

2851 Employees

533 IT Applications

500+ Projects

Effective August, 28th 2010
T-Labs – The best of three worlds as a long-term success factor for Deutsche Telekom.

Network of international partnerships with prestigious research institutes, universities, industrial partners and start-ups.

**Applied science**
- 6 professorships
- 180 high-profile researchers and students from around the globe

**Leading edge competence:**
- 1 publication per day
- 1 award per month, e.g. Leibniz-Award 2011, Scientific Award of Deutscher Marketing-Verband 2008, Award for Outstanding Publications of ITG im VDI
- 1 patent per week

**Innovation development**
- Focus on 7 key topics
- 180 Telekom experts

**Impact orientation:**
- Results of R&I projects are base of numerous current and upcoming product and services of Telekom, e.g. Mobile wallet, IPTV features, IVR, FTTH/traffic modelling, etc.
- Creation of an innovative IPR portfolio leading to e.g. 8% terminal license cost for LTE as compared to 30 % for UMTS.

**T-Labs with early launch capability**
- Start-up network in Berlin, Silicon Valley and Israel
- Track record of 7 new ventures – QiSec, Spree, Zimory, YOUCHOOSE, wahwah, Schaltzeit
- Joint innovation with SAP, Bell Labs, Ericsson, BMW, etc.

**Start-ups & industry partners**

Telekom Innovation Laboratories.
Core T-Labs process and tools.
Diverse methods support value generation from R&I.

Idea generation

Selection

Execution

Transfer

Standard innovation tools
- Technology Foresight
- Stage-Gate Process
- Roadmapping
- Functional modules approach
- Portfolio Management
- Value Tracking

Open innovation tools
- Harnessing the R&D community
  - Idea competition
- Scientific advisory board
- University-industry collaborations
- Partnering networks
- Patents
- Awards

User driven innovation tools
- Ideation workshops
- Creation Center
- User clinics
- Test markets

Telekom Innovation Laboratories.
Agenda.
What will we talk about.

- IT Process and UML-based modelling at T-Deutschland
- Interest in MBT and R&D project with T-Labs
- Results, Insights and Future Plans regarding MBT at T-Deutschland
IT Process and UML-based modeling at T-Deutschland.
Overview of T-UML Method.

- **Structured Approach**
  - **T-UML Method**
  - End-to-end modeling from processes to implementation.

- **Re-use**
  - Based on the Enterprise model, fed from projects.

- **Architectural Standards**
  - Support for Service-Oriented Architecture (SOA) and Business Object Models (BOM)
Overview IT Process Disciplines.
Process map.

<table>
<thead>
<tr>
<th>Strategy</th>
<th>IT Process Disciplines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ITS</td>
</tr>
<tr>
<td>IT Strategy</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Solution Delivery</th>
<th>Service Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>BPM</td>
<td>IM</td>
</tr>
<tr>
<td>Business Partner Management</td>
<td>Incident Management</td>
</tr>
<tr>
<td>RRM</td>
<td>CAM</td>
</tr>
<tr>
<td>Roadmap &amp; Release Management</td>
<td>Capacity Management</td>
</tr>
<tr>
<td>BSD</td>
<td>PRM</td>
</tr>
<tr>
<td>Business Solution Design</td>
<td>Problem Management</td>
</tr>
<tr>
<td>SDD</td>
<td>AVM</td>
</tr>
<tr>
<td>System Design &amp; Development</td>
<td>Availability Management</td>
</tr>
<tr>
<td>STA</td>
<td>SLM</td>
</tr>
<tr>
<td>Solution Test &amp; Acceptance</td>
<td>Service Level Management</td>
</tr>
<tr>
<td>CHM</td>
<td>SCM</td>
</tr>
<tr>
<td>Change Management</td>
<td>Service Continuity Management</td>
</tr>
<tr>
<td>IS</td>
<td></td>
</tr>
<tr>
<td>Implementation Support</td>
<td></td>
</tr>
<tr>
<td>PMM</td>
<td></td>
</tr>
<tr>
<td>IT Process- &amp; Methodology Management</td>
<td></td>
</tr>
</tbody>
</table>
The T-UML method in the context of the IT process.

Use of UML notation to describe processes, interactions, systems and data.
Modeling scope in solution design.

- **Process**
  - BSD 1
  - BSD 2
  - BSD 3
  - SDD

- **Document**
  - Requirements Specification
  - Solution Specification
  - Functional IT system specification
  - Technical Specification

- **T-UML Method**

  - **Business Requirements**
    - Business Cases
    - Requirements regarding logical architecture
    - Requirements regarding business architecture
  - **Business Architecture** (Processes)
    - Business Use Cases
    - Project-specific BusinessObjectModel (PBOM)
  - **Logical Architecture** (Enterprise-wide business model)
    - Functional Service Portfolio
    - Req. for functional and business architecture
  - **System Landscape Architecture**
    - Involved IT systems and interfaces
  - **System Model**
    - System use cases and system processes
    - Interfaces (M-M and M-H)
    - Data model and system data
  - **System Design**
    - System Design
Interest in MBT and R&D project with T-Labs.
Examining Model-based Testing at Telekom Deutschland. Reasons and Goals.

**Opportunity**
Rollout of new IT Process and UML guidelines provided an anchor for Model-based approaches.

**How can MBT be integrated into existing IT practice?**

**Interest of Projects**
Individual projects were interested in earlier and more formalized involvement of testing.

- Earlier involvement of testing discipline
- Feedback for system specification
- Consistent derivation of test cases
Project Challenge. Transferring academic MBT knowledge into industry setting.

**MBT "by the book"**

- Functional Specification
- Functional Data Model
- Test Design
- Test Design Patterns
- Automated Test Code Generation
- Executable Test cases

**Integration into real-life setting**

- Support by Fraunhofer FOKUS' Motion team
- The have extensive knowledge about Model-based testing
- But: the approach is generic and needs to be adapted to specific setting
- Existing models, tools and practices need to be understood and considered

Organizing transfer between academia and industry (i.e. operational units of DTAG) is one aspect of T-Labs' mission.
Scope: Test Case Specification. Other projects work on test case usage and execution.
Interaction between system and test specification. Triggered for each milestone of the system specification.
Deliverables of the R&D project. Method and tool-support for MBT.
Process Analysis and Adaption. MBT method needs to be integrated into IT process and UML modelling guideline.

Where are test-relevant activities and roles? Do they need to be adapted?

Which model elements of the solution modelling are relevant for testing?
Modeling Method.
Milestones in system modeling trigger test modeling activities.
Screenshots.
Test modeling in MID Innovator, using DT-specific testing profile.
Results & Insights.
Get R&D results to product grade. What is there and what needs to be done for productive use of method and tools?

<table>
<thead>
<tr>
<th>Method</th>
<th>Comprehensive method for modeling test specification</th>
<th>Complete system model as reference</th>
<th>Training</th>
<th>Pilots</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model checking</td>
<td>Basic syntax check of test input models</td>
<td>Syntactic check of system models</td>
<td>Semantic check of system models</td>
<td>Check of test models before code generation</td>
</tr>
<tr>
<td>Transformations</td>
<td>All transformations for method are specified and as far as possible implemented</td>
<td>Implement remaining M2M transformations</td>
<td>Implement M2T transformations</td>
<td>Implement configurable transformations</td>
</tr>
<tr>
<td>Integration with other projects</td>
<td>UML Test meta model reflects needs of related test projects</td>
<td>Joint testing profile for all testing activities</td>
<td>Integrated modeling approach</td>
<td>Mapping of test results to models</td>
</tr>
</tbody>
</table>

Improve Usability
Outlook.
Implementation is not guaranteed.

Model-based Testing needs to show Return on Investment.

Finalizing development of a MBT approach for Telekom-Deutschland has to compete with all the other activities undertaken to improve testing.

"Best" Case: Company wide roll-out.
- Integration of solution specification
- But also: Possibility to work independently from solution specifications.
- Automation in all steps of the process.
- (Automated) quality gates for test model inputs and outputs.

"Worst" Case: No MBT in the near future.
- Involvement of Test-Manager in approval of early specification models can lead to value feedback regardless of MBT.
- Model-checking routines can be easily implemented to check general quality attributes of solution and test-models.
Jörg Hammer
Telekom Deutschland GmbH
Brückes 2-8, D-55545 Bad Kreuznach
Phone: +49 671 964 100
E-mail: joerg.hammer@telekom.de

Sören Blom
Telekom Innovation Laboratories
Ernst-Reuter-Platz 7, D-10587 Berlin
Phone: +49 30 8353 58 123
E-mail: soeren.blom@telekom.de