Evaluation of Model-Based Testing in 3G Mobile Networks
Software Development

Agile and Automated Testing Seminar
15.08.2006
Agenda

• Introduction
• Tested software (Mobile Media Gateway)
• System Architecture
• System adapter
• UML Test Model of IMRA
• Study on Model Based Testing
• Questions
Introduction

Thesis subject:
Evaluation of Model-Based Testing in 3G Mobile Networks Software Development

Academic history
• Tampere University of Technology
  • Master of Science in Communications Engineering
• Boston University
  • Bachelor of Science in Computer Systems Engineering
  • Soccer 😊

Professional experience
• Oy LM Ericsson Ab, Finland
  • January 2005 - Present
• Nokia Mobile Phones, Finland
• General Electric Corp., USA
Thesis work

System Under Test (SUT)
  • IMRA (Interactive Messaging Resource Access)

Test Tool (Conformiq Software Test Generator)
  • UML state diagrams
  • XML Test Logs

Research work

1. Model-based testing tool integrated to Real-Time Operating System (SimCello)
2. State diagram test model of IM RA’s basic use case
3. Do a qualitative study on Model-based testing
Mobile Media Gateway

- Layered architecture
  - Control Layer – signaling information
  - Connectivity Layer – data transfer

Control Layer
- MSC Server
- GMSC Server
- TSC Server
- HLR

Connectivity Layer
- Backbone network: TDM, ATM, IP
- WCDMA
- GSM
- PSTN
- MGw/SGw
Interactive Messaging

1. Send Request
2. Configuration
3. Play Request

"1234567890"

4. "Number you dialled can't be reached."

MSC
(Media Gateway Controller)

Media Gateway
CPF
(Control Plane Functions)

O&M
IM RA
DSP
System Architecture

Test Generator (CTG)

TCP/IP

Datum Signal

Library

C++

CTGTestPort

TITAN (TTCN-3 RTE)

OSE Delta Signal

OSE TestPort

Real-Time Operating System

IMRA

System Under Test
System Adapter

WIN ➔ Solaris ➔ OSE ➔ IM RA

CTG Adapter
CTG TestPort
TITAN RTE
OSE TestPort
OSE Gateway

CTGAdapter.cc

Receive() (2)
→ vector<OSESignal> incomingMessages;
Send () (5)
→ Generate Datum
→ Send to CTG

CTGTestPort.cc

mCTGAdapter ➔ Run() (1)
→ Install_Handler ()
Event_Handler () (3)
→ TITAN Polling 0,5 s
mCTGAdapter ➔ Send () (4)
UML Test Model of IMRA
(Interactive Messaging Resource Access)

- IMRA Client
- Configuration
- Activate IMRA
Educational Test Model

1) What is the test coverage of MBT?
2) Learning benefits?
3) Implementation?
1. Group Study: 15 professional testers
   - Written questionnaire
   - Group interview

2. Independent Consultant
   - Expertise in software testing

3. M-MGw software architect
   - Interviewed

🌟 How testers and designers understand state diagram test model?
🌟 Analyse the results using Qualitative research methods
Qualitative Study

Written Questionnaire:
- 94 % answered 2 or more questions right
- Good learning curve in short time! (15 minutes)
- Question 3 not taken into account

Interviews:
- Positive reaction to the model
- Uncertainty of what is tested

(More information: "Evaluation of Model-Based Testing in 3G Mobile Networks Software Development" Tampere University of Technology)
Conclusion

- Proved that state diagrams can be used for testing 3G mobile networks functionality.

Testers:

"Need to see the tool."

Consultant:

"Model is clear and easy to understand. It is logical!"

Architect:

“The model was understandable, maybe even better than TTCN.”
Questions?
Contact

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Appendix

- MGC: Media Gateway Controller
- M-MGw: Mobile Media Gateway
- IM RA: Interactive Messaging Resource Access
- O&M: Operations and Maintenance
- SUT: System Under Test
- DSP: Digital Signal Processor
- CPF: Control Plane Functions
Appendix

Model-based testing tools:

- TorX
- Leirios Test Generator

Model-based testing languages:

- Abstract State Machine Language (AsmL)
- Test Generation with Verification (TGV)