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Automated Interoperability Testing with TTCN-3

Experiences from ETSI's STF 370 project

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Outline

- Why is interoperability testing of interest to ETSI?
- How can we make interoperability testing for effective?
- About the ETSI STF 370 project
- A methdology for automated interoperability testing
- Interoperability testing with TTCN-3
  - About the IMS case study
  - About TTCN-3 IMS IOT test system design
  - Findings & Stastics from the 3rd ETSI IMS Plugtest
- Conclusion

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Rise of Interoperability Testing

- Classical conformance testing may not be appropriate for every technology
  - Can be costly to develop
  - Does not guarantee interoperability of tested products
- Bi-lateral testing and interoperability events are increasingly accepted as a solution to improve interoperability
  - ETSI - interoperability test specifications & Plugtests™ for a wide range of technologies including IMS, HDMI, IP, VoIP, RFID, grid, etc
  - OMA - interoperability test specifications & testfests for enablers
  - WiMax - network infrastructure interoperability testbed
  - Over 700.000 hits with Google, more than 1,3 million hits with Yahoo
- BUT: (pure) interoperability testing does not answer all questions
  - Does not guarantee that products follow standards
  - Interoperability is not transitive relation and may be elusive!

Interoperability Testing: the ETSI approach

- Integrate conformance checking with interoperability testing!
  - In practice achieved by recording traces at standardized interfaces during each interoperability test
- Get the best of both worlds
  - Vendors get instant feedback about the interoperability of their product with others
  - ETSI gets an idea about the conformance of products to standards
- Requires additional test specification development work, i.e., identification and association of conformance checks
- Does not replace need for conformance testing
  - Inherent limitation in IOT to expose all standardized behavior

Interoperability Testing Today

- Interoperability testing means different things to different people
  - Attend an event
  - Test whatever with whoever whenever you want (ad-hoc)
  - Scheduled test sessions (attempting to cover all possible pairings of different participating products)
  - Execution of agreed test list in each test session
  - Validation of execution traces against standards
  - As well as various combinations of the above
- Majority of interoperability testing and validation is performed manually
  - Labor intensive
  - Does not scale
  - Error prone
  - Frequently inconsistent

Example: Test Effort for ETSI's 1st IMS Plugtest

- **Background**
  - A 4 day interoperability event intended to assess the interoperability of IMS core networks at network-to-network (NNI) interface
  - 23 different interoperability tests
  - 6 IMS core network implementations tested all against each other
  - 30 recorded test sessions (A -> B as well as B -> A)
  - 482 test execution traces to be evaluated (SIP message flows)

- **Effort spent on test execution & analysis**
  - About 180 h of interoperability testing (46%)
  - About 204 h of manual analysis of execution traces (54%)
    - With a lot of work being done after 9pm each day …
  - Sums up to total effort of **384 h** / **48pd** (100%) related to testing!

How can we make IOT more effective?

- *Automate* IOT as much as possible
  - Example: Automate interoperability trace checking
  - Reduce cost and time
  - Increase consistency of results
- Reuse constructs from existing test frameworks
  - Profit from investments already made
- Use industrial grade test automation tools
  - Benefit from well accepted processes, workflows and tools

Use TTCN-3 as <u>the</u> unifying test language to drive automated interoperability testing!

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STF 370 – Automating interoperability testing

- ETSI Project funded by European Commission and ETSI
  - Objective is to extend existing ETSI interoperability testing concepts with automation and in context of distributed systems
- Main stakeholders
  - ETSI TC Methods for Testing and
  - ETSI TC IMS Network Testing
  - ETSI TC Grid
  - B2B community (mainly around HL7)
  - TETRA Association
  - WiMax Forum (NWIIOT)
- Further signalled interest
  - IPv6 community
  - ITS community
  - Testing labs

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Project Overview

- Planned duration Jan 2009 to Jun 2010
- Involves 12 experts with various background led by ETSI CTI
- Methodology and Framework for automated IOT
  - Output is ETSI Guide 202 810 (independent of TTCN-3)
- IMS case study based on use of TTCN-3
  - Application of automated IOT concepts in context of IMS
  - Basis was IMS IOP test specification for 3rd ETSI IMS Plugtest
  - Output is TTCN-3 test suite & documentation, TCI SIP codec & TRI adapter implementation, and report on IMS Plugtest experience
  - Validation of TTCN-3 test system and IOT concepts at IMS Plugtest!
- Dissemination
  - White paper & training material (in 2010)
  - Presentation to TETRA Forum and at T3UC 2009 + T3UC Asia 2009

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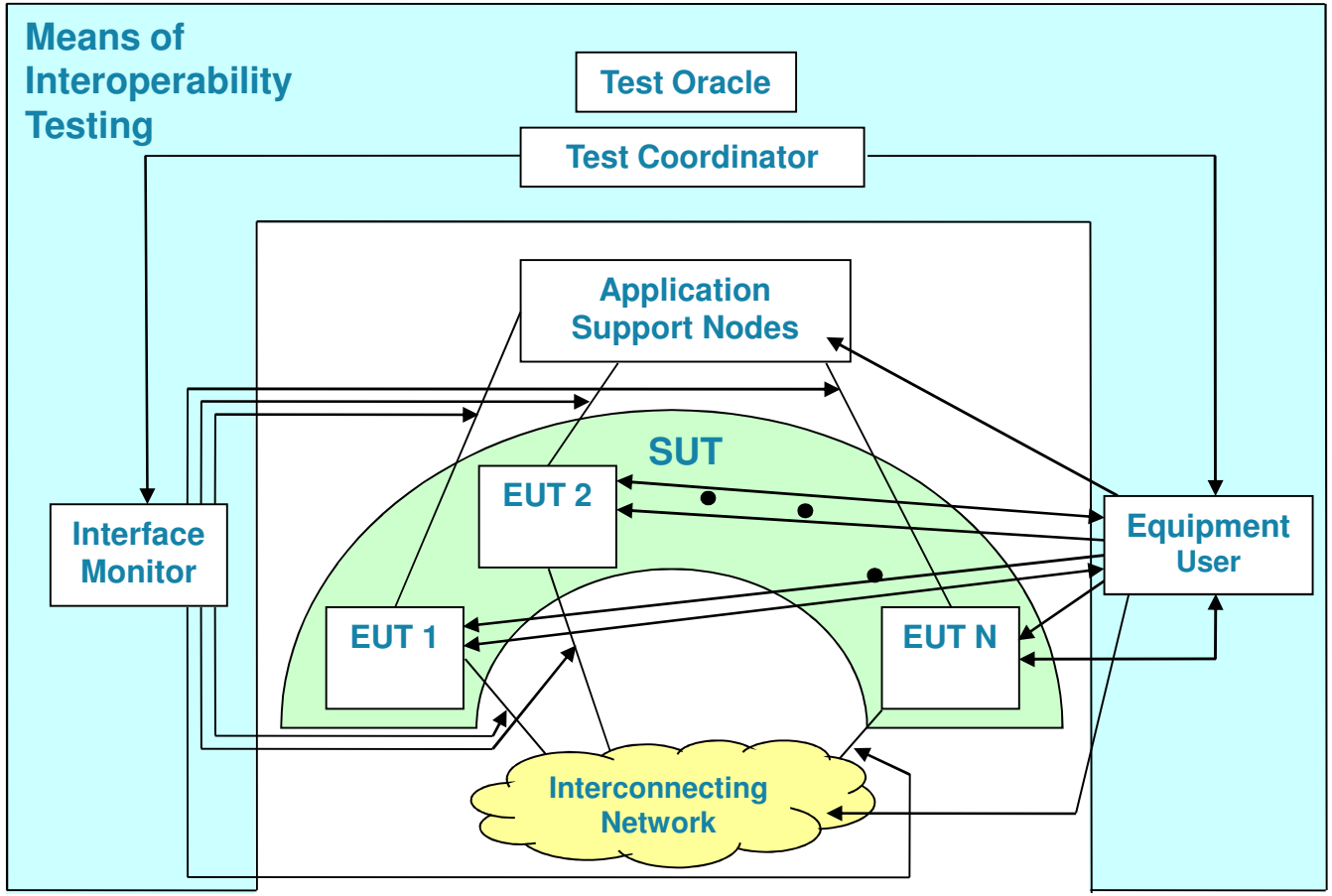
About automated IOT methodology & framework

- Analysis of automated IOT in various contexts
  - IOT in IMS, WiMax, IPv6, HL7, ROHC, IPTV, WiMedia, SIP VoIP, etc
- Methodology extends ETSI's generic approach to IOT (EG 202 237)
  - Adds aspects of automation and test system implementation
- Main points captured in this document (EG 202 810)
  - Independent of technology to be tested
  - Independent of testing language
  - Collection of key terminology
  - Separation of verdicts for end-to-end and conformance assessment
  - Discussion of limitations and feasible degree of automation
  - Controllability of Equipment Under Test (EUT) interfaces
  - Definition of generic means of interoperability testing
  - Definition of process for IOT test system development

Generic Automated IOT Test Architecture



About TTCN-3 based IMS case study

- Designed and implemented a TTCN-3 based framework for IMS interoperability testing
  - Library based design
    - LibCommon, LibIot, LibSip, LibIms, LibUpperTester plus AtsImsIot
  - Separation of individual EUT information and EUT pairings
  - Support for en/disabling of interface checks upon need
  - Separation of conformance and interoperability verdict management
  - Support for live vs. offline interoperability test execution
  - Reuse of TTCN-3 SIP/SDP constructs from conformance test suites
- Implemented 50 IMS IOT TTCN-3 tests within framework
  - Development lead to discovery of a number of issues in the IMS IOP test specification (mainly related to conformance checks)
  - Included some basic test validation

About TTCN-3 based IMS case study (contd.)

- Implemented TCI SIP and SDP codecs
  - Based on open source IRISA t3dev codec C++ development kit
  - Excludes checking of XML message bodies
  - Includes codec test framework
  - Reusable beyond interoperability testing!
- Implemented TRI Upper tester and PCAP test adapter
  - Based on open source IRISA t3dev codec C++ development kit
  - Protocol independent, extensible design including test adapter configuration protocol
  - Also adapted Testing Tech Trace Player adapter to new interface
- TTCN-3 test system mainly validated at IMS Plugtest
  - Used two different commercial TTCN-3 compilers: Testing Tech TTWB and Elvior MM

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Findings & Statistics from the IMS Plugtest

- 3 test engineers were validating tests and checking 317 interoperability test executions from 54 test sessions
  - Included voluntary contributions from Testing Tech and Elvior
- A number of design decisions proved very helpful to speed up test execution
  - Example: Separation of EUT information, template design, etc
  - Significant improvement over first TTCN-3 tool from 2nd IMS Plugtest
- After test validation analysis achieved speed of 5 test sessions per day per test engineer
  - Includes manual verification of all fail verdicts!
  - Total effort: 3*8*4 = 96 h(!) – compared to 204 h manual work!
- Code really worked with different TTCN-3 tools!
  - Collected feedback on further TTCN-3 tool improvements to even further speed up trace analysis

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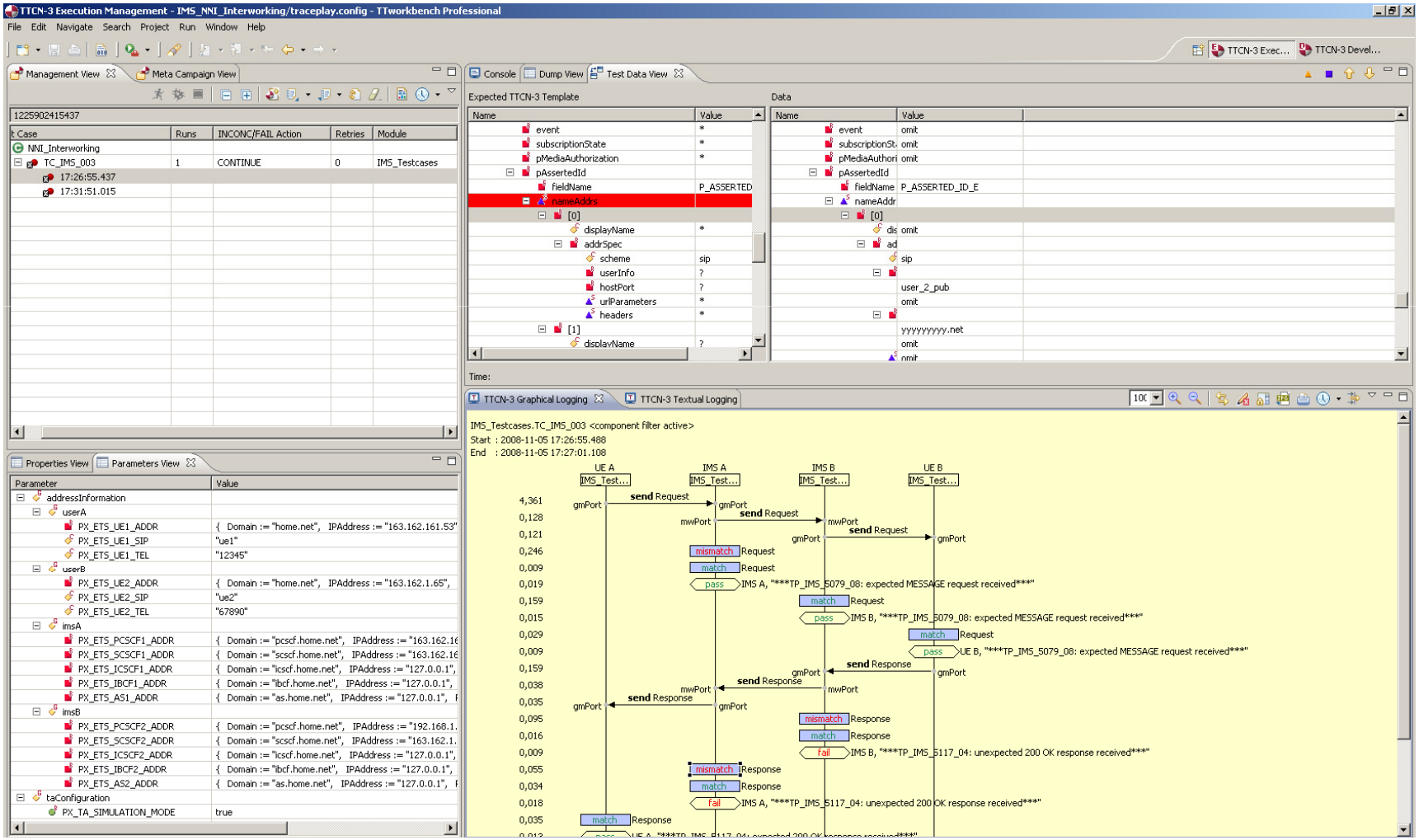
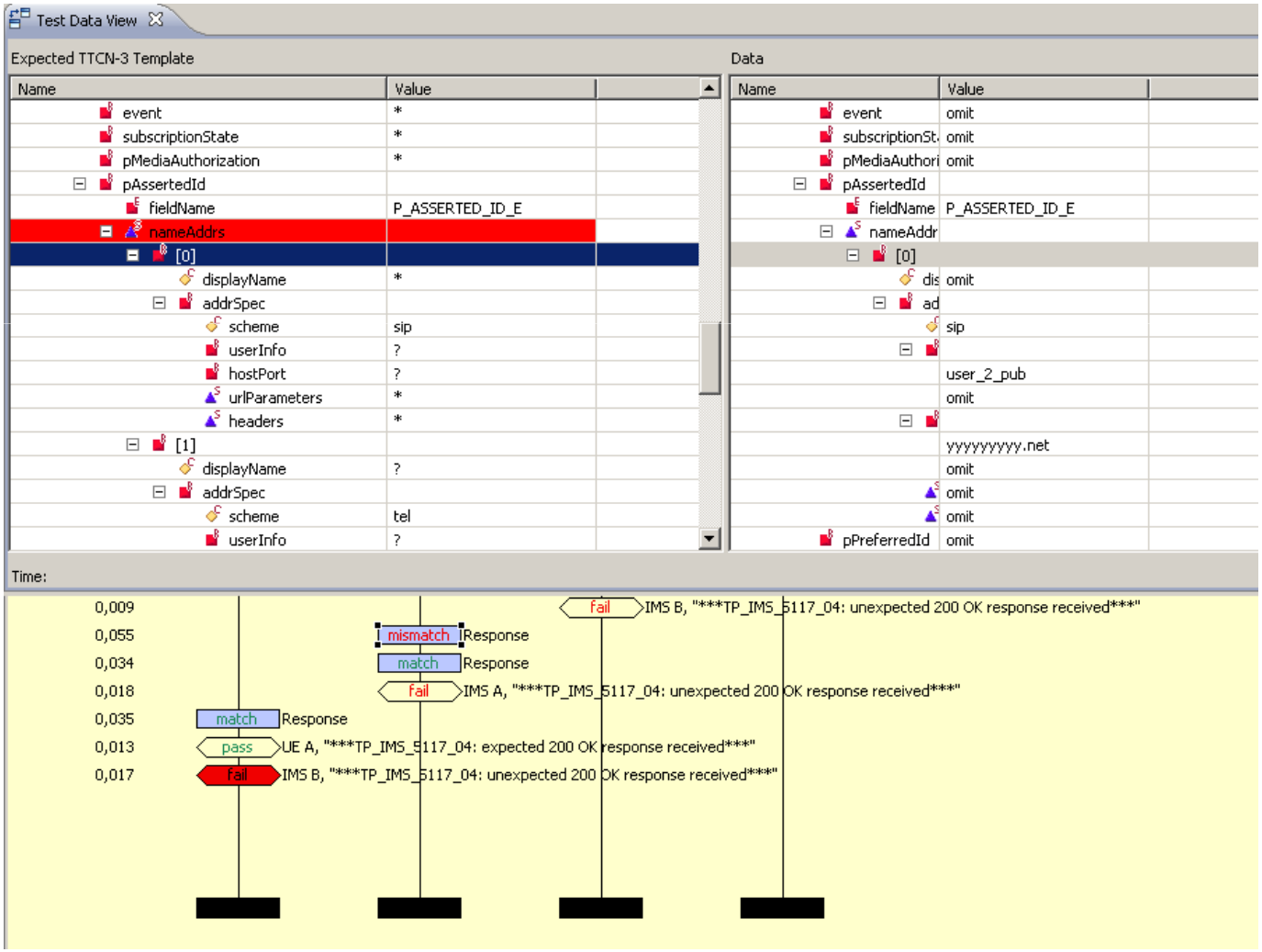
Checking of Failed Tests in Practice (TTWB)



Mismatches in Practice (TTWB)



Conclusions

- Interoperability testing is an accepted way to reduce interoperability problems
- Manual interoperability testing is time consuming and error prone and therefore expensive
- Automation of interoperability trace checking can reduce costs by more than 50 % compared to manual validation
  - Standardized test methodology
  - Reusable TTCN-3 test framework
  - Off-the-shelf TTCN compilers
- Standards, tools, and people are available today

Road Ahead

- Finalization of methodology, TTCN-3 based IMS Architecture, Plugtest experience report for ETSI publication
  - Will include also TTCN-3 code
- Start of work on training material and white paper
  - Expected to be finished latest by summer 2009
- SIP & SDP codecs, IOT adapter, and corresponding design documents are planned to be made available via open source project
- Target for next IMS Plugtest automatic execution of interoperability tests
  - Augment a commercial IMS client to be controllable via TTCN-3

THANK YOU!

Questions?