With the gap between manufacturers and clinical environments widening, integration of complex medical IT systems into heterogeneous clinical networks becomes increasingly challenging. This needs to be addressed says **Prof Dr -Ing Ina Schieferdecker** and **Dr Armin Metzger** of the ReTeMeS project

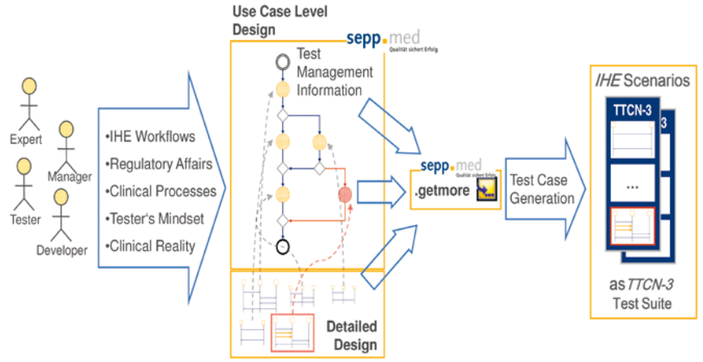
Closing the gap between lab and clinical environment

Managing and optimising the workflows of clinical environments is currently being hampered by a lack of integration capabilities of medical IT. This, as well as perpetually increasing gaps between users and vendors is causing major obstructions to successful workflow implementation. These need to be addressed and the EUREKA integrated ReTeMeS (Reliability Testing of Medical Systems) project – led by Prof Dr -Ing Ina Schieferdecker and Dr Armin Metzger – is dedicated to this task.

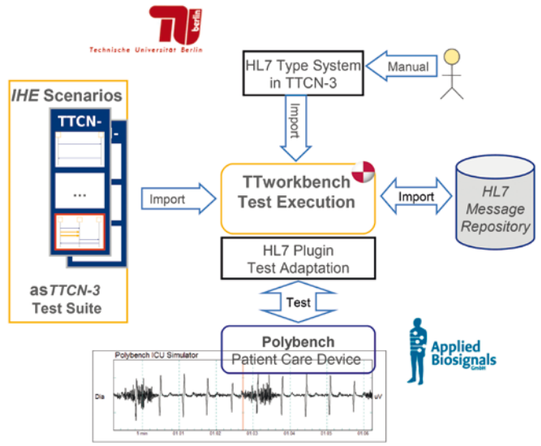
In order to overcome the challenges posed, the European project ReTeMeS – in cooperation with the German national project TestNGMed and Romanian partners – is dedicated to the development of a TTCN-3-based (Testing and Test Control Notation Version 3) methodology for validation of interoperability and conformance of IHE- (Integrating the Healthcare Enterprise) and HL7-based (Health Level 7) medical systems and components. Validation focuses at the interface between manufacturer and clinical user to provide medical IT-systems capable to fulfil the needs of clinical reality.

To do this, it has created the TestNGMed test bed focussing on interoperability and conformance tests using a model-centric test method (.mzT) to provide a highly automated process for software validation. This is a pioneering step in this field as a core feature of .mzT is the use of visual and systematic test models for managing complexity to define test workflows. This, in reality, means that medical standards can be used to great affect. Maintainability issues are addressed by exploiting reuse and high adaptability capabilities of the TestNGMed method and tooling during test design and automation.

"The automated derivation of TTCN-3 test scripts from the test design supports both full workflow coverage and structured reduction of test cases using test management information stored in the test model," notes Metzger. "In contrast to standard, document-based specification of test cases, the visual test model is actually a common ground/language as it provides a direct understanding even involving non-technical stakeholders."



Automated Generation of Test Scripts from the Test Model including Medical Processes, IHE and Test Management



Model Based Test Automation with TTCN-3 and the Polybench Validation Environment

Indeed, considering the forward-thinking nature of the ReTeMeS project, the TestNGMed approach is surprisingly simple by reusing existing technologies, but being based on leading-edge solutions for model-based test generation and automated test execution. Schieferdecker elaborates, stating that, "the standards the test bed is built on include pre-existing communication standards of the medical domain. For example, IHE is used for system interaction over networks and HL7 is used for specifying the exchanged data formats. For test design a UML-based (Unified Modeling Language) test model is used, as UML is a widespread standard with excellent tool support. Basis for the visual test designs are the IHE workflows, enhanced with tester's mindset and real life scenarios," she adds. "From the test models executable test cases based on the testing standard TTCN-3 are then generated and executed."

From prototype to practice

Currently, the TestNGMed test bed is in a productive validation phase including the methods supporting tool chain with the test generator .getmore by sepp.med GmbH and the test execution platform TTworkbench by Testing Technologies IST GmbH. In addition, the test bed also includes the prototype process to facilitate the ReTeMeS goal of providing a model-centric approach to system validation in the medical domain. Through this, all relevant aspects of software testing are considered. The test bed itself is currently being validated through the application of intensive care workflows and systems. The systems are provided by the medical software development platform Polybench. Polybench (by Applied Biosignals GmbH) is used as back-end by medical instrument manufacturers, but can also re-play recorded measurements and so simulate e.g. patient care devices as used in a real-life environment. The application of Polybench allows to set-up a complex medical environment easily reconfigurable to simulate various scenarios, without requiring sensitive medical equipment. From the medical industry's point of view, this provides valuable information about how to improve automated testing to inter-connecting medical systems.

"The next steps that will be taken are the scaling of both the method and the test bed within larger industrial projects with increasingly complex systems and environments, as well as more complex application scenarios," says Metzger. "The current vision is to establish the TestNGMed test bed as the quasi standard approach to system validation and conformance and interoperability testing for IHE/HL7-based applications in the medical domain." ★

In contrast to standard, document-based specification of test cases, the visual test model is actually a common ground/language as it provides a direct understanding even involving non-technical stakeholders

Fluid Testing

Within TestNGMed, a central focus is placed on the conformance to IHE defined workflows tailored to real applications in the clinical environment and adherence to HL7 message type standards and their adaptations to real life scenarios.

Due to the medical domain adopting common communication standards with manufacturer and clinical environment specific interpretations, interoperability testing is essential. The TestNGMed test automation framework creates a simulator for each individual system (or 'actor' of the IHE integration profile) to complement the system under test. By providing a mock up of the environment, the system is tested along the anticipated integration behaviour. The test bed's set up and behaviour of each simulated system are defined within the test models that are based on the standards as well as user and vendor specifications.

In essence this means that the TestNGMed test framework trial-runs new systems for integration capabilities into their productive environment before they are integrated into

At a glance

Full Project Title

European – Reliability Testing of Medical IT Systems (ReTeMeS); German – Test Automation for the Next Generation of Medical IT Systems (TestNGMed)

Project Partners

- Germany: sepp.med GmbH (Dr Armin Metzger), Technical University Berlin (Prof Dr -Ing Ina Schieferdecker), Applied Biosignals GmbH (Hilbert Koetsier)
- Romania: University Politehnica of Bucharest, Infoworld

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Dr Armin Metzger (left)
Prof Dr -Ing Ina Schieferdecker

Project Leader

As department manager within sepp.med GmbH, Dr Armin Metzger is responsible for IT-multiprojects in complex and safety relevant domains. He has 16 years of experience in quality assurance, development and processes in scientific and industrial projects mainly in the area of medical IT. Dr Armin Metzger is founding member of German Testing Board.

Technical Project Leader

Prof Dr -Ing Ina Schieferdecker works in the area of design, analysis, testing and evaluation of communication-based systems using specification techniques like UML, MSC (Message Sequence Charts) and TTCN-3. Prof Dr -Ing Schieferdecker authored many scientific publications in the area of development, quality assurance, and testing. She is active member e.g. of ETSI MTS and of the German Testing Board.