

Requirements Management & Model-Based Testing in Defence

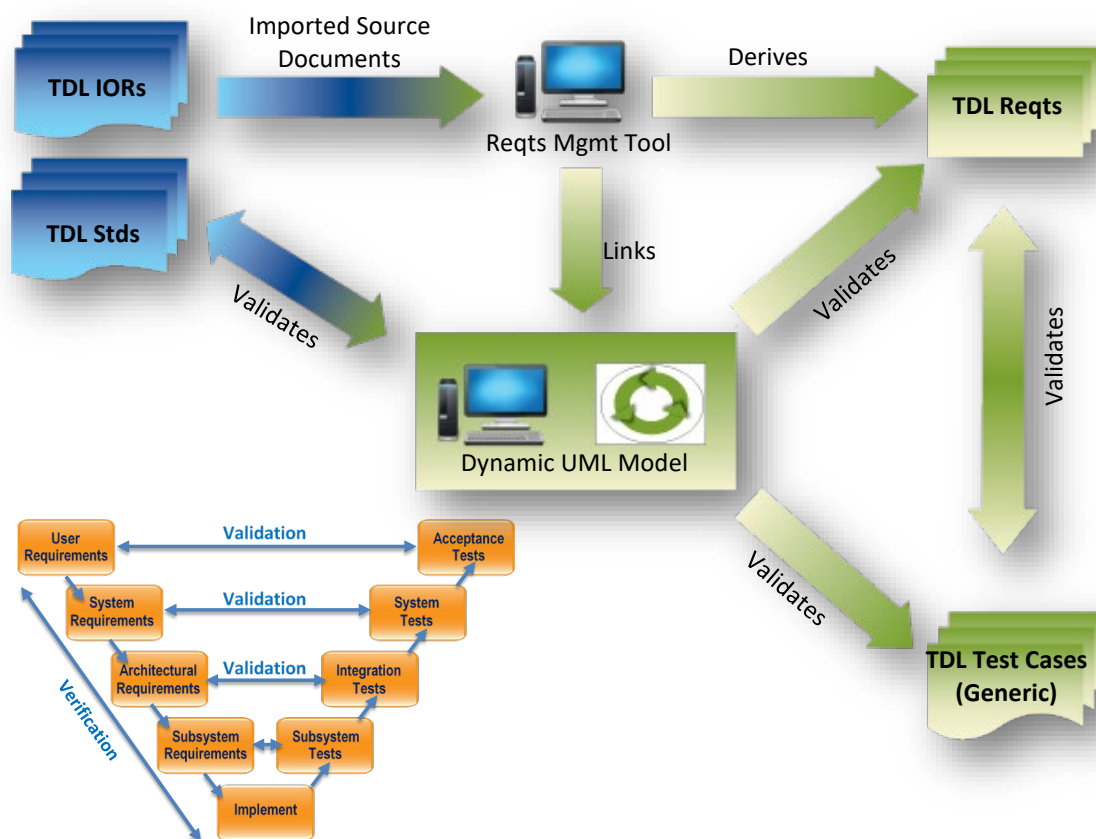
It's well known that testing of Tactical Data Link (TDL) implementations of military platforms is high cost, particularly when testing interoperability between multiple platforms of different nations in a live environment with aircraft flying and ships at sea.

The application of requirements-based testing, underpinned by a model-based approach during requirements definition, helps to identify issues early in the development life cycle. This serves to minimise costs and risks in the development and maintenance of the system, as well as providing a direct correlation between clarified requirements and test cases for validation and verification purposes.

In this technical article, we aim to show how TDL model-based testing helps to make the most of all available benefits.

Let's look at TDLs as being the vascular networks that enable the operational military System-of-Systems (SoS). If they do not operate correctly, the platforms that they support will be starved of information, the vital nutrient in today's military enterprise without which it will cease to function cohesively or may even die. It's fair to say that it is critical that TDLs are implemented in a consistent and coordinated manner across the enterprise to ensure the flow of that vital nutrient.

Analogies aside, interoperability can be considered to be concerned with the timely, consistent, and coordinated flow of information across the TDL network. This can be achieved through an approach called standards-based interoperability, which ensures the consistent implementation of platforms by building them in accordance with underlying standards and specifications. This is also referred to as a 'network-centric' approach and contrasts with traditional approaches in which platform TDL implementations have been focused on the needs of individual platforms, the so-called 'platform-centric' approach.



The standards-based interoperability approach can only be successful if the underlying baseline of standards and specifications is complete, consistent, and correct.

Unfortunately, in the TDL case, the governing standards (some United States (US) originated and managed, others originated and managed by the North Atlantic Treaty Organisation (NATO)) are large and complex documents that are evolving under an intricate change management system, with (in the NATO case) all participating nations contributing and agreeing on changes to the standard.

A further issue is that the structure of the requirements within the standard do not follow best practice in requirements writing techniques. These issues compound to the extent that the interpretation and misinterpretation of the complex requirements for a particular platform is an ongoing problem, leading to non-standard implementations and the creation of interoperability issues.

So, let's consider a scenario whereby a dynamic model of the requirements in the TDL standards and specifications is constructed in Unified Modelling Language (UML) to help ensure their integrity. Furthermore, as well as being able to provide feedback to the authors of the documents, this visual, functional model enables users to manage complexity and minimise ambiguity.

Here at SyntheSys, we have achieved just that.

The adoption of a model to represent the requirements gives the capability to dynamically simulate transactions with the appropriate stimuli, exercising the constraints and processing all possible paths through the model. The modelling software tracks the live progress through the model, creating a sequence diagram identifying inputs, outputs and actions. It also provides a model coverage statistic and history of the stimulation and decisions taken in execution.

The standards are constantly evolving with new functionality and modifications to existing capability under change control. The model and dynamic execution provide a means to carry out what-if analysis for changes to the standard that can identify knock-on effects and issues not readily apparent from the basic text. Any changes to the requirements are therefore easily identified within the model.

We advocate a requirements-based testing approach in which the testing of platforms is carried out against the governing standards and specifications. The models have enabled us to develop a comprehensive set of meaningful interoperability test cases since they clearly identify all decision points and, therefore, where a test case should be produced to address a specific route through the transaction. These test cases are traceable to both the source requirements, as captured within the requirements management database, and the specific UML diagram that describes that functionality. Impact analysis of a test failure is therefore readily identified against the source requirement.

Mark Williamson

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Mark Williamson, SyntheSys Technologies Managing Director believes that “...the modelling approach reduces interoperability issues. Together with requirements-based testing, it readily identifies differences between a platform implementation and the standard, enabling those differences to be subject to systematic management.”

TECHNICAL ARTICLE

About SyntheSys

SyntheSys provides defence systems, training, systems and software engineering and technical management services over a spectrum of different industry sectors. Along with distinct support and consultancy services, our innovative product range makes us first choice provider for both large and small organisations. Established in 1988, the company focus is on fusing technical expertise with intuitive software applications to solve common industry challenges.

