Technical Solution & White Paper

AFDX/ARINC664 Switch Testing
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General

Following Paper outlines the AIM approach for testing of AFDX/ARINC664 Switches against the ARINC664 Specification.

An AFDX Switch hosts generally the following functional blocks (see Figure 4-1 below from ARINC664P7 specification page 48).
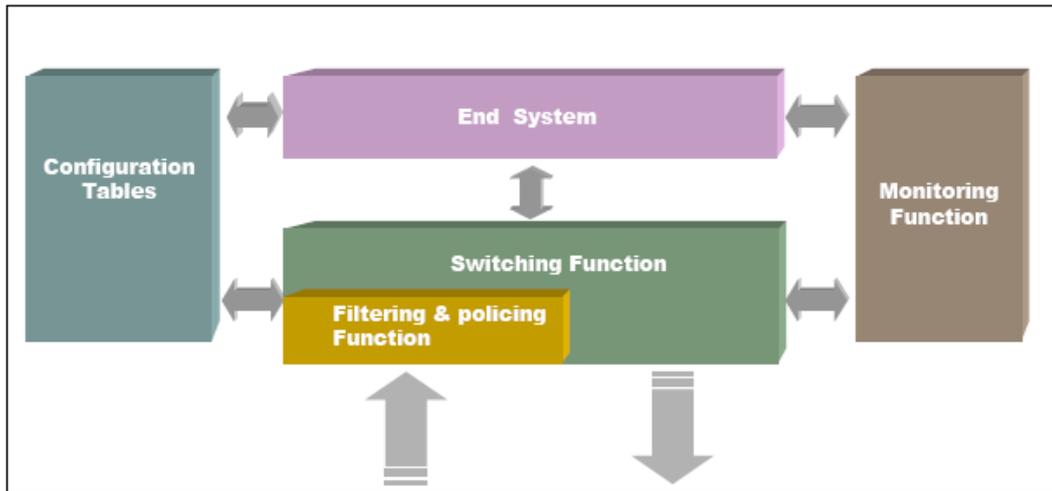

Figure 4-1 - Main Functional Blocks of the AFDX Switch

The AFDX/ARINC664 Switch Testing approach is somewhat different from End System Testing since the Switch is tested as an "Operational" unit. An End System requires a dedicated Test Application running which is typically not the final Avionics Application (see White Paper about End System Testing). Therefore the Switch does not need to host a special Test Application or run in special testing mode but simply tested as a "black box" method. The test cases require different Switch configurations which will be one time programmed /loaded prior to the execution of the test procedure and then enabled via PIN programming, which is a feature the Switch has to support in any case in order to be compliant to ARINC664 specification.

> **Note**: PIN programming is typically used to determine the position of the Switch
> Inside the aircraft/system in order to activate the proper configuration for the encoded
> Position (=PIN).

The use of a dedicated UUT maintenance port is not mandatory since the evaluation of test stimulations are performed by using the monitored Switch ports via a corresponding Test System. Such a Test System requires a 1:1 connection to the Switch's ports. Furthermore, it is mandatory the End System functionality of the Switch supports SNMP protocol to query the Switch's MIB for further evaluations.

The AFDX Interface Boards on the Test Equipment side needs to be synchronized to a common time base (IRIG-B) which is achieved by using one AIM board as a Time Master (Time Code output) and the remaining AIM Boards as Time Slaves (Time Code input).

Switch Testing Approach

The following schematic shows a simplified schematic for the connection of the UUT (AFDX Switch) to the Test System.
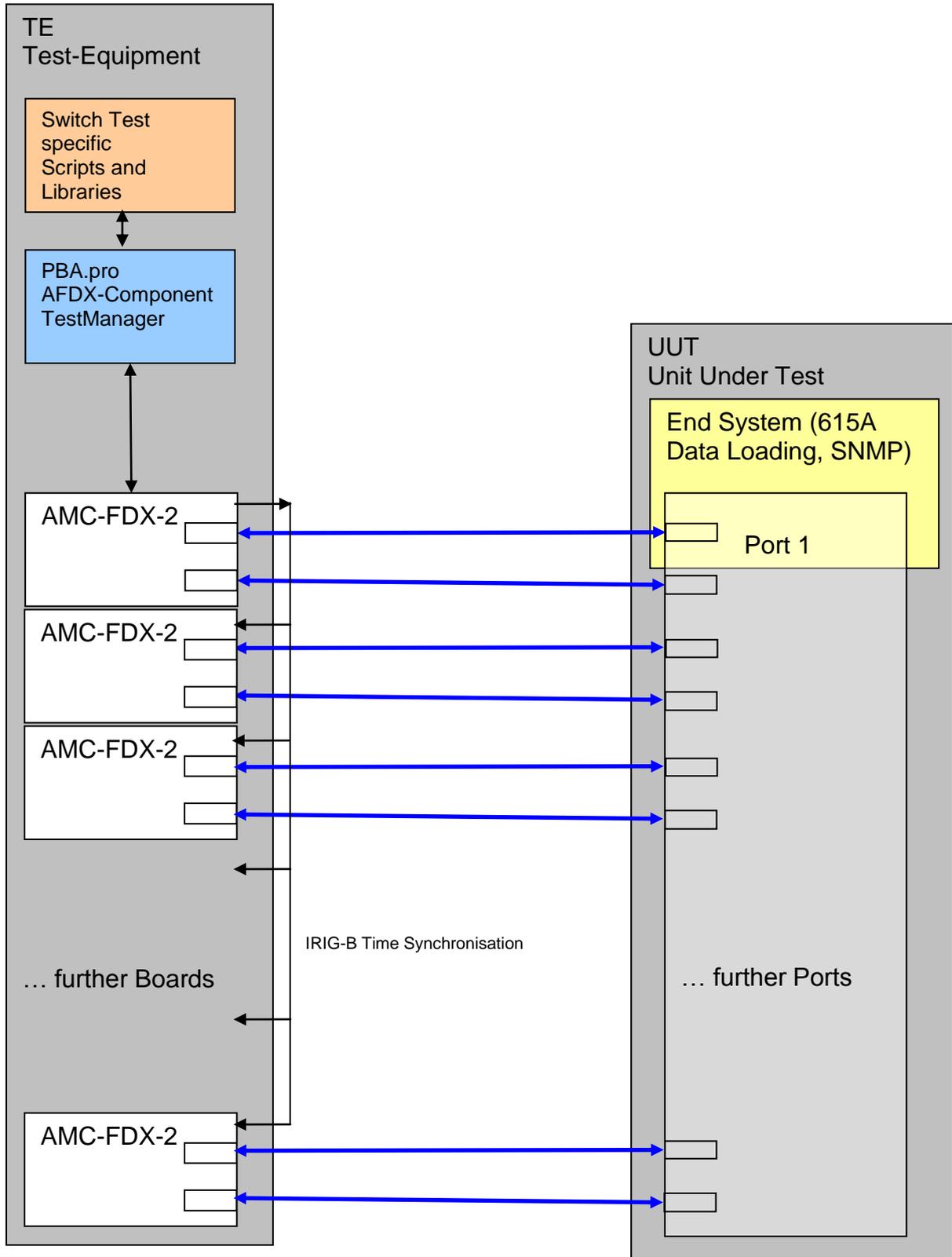
Tests related to 615A Data loading require the use of the AIM EasyLoad615A software.

The test scripts offer a suite of tests for checking the compliance of a Switch against the ARINC Specification ARINC664P7, Chapter 4 Switch Specification and are structured as follows:

Switch Test Cases Overview

- Basic Communication Tests
- Frame Filtering
- Traffic Policing
- Switching Function
- Monitoring
- Configuration
- Operating Modes
- Data loading
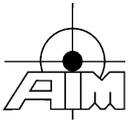- Pin Programming
- Performance

59 Test Cases in total

Following Overview outlines the testing approach and the associated documents relations.
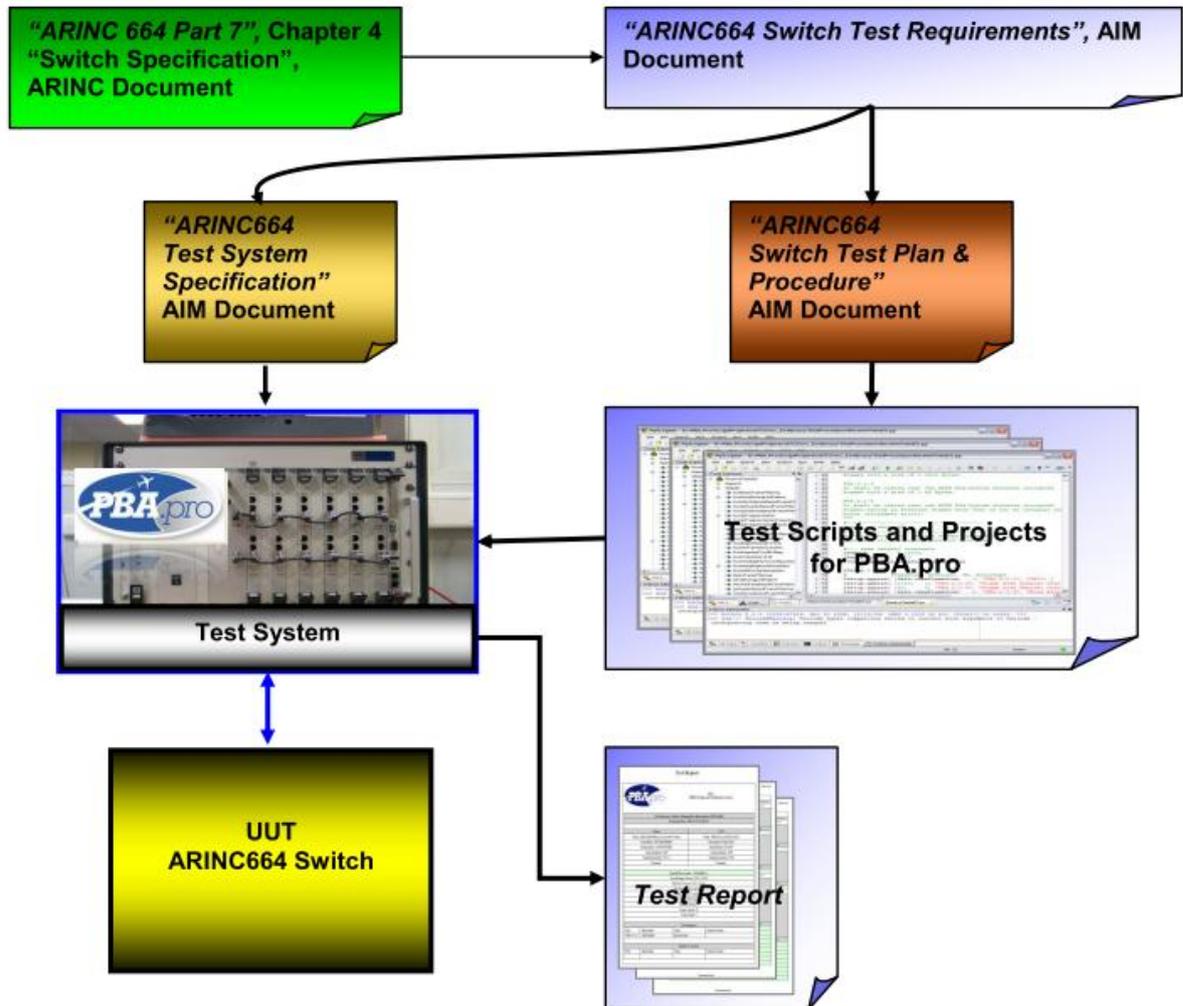
Following picture shows the PBA.pro Test Manager Project, setup with the Switch Testing
Project.
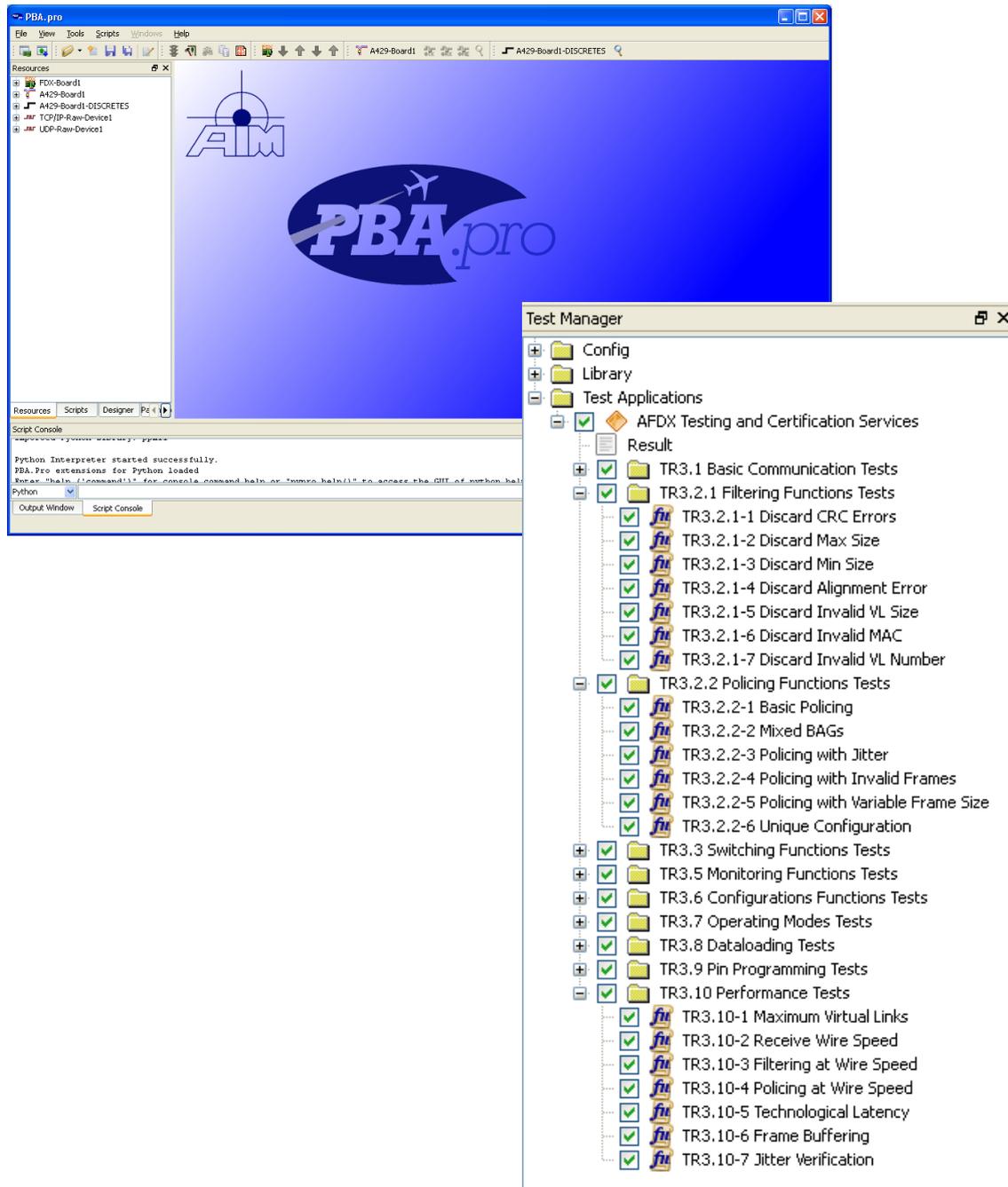
The PBA.pro Test Manager automatically creates a PDF Test Report (customisable) which is shown below (excerpt of a full 14 pages report)

Testmanager Report   Page 3 of 14

		Test Records		
TR	Test	Group Test Result	Performed by	Test-Inspector

TR4.2.1-5 Send During Link Failure

    TR4.2.1-5 It shall be tested that the AFDX End-System continues to transmit in case of a physical link failure.

Teststeps	Result
TR4.2.1-5 Send During Link Failure	Passed

TR4.2.2-1..6 MAC Address Based Frame Filtering

    It shall be tested that the AFDX End-System:

    TR4.2.2-1 discards corrupted frames having an error in the MAC destination address constant field (MAC Destination Address error).

    TR4.2.2-2 discards corrupted frames having an error in the 24 bit MAC source address constant field (MAC Source Address error).

    TR4.2.2-3 receives all frames having valid value in the 16-bit MAC source address field "User.Defined .ID".

    TR4.2.2-4 receives valid frames having an arbitrary value in the 3-bit MAC source address field "Interface.ID".

    TR4.2.2-5 discards corrupted frames having an error in the 5-bit MAC source address constant field (MAC Source Address error).

    TR4.2.2-6 discards corrupted frames having an error in the MAC Protocol Type fields (MAC Type error).

Teststeps	Result
TR4.2.2-1 MAC Destination Address Error on Port 1: all 240 valid messages received as expected.	Passed
TR4.2.2-2 MAC Source Address 24-bit-const Error on Port 1: all 49 valid messages received as expected.	Passed
TR4.2.2-3 MAC User Defined ID Error on Port 1: all 21 valid messages received as expected.	Passed
TR4.2.2-4 MAC Interface ID Error on Port 1: all 8 valid messages received as expected.	Passed
TR4.2.2-5 MAC Source Address 5-bit-const Error on Port 1: all 10 valid messages received as expected.	Passed
TR4.2.2-6 MAC Type Error on Port 1: all 49 valid messages received as expected.	Passed
TR4.2.2-1 MAC Destination Address Error on Port 2: all 240 valid messages received as expected.	Passed
TR4.2.2-2 MAC Source Address 24-bit-const Error on Port 2: all 49 valid messages received as expected.	Passed
TR4.2.2-3 MAC User Defined ID Error on Port 2: all 21 valid messages received as expected.	Passed
TR4.2.2-4 MAC Interface ID Error on Port 2: all 8 valid messages received as expected.	Passed
TR4.2.2-5 MAC Source Address 5-bit-const Error on Port 2: all 10 valid messages received as expected.	Passed
TR4.2.2-6 MAC Type Error on Port 2: all 49 valid messages received as expected.	Passed
TR4.2.2-1..6 MAC Address Based Frame Filtering	Passed

Testmanager Report

A commercial off the shelf (COTS) solution as described above can be offered from AIM as follows:

- **Test Standard Hardware:** Boards only or the entire System

- **Test Standard Software:** PBA.pro-FD, PBA.pro-AFDX-2, PBA.pro-TSM, EasyLoad615A

- **Switch Test Script Package:** PBA.pro-AFDX-SW-TEST
  (PBA.pro Project and Python Scripts and Libraries) which also includes

  o **Switch Test Plan and Procedure:** Text document only

Special Note: The Test Standard Hardware and Software could also be used for E/S Testing!