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Introduction

- A UK MoD sponsored development.

- Test system software:
  - MoD’s DEFSTAN 66-31 (Open Systems Architecture)
  - IEEE 1641.
  - IEEE ATML.

- Source code is ‘open’ to contractors to the MoD and coalition partners.

- Binds COTS tools and test information

- OSA RTS covers:
  - **ATML Test Description Importer** – Generating CVI with inline 1641 Test Procedure Language.
  - **1641 Signal Translator** – Matching 1641 TPL to ATML Test Station Capabilities.
  - **Signal Routing** – Connecting test resources to UUT pins.
  - **1641 Test Signal Framework IDL Generator** – Generating a run-time software interface.
  - **1641 Run-time** – Implementing a runtime interface to control test resources.
COTS Products

Cassidian newWaveX®

newWaveX IEEE 1641™ Signal-based test and measurement software fulfils two specific functions:

- **newWaveX SD (Signal Development) 4.1.5**
  - A complete graphical signal modelling & simulation environment for automatic test, compliant with the following standards’ signal requirements:
    - IEEE 1641 Signal & Test Definition.
    - IEEE 1671.1 ATML Test Description.
    - IEEE 1671.2 ATML Instrument Description.
    - IEEE 1671.6 ATML Test Station.
  - newWaveX SD supports the creation and editing of IEEE 1641 Signals & TSF libraries; XML, XSD, IDL and HTML file formats for storage, interface specification and documentation. Additionally, newWaveX SD provides ActiveX controls, enabling easy embedding in third-party applications.

- **newWaveX PD (Platform Development) 1.2.8**
  - A test platform integration toolset, targeted at getting test signals to test pins, newWaveX PD fulfils two primary functions:
    - A resource (instrument) description and validation environment for:
      » IEEE Std.1671 ATML Instrument and Test Station Description.
    - A compile-time resource manager/translator, reading signal orientated test program descriptions and outputting driver orientated test code, applicable to:
      » IEEE Std. 1641 IDL and TPL
      » IEEE Std. 1671 ATML Test Description.
COTS Products

National Instruments ATML Toolkit 1.0
• NI provides an ATML Toolkit that supplements NI TestStand to import ATML Test Description and test sequences & actions and, also, export ATML Test Results. The Toolkit is not intended to handle IEEE 1641 Signals; it provides an API (Application Programmer Interface) to supplement its capability, using such tools as Cassidian newWaveX.

National Instruments Test Stand 2010 SP1
• NI TestStand comprises the test sequencer and test executive and is used to assist in the development of automated test sequences, a key component of a TPS. TestStand is both a development and execution environment in this respect.
• In terms of an ability to exchange test definitions to support portability of tests, TestStand is generally considered to be a closed and proprietary test environment, though it has significant universal acceptance and ongoing support. Despite this, signal and sequence test code contained within the tool is accessible to the user and hence the inclusion of this tool in open systems architectures has been recommended.

National Instruments LabWindows™ /CVI 2010 SP1
• LabWindows/CVI is a proven ANSI C development environment for test and measurement that greatly increases the productivity of engineers and scientists. For more than 20 years, C developers have used LabWindows/CVI to develop high-performance, stable applications in the manufacturing test, military and aerospace, telecommunications, design validation, and automotive industries. LabWindows/CVI streamlines development with hardware configuration assistants, built-in measurement libraries, comprehensive debugging tools, interactive execution capabilities that developers can use to run functions at design time, and advanced analysis and scientific user interface tools.
COTS Products

Teradyne Xpress Services 6.5

- Xpress Services has been used as part of the ATML demonstrations, where it was a key component in describing ATE resources, capabilities and their interconnections. It is also in active use within MoD test facilities.
COTS Products

Microsoft Visual Studio .NET C# 2008

- MS Visual Studio is an IDE and command line toolset for software development. Pertaining to the RTS, it provides C# coding, interface stub generation, compilation and IDL compilation to type library.
Baseline

• ATML Demo
  – ATML Test Description
  – 1641 TSF Libraries
  – ATML Test Station Description
  – C test program.

• 1641 Demo
  – C# Test Program
    • Directly accesses a 1641 Run-Time System
  – ATML Test Station Description
  – C# IVI-based test program (baseline for 1641 Demo)
Design

The Following Slides Cover the Development of each of:

- ATML Importer (Test Description).
- 1641 Signal Translator.
- Signal Routing.
- 1641 TSF IDL Generator.
- Run-time Environment.
ATML Importer

- ATML Toolkit creates a Test Stand sequence and CVI test actions.
- 1641 Signal statements create callbacks into Open Source Software.
- OSS translates 1641 Signal statements in test actions into TPL.

/*<TPL>
Setup
  <std:Signal Out="Measure1">
    <std:Instantaneous name="Measure1" type="Resistance" samples="1" nominal="13.2kOhm"
      measuredVariable="DEPENDENT" measurement="0" count="0" gateTime="1"
      condition="NONE" GO="0" NOGO="0" HI="0" LO="0" UL="0" LL="0" channels="0"/>
  </std:Signal>
as ls1
<TPL>*/
1641 Signal Translator

- TPL statements extracted
- newWaveX SD validates
- newWaveX PD allocates
- Native driver code is generated

Key:

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1641 Signal Translator

Capability Driver Description

- Each of the 1641 interface elements is used to build up a dictionary of driver functions to implement each capability:
  - `Require (<SignalDescriptor>)`
  - `Run(<timeOut>)`
  - `Change(<timeOut>)`
  - `Stop(<timeOut>)`

- Additionally:
  - `.attribute`
  - `Create` (to control object lifetimes)
  - `Destroy` (to control object lifetimes)
1641 Signal Translator

Capability Driver Description

- Driver element used without Member element.

- Supports non-OO paradigm.
  - Note that CVI example is not object orientated.

- Supplements ATML Capabilities (e.g. Test Station Description) to describe the native driver actions needed to implement each capability.

- In this case, used to describe the TSFs provided by the 1641 Runtime.
1641 Signal Translator

Capability Driver Description

- Alternative C# example.
- Shows object orientated languages.
  - As does 1641
- Note use of Member element.
1641 TSF IDL Generator

• Parses ATML Test Station Description using newWaveX, to extract a list of TSF libraries.

• Loads each TSF library into newWaveX SD, which exports its interface definition as IDL.

• Combines IDL to create a Test Station IDL.
Signal Routing – Part 1

TPL to IVI Translator

- Parses TPL Connect/Disconnect.
- Traces Capabilities to Resource Ports in ATML Test Station Description
- Constructs IVI Switch statement to connect TPL stated pin to traced Resource Port.
Signal Routing – Part 2

IVI Switch Wrapper

- Provides IVI Switch Wrapper around Xpress Services.
- Implemented in CVI, for inclusion in the ATML Importer output test action file.
1641 Runtime Environment – Part 1

1641 Runtime

- IDL compiled to a type library.
- Type library imported into a Visual Studio C# project.
  - Generates function and attribute stubs.
- Trace statements added to stubs provide for validation.
1641 Runtime Environment – Part 2

Test Executive and ATML Test Results

- Test Stand Sequence
- CVI Test Actions
- ATML Toolkit Test Results Generation

Accessing a .Net Implementation of a Test Station Runtime Interface from CVI:

- 1641 Runtime CVI Wrapper

Note: Specific to CVI as a test carrier language.
Alternative Carrier

• A C# test program, produced by MoD 1641 Demo 2.5.

• ATML Test Station and 1641 TSF libraries are used to build a 1641 runtime, as before.

• The 1641 Demo 2.5 test program may be successfully executed against the new 1641 Runtime.

Note: This scenario is equivalent to producing a new test program on the test station, rather than importing and translating a test program from different or historical test station.
Conclusions

• Provided a complete working ATS software framework.
  – Sees ATML Test Description through to UUT test pin.

• Meets DEFSTAN 66-31 (Open Systems Architecture); in particular:
  – IEEE 1641.
  – IEEE ATML.

• ‘Open source software’ suite of source code
  – Managed by the UK MoD
  – To be developed by contractors to the MoD and coalition partners.

• COTS tools from 3 manufacturers have been used to fulfil the ATML, 1641 and signal routing requirements.

• A code base that is readily useable and able to be built upon by a large group of developers and maintainers, now and in the future.
Conclusions

Specifically, the framework is broken down into the areas of:

- **ATML Test Description** Importer – converting test requirements into a test program implementation carrying 1641 Test Procedure Language.

- **1641 Signal Translator** – mapping test signal requirements onto test resource capabilities (making use of ATML Test Station Description).

- **Signal Routing** – connecting test resources to UUT pins.

- **1641 Test Signal Framework IDL Generator** – generating a run-time interface from 1641 signal libraries.

- **1641 Run-time** – implementing a 1641 runtime interface with calls to underlying test resources.
Thank you for your attention!
ATML Importer

Loading ATML Test Description
ATML Importer

Generated Test Stand Sequence
ATML Importer

Generated CVI Test Actions
1641 Signal Translator

Translation and Validation via ATML Test Station
1641 Signal Translator

CVI Test Actions Translated
1641 TSF IDL Generator

ATML Test StationParsed for TSF Libraries and Converted to IDL
1641 Runtime Environment – Part 1

IDL to Type Library
1641 Runtime Environment – Part 2

CVI Test Actions Compiled and Executed

Test Sequence Passed
ATML Test Results

Test Station: TES-BUILD-09PRD
Operator: administrator
Unit: NONE
Unit Type: hardware
Test Description document reference: {FOED240A-AB41-447e-B8B8-1A46F8D43C48}

References:
- Reference: 9715D1B5-2F25-4aa3-A999-6BD04CFDE4
- Name: Theory of Operation
- URL: file:///C:/Work/ATML/TestDescription/Samples/TheoryOfOperationSample.doc

Result Set (15):
- C:\USA-RTS\ExchangePointData\TestProgram\ATMDemo1.0.4\Report\Empty_UUT_SerialNo[15 48 45][10 07 2012].xml

Outcome: Passed

- MainSequence TestGroup (15):
  - C:\USA-RTS\ExchangePointData\TestProgram\ATMDemo1.0.4\seq#MainSequence
  Outcome: Passed
  - Xpress Services SessionAction (16):
    Outcome: Done
  - Set Remoting URI SessionAction (17):
    Outcome: Done

- SequenceCall TestGroup (18):
  - C:\USA-RTS\ExchangePointData\TestProgram\ATMDemo1.0.4\seq#FaultDetectionAndIsolation
  Outcome: Passed
  - TestGroupSessionEntryPoint SessionAction (19):
    Outcome: Done
  - V_OC_in_DND_Resistance Test Test (28):
    Outcome: Passed
      - TestResult: Numeric
      - TestResult Type: Double
      - TestResult Value: 42 kOhm
      - Limit Comparator: GE