

# OPC UA – Test automation for regression & application testing with Robot Framework

Valmet

Mika Karaila

# Agenda

## Y Motivation

## Y Robot Framework

- Basics & principles
- OPC UA – FreeOpcUa
- RIDE

## Y Use cases

- Unit & regression testing
- CI – Jenkins build & test automation

## Y Demo

## Y Summary

# Motivation

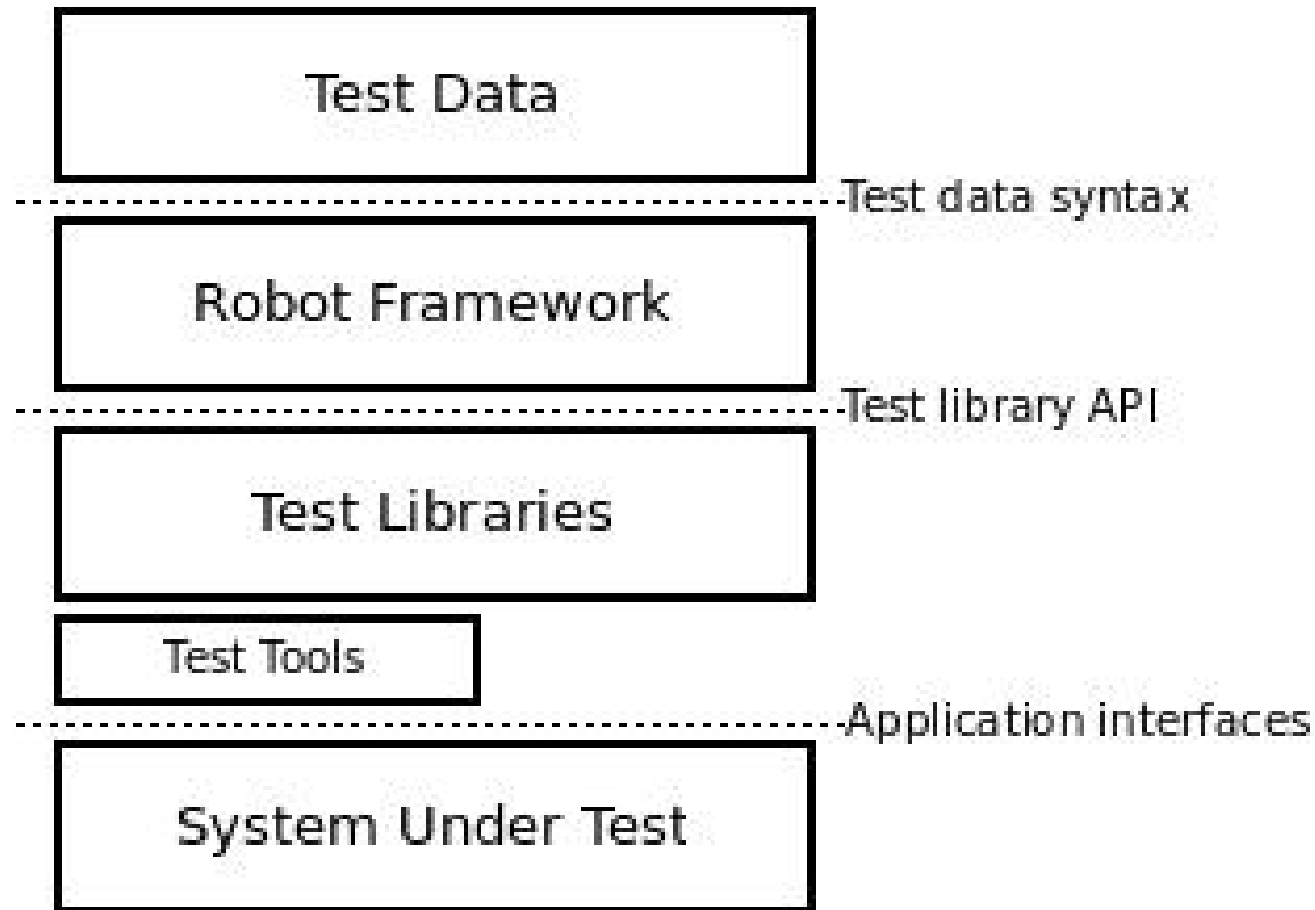
- ÿ How to test large software that is not totally in your hands?
- ÿ Refactor code asset totally, will it work in the same way?
- ÿ Did you improve your code or is it slower than earlier version?
- ÿ Do you want to run manual 100 step tests every day 5 times?

# Robot Framework

<http://robotframework.org/>

- Y Robot Framework is a Python-based, extensible keyword-driven test automation framework for end-to-end acceptance testing and acceptance-test-driven development (ATDD). It can be used for testing distributed, heterogeneous applications, where verification requires touching several technologies and interfaces.
- Y The framework has a rich ecosystem around it consisting of various generic test libraries and tools that are developed as separate projects.

# Robot Framework architecture



# Extending Robot Framework

## Add your own TestLibraries

- ÿ In Valmet case two additional libraries
  - DNA communication (based on DLL library)
  - OPC UA communication (based on Free OPCUA)
  
- ÿ Resource files for DNA and OPC UA:
  - Clear text keywords for test cases
  - Hide actual function complexity

# Valmet use cases

- ÿ Basic unit test cases for type conversions
- ÿ Quality mapping between DNA and OPC UA
- ÿ Table access
- ÿ Event testing:
  - DNA alarms synced to OPC UA
  - Limit alarms
  - Discrete alarms

# DNA alarms & OPC UA Events

Alarm hierarchy, possible to get selected hierarchy alarms

The screenshot displays the Unified Automation UaExpert interface. The main window shows a project configuration with a tree view on the left and a central table of alarms. The tree view shows a hierarchy starting with 'Project' and 'Servers', leading to 'DNA-NodeOPCUA'. Underneath, there are 'Documents' and 'Data Access View'. The 'Address Space' section shows a 'Root' node with 'Objects' and 'Alarms'. The 'Alarms' folder is expanded to show a 'T1A1' folder, which contains several sub-folders like '/dnaAlarmArea/T1A1:BALEHS', '/dnaAlarmArea/T1A1:HARDWL', and '/dnaAlarmArea/T1A1:PULPDS'. Below these are 'DNA' and 'TP01' folders, with 'TP01' containing a 'pr' folder and several alarm objects like '220CTM', '220E-001', etc.

The central table lists the following alarm data:

A	C	Time	Severity	Server/Object	SourceName	Message	EventType	Active
		8.10.2017 13...	700	DNA-Node...	270GSV1-283	Disturbance	DNAdiscret...	Inactive
		8.10.2017 13...	700	DNA-Node...	270GSV1-284	Disturbance	DNAdiscret...	Inactive
		8.10.2017 13...	700	DNA-Node...	270GSV1-285	Disturbance	DNAdiscret...	Inactive
		8.10.2017 13...	700	DNA-Node...	270GSV2-283	Disturbance	DNAdiscret...	Inactive
		8.10.2017 13...	700	DNA-Node...	270GSV2-284	Disturbance	DNAdiscret...	Inactive
		8.10.2017 13...	700	DNA-Node...	270KZ1-301	ACTIVE	DNAdiscret...	Inactive
		8.10.2017 13...	700	DNA-Node...	270KZ1-304	OPENED	DNAdiscret...	Inactive
		8.10.2017 13...	700	DNA-Node...	270PS1-035...	SEC CARR TS	DNAdiscret...	Inactive
		8.10.2017 13...	700	DNA-Node...	270PS2-035...	SEC CARR ...	DNAdiscret...	Inactive
		8.10.2017 12...	700	DNA-Node...	270TC-016	Meas. < LL	DNAlimitAl...	Inactive
		8.10.2017 13...	700	DNA-Node...	270W11-141	Acknowledge	DNAlimitAl...	Inactive
		8.10.2017 13...	700	DNA-Node...	270E-001...	Interlock	DNAdiscret...	Inactive
		8.10.2017 13...	700	DNA-Node...	270E-001...	Interlock	DNAdiscret...	Inactive
		8.10.2017 13...	700	DNA-Node...	270E-001...	Interlock	DNAdiscret...	Inactive
		8.10.2017 13...	700	DNA-Node...	270E-001...	Interlock	DNAdiscret...	Inactive
		8.10.2017 13...	900	DNA-Node...	270ES11-00...	Aux Voltage...	DNAdiscret...	Inactive
		8.10.2017 13...	900	DNA-Node...	270ES11-00...	Aux Voltage...	DNAdiscret...	Inactive
		8.10.2017 13...	900	DNA-Node...	270ES11-00...	Breaker Open	DNAdiscret...	Inactive
		8.10.2017 13...	700	DNA-Node...	284LI-002	Acknowledge	DNAlimitAl...	Inactive
		8.10.2017 13...	500	DNA-Node...	TEST-AM	Acknowledge	DNAlimitAl...	Inactive
		8.10.2017 13...	700	DNA-Node...	TM2-BWRL...	Cntrl disturb.	DNAdiscret...	Inactive
		8.10.2017 12...	700	DNA-Node...	TM2-CRC1...	Meas. < LLL	DNAlimitAl...	Inactive
		8.10.2017 13...	700	DNA-Node...	TM2-ODFF...	Cntrl disturb.	DNAdiscret...	Inactive
		8.10.2017 13...	700	DNA-Node...	TM2-ODRL...	Cntrl disturb.	DNAdiscret...	Inactive

The right side of the interface shows the 'Attributes' panel for the selected alarm, listing attributes like 'Nodeid', 'NamespaceIndex', 'IdentifierType', 'Identifier', 'NodeClass', 'BrowseName', 'DisplayName', 'Description', and 'WriteMask'. Below this is the 'References' panel, showing a list of references with 'Reference' and 'Target Display Name' columns.

The bottom of the interface shows a 'Log' window with the following entries:

Timestamp	Source	Server	Message
8.10.2017 14...	TypeCache	DNA-Node...	Reading type info of NodeId NS1 Numeric 1004 succeeded
8.10.2017 14...	TypeCache	DNA-Node...	Reading type info of NodeId NS1 Numeric 1265 succeeded
8.10.2017 14...	TypeCache	DNA-Node...	Reading type info of NodeId NS1 Numeric 1100 succeeded



# Demo

- ÿ RIDE and running some tests
- ÿ UaExpert to show OPC UA address space

# RIDE & run selected test cases

RIDE - Tests

File Edit Tools Navigate Macros Help

Tests

- OPCUA
  - \$(ref1)
  - \$(ref2)
  - \$(ref\_ints)
  - \$(ref\_ints2)
  - \$(fails\_48)
  - \$(fails\_128)
  - \$(uns8)
  - Test DNA basic types
  - Test OPCUA basic types
  - Test Ana
  - Test Ints
  - Test Intl
  - Test Fails
  - Test Bin
  - Test Binrev
  - Test Bo
  - Table types
  - Table\_value\_test
  - Test DNA\_list\_folder
  - Test OPCUA\_events
  - Test OPC basic types
  - Test AM HH events
  - Test AM H \ events
  - Test AM L \ events
  - Test AM LL events
  - Test AM FA events
  - Test OPCUA\_faults
  - resource\_dna.robot
  - resource\_opcu.robot
- External Resources

Execution Profile: pybot

Arguments: ae

elapsed time: 0:00:19 pass: 3 fail: 0

```

Test DNA basic types :: Test all basic type conversions between DNA. | PASS |
-----
Test Ana :: Test will run communication in both ways: | PASS |
-----
Test Ints :: Test will run communication in both ways: | PASS |
-----
Tests.OPCUA :: OPC UA server testing suite. | PASS |
3 critical tests, 3 passed, 0 failed
3 tests total, 3 passed, 0 failed
-----
Tests | PASS |
3 critical tests, 3 passed, 0 failed
3 tests total, 3 passed, 0 failed
-----
Output: c:\users\karaimi\appdata\local\teap\RIDEpnefen.d\output.xml
Log: c:\users\karaimi\appdata\local\teap\RIDEpnefen.d\log.html
Report: c:\users\karaimi\appdata\local\teap\RIDEpnefen.d\report.html

test finished 20171010 22:57:58
-----
20171010 22:57:50.339 : INFO : create_session
20171010 22:57:50.349 : INFO : activate_session
20171010 22:57:50.418 : INFO : Reference values=10 and -12
20171010 22:57:52.424 : INFO : Slept 2 seconds
20171010 22:57:52.431 : INFO : ${value} = 10
20171010 22:57:52.433 : INFO : Value=10
20171010 22:57:52.437 : INFO : read
20171010 22:57:52.441 : INFO : ${value2} = 0
20171010 22:57:52.443 : INFO : OPC UA value=0
20171010 22:57:52.445 : INFO : read
20171010 22:57:57.450 : INFO : Slept 5 seconds
20171010 22:57:57.466 : INFO : ${value} = -12
20171010 22:57:57.468 : INFO : Value=-12
20171010 22:57:57.471 : INFO : Testing done, closing connection & session.
20171010 22:57:57.471 : INFO : close_session
20171010 22:57:57.536 : INFO : close_secure_channel
20171010 22:57:57.536 : INFO : stop request
Ending test: Tests.OPCUA.Test Ints
-----
20171010 22:57:57.540 : INFO : Testing done, closing connection & session.

```

# Test report

## Tests Test Report

Generated  
20171010 22:57:57 GMT +03:00  
1 minute 17 seconds ago

LOG

### Summary Information

<b>Status:</b>	All tests passed
<b>Start Time:</b>	20171010 22:57:39.775
<b>End Time:</b>	20171010 22:57:57.544
<b>Elapsed Time:</b>	00:00:17.769
<b>Log File:</b>	<a href="#">log.html</a>

### Test Statistics

Total Statistics	Total	Pass	Fail	Elapsed	Pass / Fail
Critical Tests	3	3	0	00:00:15	<div style="width: 100%; height: 10px; background-color: green;"></div>
All Tests	3	3	0	00:00:15	<div style="width: 100%; height: 10px; background-color: green;"></div>

Statistics by Tag	Total	Pass	Fail	Elapsed	Pass / Fail
basic	3	3	0	00:00:15	<div style="width: 100%; height: 10px; background-color: green;"></div>

Statistics by Suite	Total	Pass	Fail	Elapsed	Pass / Fail
Tests	3	3	0	00:00:18	<div style="width: 100%; height: 10px; background-color: green;"></div>
Tests.OPCUA	3	3	0	00:00:18	<div style="width: 100%; height: 10px; background-color: green;"></div>

### Test Details

Totals
Tags
Suites
Search



<b>Type:</b>	<input type="radio"/> Critical Tests <input type="radio"/> All Tests
--------------	---

# Test log



## Tests Test Log

Generated  
20171010 22:57:57 GMT +03:00  
1 minute 44 seconds ago

### Test Statistics

Total Statistics	Total	Pass	Fail	Elapsed	Pass / Fail
Critical Tests	3	3	0	00:00:15	
All Tests	3	3	0	00:00:15	

Statistics by Tag	Total	Pass	Fail	Elapsed	Pass / Fail
basic	3	3	0	00:00:15	

Statistics by Suite	Total	Pass	Fail	Elapsed	Pass / Fail
Tests	3	3	0	00:00:18	
Tests . OPCUA	3	3	0	00:00:18	

### Test Execution Log

**SUITE Tests**

**Full Name:** Tests

**Source:** <D:\GIT\OPCUA\opcua\tests>

**Start / End / Elapsed:** 20171010 22:57:39.775 / 20171010 22:57:57.544 / 00:00:17.769

**Status:** 3 critical test, 3 passed, 0 failed  
3 test total, 3 passed, 0 failed

---

**SUITE OPCUA**

**Full Name:** Tests.OPCUA

**Documentation:** OPC UA server testing suite.

**Source:** <D:\GIT\OPCUA\opcua\tests\OPCUA.robot>

**Start / End / Elapsed:** 20171010 22:57:39.885 / 20171010 22:57:57.541 / 00:00:17.656

**Status:** 3 critical test, 3 passed, 0 failed  
3 test total, 3 passed, 0 failed

# UaExpert & address space

Unified Automation UaExpert - The OPC Unified Architecture Client - NewProject\*

File View Server Document Settings Help

Project

- Project
  - Servers
    - DNA-NodeOPCUA - None - None (uatcp-uasc)
  - Documents
    - Data Access View

Address Space

- No Highlight
- Root
  - Objects
    - Alarms
      - T1A1
        - /dnaAlarmArea/T1A1:
        - /dnaAlarmArea/T1A1:BALEHS
        - /dnaAlarmArea/T1A1:DRIVES
        - /dnaAlarmArea/T1A1:ETREAT
        - /dnaAlarmArea/T1A1:HOOD
        - /dnaAlarmArea/T1A1:MIXAPP
        - /dnaAlarmArea/T1A1:PULPDS
        - /dnaAlarmArea/T1A1:SOFTWL
        - /dnaAlarmArea/T1A1:TM
      - DNA
        - TP01
          - pr
            - 220CTM
            - 220E-001
            - 220E-001.B
            - 220E-001.D
            - 220E-001.REF
            - 220E-001BY
            - 220E-002
            - 220E-002.B
            - 220E-002.D
            - 220E-002.REF

Data Access View

#	Server	Node Id	Display Name	Value	Datatype	urce Timestar	rver Timestan	Statuscode
1	DNA-Node...	NS1 Strinql...	220CTM	0	UInt16	23.01.17	23.01.17	Good

Attributes

Attribute	Value
NodeId	NodeId
NamespaceIndex	1
IdentifierType	String
Identifier	220CTM
NodeClass	Variable
BrowseName	0, "220CTM"
DisplayName	""; "220CTM"
Description	""; ""
WriteMask	0
CanWriteMask	0

References

Reference	Target DisplayName
HasTypeDe...	BaseDataVariableType

Log

Timestamp	Source	Server	Message
10.10.2017 2...	AddressSpa...	DNA-Node...	Browse succeeded.
10.10.2017 2...	AddressSpa...	DNA-Node...	Browse succeeded.
10.10.2017 2...	AddressSpa...	DNA-Node...	Browse succeeded.

# OPC UA Diagnostics in Valmet DNA

Valmet DNA Operate D1U1/Boiler/D1UA OPC UA Server diagnostics

**D1UA OPC UA Server diagnostics**

**OPC UA Server** State **Running (0)** Seconds till shutdown **1** Current time **17-10-08 22:59:29** D1UA  
 Shutdown reason Start time **17-10-03 10:28:07**

**Version information**

ProductUri	DNA-NodeOPCUA
ManufacturerName	Node-OPCUA : MIT
ProductName	NODEOPCUA-SERVER
SoftwareVersion	0.1.0-6
BuildNumber	1012
BuildDate	Mon Jan 01 1601

**Diagnostics**  **On**

Diagnostics		Capabilities		OperationLimits	
ServerViewCount	0	MinSupportedSampleRate	OVF	MaxNodesPerRead	1000
CurrentSessionCount	2	MaxBrowseContinuationPoints	0	MaxNodesPerHistoryDataRead	10
CumulatedSessionCount	35	MaxQueryContinuationPoints	0	MaxNodesPerHistoryReadEvents	0
SecurityRejectedSessionCount	0	MaxHistoryContinuationPoints	0	MaxNodesPerWrite	0
RejectedSessionCount	0	SoftwareCertificates	0	MaxNodesPerHistoryUpdateDate	0
SessionTimeoutCount	12	MaxArrayLength	0	MaxNodesPerHistoryUpdateEvents	0
SessionAbortCount	0	MaxStringLength	0	MaxNodesPerMethodCall	0
PublishingIntervalCount	0	AggregateFunctions		MaxNodesPerBrowse	2000
CurrentSubscriptionCount	10	ModellingRules		MaxNodesPerRegisterNodes	1
CumulatedSubscriptionCount	79			MaxNodesPerTranslateBrowsePathsToNodeIds	0
SecurityRejectedRequestsCount	0			MaxNodesPerNodeManagement	0
RejectedRequestCount	0			MaxMonitoredItemsPerCall	0

**Sessions**      **Subscriptions**

# Summary

- ÿ Automate your software production process
  - Jenkins for building, packaging & automated tests
  
- ÿ Test automation importance, step by step evolution
  - Basic tests
  - Simple tests
  - Advanced tests
  - Stress & benchmark tests
  
- ÿ Other benefits:
  - Interoperability (different implementations)
  - People learning new techniques
  - Test asset coming as important as software asset

INTERNAL

