

CAPE-OPEN Test Suite

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Overview

- ❑ **PMC Test Suite**
 - What have we done since last year
 - Process for specifying the tests
 - Demo of latest beta
 - What's not in the beta
 - Plans for 2024 & 2025
- ❑ **PME Test Suite**
 - What have we done since last year
 - Plans for 2024 & 2025
- ❑ **Certification process**
 - How will certification work?
 - What is compliance?
 - How much effort will be required to certify a PMC or PME?
 - Plans for 2024 & 2025
- ❑ **How to contribute**
- ❑ **Questions & discussion**

PMC Test Suite

PMC Test Suite - Progress since last year

- ❑ Consistency of command line arguments improved
- ❑ Improved user interface
 - ⇒ Clearer terminology, more intuitive
- ❑ Now with 98 tests for Property Package interfaces and Identification
 - ⇒ Further tests still need to be implemented
 - ⇒ But current Beta is fully functional and will give meaningful results for developers of CAPE-OPEN software
- ❑ Improved reporting of summary of tests
 - ⇒ Tests executed = total number of tests actually attempted
 - ⇒ Tests skipped = skipped by user
 - ⇒ Not executed tests = tests that can't be completed because of the failure of a prerequisite
 - ⇒ Failed tests = tests that have specifically failed the test
 - ⇒ Total number of info, warning & error messages

 - ⇒ Further improvement in wording & detail is still required – any suggestions?

PMC Test Suite - Progress since last year (cont.)

- ❑ **UUID included in all test results and in test specification, to allow for quick location of the documentation for an individual test**
 - **All test specification documents will be made available**
- ❑ **Report (output) file is a JSON**
 - **Machine readable, schema published on CO-LaN website**
 - <https://www.colan.org/cots/jsonschema/report.schema.json>
 - **Enables use of an automated environment to run the tests (via command line interface) and analyse the results**
 - **Results file can be transformed into user required format using JSON schema and user-specific code**
- ❑ **68 tickets have been addressed, covering:**
 - **Other minor useability improvements**
 - **Defects identified through internal testing in**
 - **Test Engine**
 - **Test Implementation**

PMC Test Suite - Process for specifying tests

- ❑ **Relevant SIG defines a list of all tests**
 - ⇒ Purpose of the test and how it should be performed
- ❑ **Experience from the Thermo SIG has shown**
 - ⇒ This can be a complex, iterative process, over multiple SIG meetings. It therefore takes (a lot of) time
 - ⇒ Defining the tests may show up issues with the actual textual document describing the interface specifications
 - ⇒ Changes to the Errata & Clarifications will be required
- ❑ **Definition of test is passed to CO-LaN Software Developers**
 - ⇒ Turned into a full test specification & reviewed internally
 - ⇒ Implemented in Test Suite
 - ⇒ This is another iterative process
 - internally within Software Development Resource
 - and with SIG as well

Implications for releasing Test Suite

- ❑ Tests implemented in Test Suite are based on updated E&Cs
 - ⇒ The Test Suite can't be released as a production version until the E&Cs have been through the formal RFC process
 - ⇒ Otherwise CO components may fail testing because they do not adhere to the unapproved updated E&Cs
 - ⇒ Beta version of Test Suite could be supplied along with RFC, to aid understanding of why the E&C has been changed

PMC Test Suite - Demo of v0.2.2.0 Beta

Live demo!

PMC Test Suite - What's not in the Beta

- ❑ 3 tests for Property Routine
- ❑ 12 tests for Equilibrium Routine
- ❑ UI for configuration of test conditions for Property Routine & Equilibrium Routine
 - Easy to automate addition of extra test conditions
 - UI will also be provided to allow easy addition of test conditions by end-user
- ❑ Nested loop for Equilibrium Routine, with automatic generation of flashes to be performed
 - Currently only does flashes specified by the Test Suite user

```
"content": {  
  "condition_01": {  
    "type": "Node",  
    "content": {  
      "allowed_phases": [],  
      "solution_type": "",  
      "mole_comp": {  
        "type": "Node",  
        "content": null  
      },  
      "spec1": {  
        "type": "Node",  
        "content": {  
          "values": {  
            "basis": "",  
            "compound": "",  
            "phase": "overall",  
            "property": "temperature",  
            "values": {  
              "type": "CapeArrayReal",  
              "value": [  
                300.0  
              ]  
            }  
          }  
        }  
      },  
      "spec2": {  
        "type": "Node",  
        "content": {  
          "values": {  
            "basis": "",  
            "compound": "",  
            "phase": "overall",  
            "property": "pressure",  
            "values": {  
              "type": "CapeArrayReal",  
              "value": [  
                100000.0  
              ]  
            }  
          }  
        }  
      }  
    }  
  }  
}
```

PMC Test Suite - What's not in the Beta (cont.)

- ❑ **Basis conversions in Test Suite-provided Material Object**
- ❑ **12 Open tickets (required for testing of Property Packages), including**
 - **Finalisation of user documentation**
 - **Review & rewording of failure messages**
- ❑ **Tests for 3 common interfaces that may be used by Property Packages**
 - **ICAPEUtilities**
 - **ICAPEParameters**
 - Has been changed from released specification
 - Production COBIA is based unreleased modified version
 - Test Suite will therefore also be based on same unmodified version
 - **ICAPEPersistence**

Property Packages are defined in section 7.1.1

A Material Object client may get or set any basis-dependent Physical Property of a Material using any basis. It is the Material Object's responsibility to ensure that the client sees consistent values whatever basis is used. This means that the Material Object must:

- ❑ Allow a client to set any basis-dependent Physical Property on any basis.
- ❑ Allow a client to get any basis-dependent Physical Property using the basis with which it was stored.
- ❑ Perform basis conversions, or delegate basis conversion as necessary. If basis conversion is not meaningful (*e.g.* in the case of cement), the Material Object must be able to return the quantity in its original basis and to return an error should the quantity be requested in a different basis.
- ❑ Ensure that quantities set in one basis are consistent with quantities set in another basis, or delegate that function as necessary. Where the basis conversion on a quantity is not feasible, the Material Object must only store the quantity in the basis with which it was set most recently

PMC Test Suite - Plans for 2024 & 2025

□ 2024

- ⇒ Complete Property Package implementation
- ⇒ Except Common Interfaces
- ⇒ M&T will however need to define the required tests

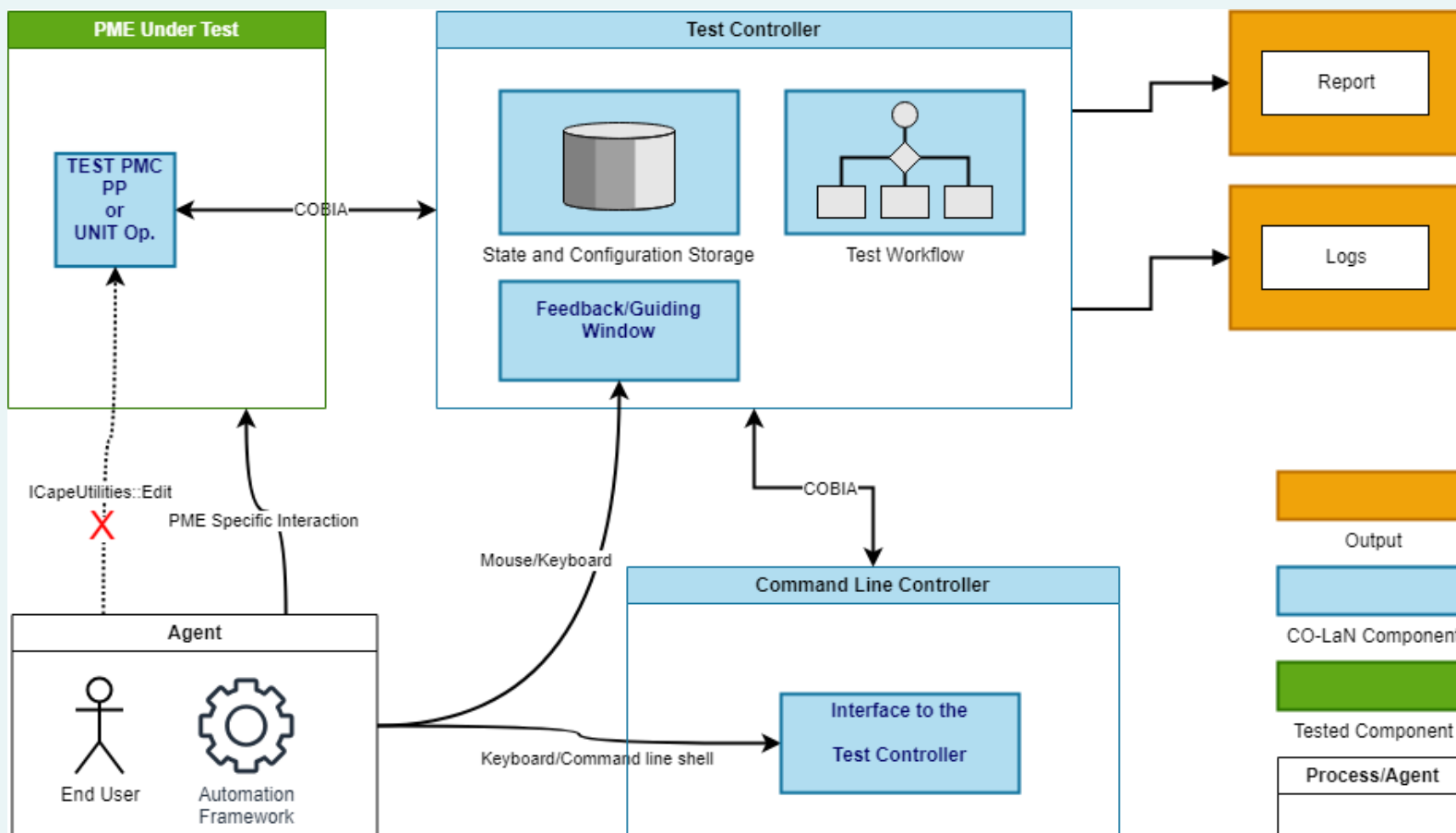
□ 2025

- ⇒ Implement required Common interfaces
- ⇒ Support to users of PMC Test Suite for Property Packages
- ⇒ PMC Test Suite for Unit Operations
- ⇒ Use Common Source documentation for all new documents?

PME Test Suite

PME Test Suite - Progress since last year

- ❑ Significant updates to design document
 - Including design of required external interfaces



PME Test Suite - Progress since last year (cont.)

- ❑ **Test Controller has 3 main functions:**
 - display the list of next required actions
 - allow the user to provide yes/no feedback
 - allow the user to control the testing process (particularly abort testing)
- ❑ **ICapeUtilities_Edit**
 - May not always be available
 - Therefore not used as part of the Test Suite
- ❑ **Major design decisions**
 - **Handling of multiple PMC instances**
 - Requires COBIA Phase 3 for implementation
 - **Windowing application:**
 - Written in C++
 - Native Windows (MS Windows)
 - GTK (Unix/Linux, MacOS)

PME Test Suite – Plans for PoC

- ❑ “Ultra-minimal” PoC
- ❑ Unit PMC testing, with no thermos
- ❑ Required steps:
 - Create IDL and stub-code
 - Create Test UNIT PMC framework
 - Create PME Test Suite Controller framework

PME Test Suite - Plans for 2024 & 2025

☐ 2024

- ⇒ Complete “ultra-minimal” PoC
- ⇒ Share with selected reviewers for feedback

☐ 2025

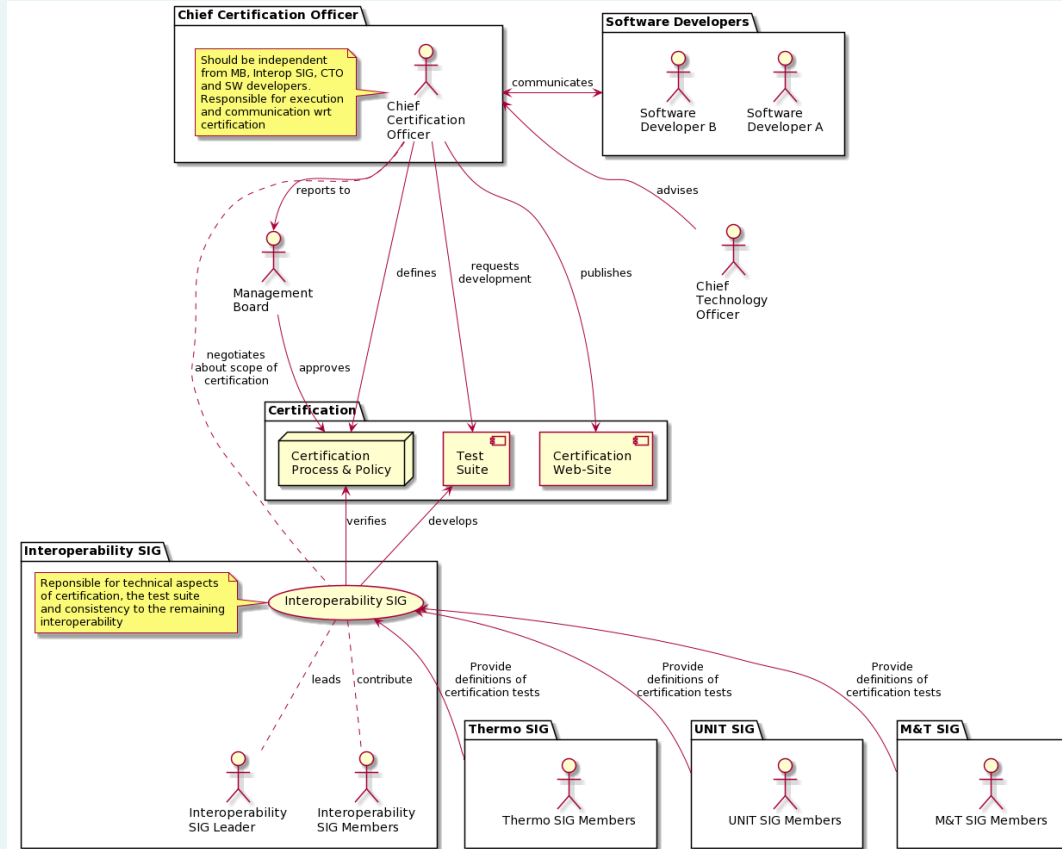
- ⇒ Further development of PoC
- ⇒ First release version?

☐ PMC Test Suite will take priority

Certification

Certification

- Proposal unchanged since Annual Meeting from 2022



- Flowchart from original presentation
- Interoperability SIG Leader effectively acting as interim Certification Officer

Certification - Process

- ❑ **Developer runs Test Suite on PMC or PME**
 - ⇒ **Sends output file to Certification Officer**
 - ⇒ **Certification Officer reviews output file**
 - ⇒ **Iterative process between developer and Certification Officer**
 - **To get answers to any questions arising from messages in output file**
 - **To allow developer to challenge tests**
- ❑ **Either**
 - ⇒ **Certification granted, or**
 - ⇒ **Developer modified software to address issues, or**
 - ⇒ **CO-LaN updates test specification and / or Test Suite**
- ❑ **Results published on Certification website**

Certification – Challenge to results or tests

- ❑ Email to certification@colan.org
 - Include details of the issue
 - Certification Officer & Interoperability SIG will review and discuss further with you
 - May need to be referred to relevant SIG
- ❑ Possible outcomes:
 - No change required to test specification or Test Suite
 - Developer re-reviews test results & identifies changes required to code
 - Test Specification needs to be modified
 - Needs SIG approval
 - Documentation updated
 - Test implementation updated in Test Suite or Test Suite itself modified
 - New release of Test Suite
- ❑ Test Suite needs to be modified
 - New release of Test Suite

Certification – Handling Test Suite messages

❑ Info messages

➤ **GetCompoundConstantPartialResults**

- No compound constant was found that is available for some but not all compounds. Testing is not performed

➤ **GetPDependentPropertyHandlesUndefinedList**

- List of supported pressure dependent properties is empty

➤ **GetTDependentPropertyHandlesUndefinedList**

- List of supported temperature dependent properties is empty

➤ **Are these important for certification?**

➤ **Manual process between CO-LaN and developer to ascertain?**

❑ Warnings

➤ **None currently described in test specifications**

➤ **But if there are, a similar investigation will be required**

❑ Errors

➤ **A direct result of a failure in another test**

➤ **Fixing the other test will result in the error no longer appearing**

➤ **But this test may then fail**

Certification – What is compliance?

- ❑ How to determine what is required for compliance

- ❑ Please note, I am acting as “devil’s advocate” – I want feedback from the wider community!

- ❑ Look at test specifications for:
 - ⇒ Property Routine
 - A CO method exists to give list of properties provided by a Property Package
 - ⇒ Equilibrium Routine
 - No CO Method available to provide list of supported flash types

Certification – Property Routine Option 1

- ❑ Test a few of the supported properties to check they calculate a value properly
- ❑ Test a few of the unsupported properties
 - ⇒ To ensure a value is not returned
 - ⇒ The request for an unsupported property is handled correctly
- ❑ Test that reordered compound list returns values
- ❑ Test that providing a subset of compounds returns values

Certification – Property Routine Option 2

- ❑ Test every property that is supported to check that they all calculate a value
- ❑ Test every property that is not supported
 - ⇒ To ensure a value is not returned
 - ⇒ The request for an unsupported property is handled correctly
- ❑ Test that reordered compound list returns values
 - ⇒ *Which are the same as those returned by the original compound order*
 - ⇒ *Within a tolerance*
- ❑ Test that providing a subset of compounds returns values
 - ⇒ *Which are the same as the values returned when the missing compounds have a composition of zero*
 - ⇒ *Within a tolerance*
- ❑ Thermo SIG have specified Option 2
 - ⇒ Complex implementation
 - ⇒ How is a suitable tolerance specified?
- ❑ Would Option 1 be sufficient for compliance?
 - ⇒ More detailed tests moved to Best Practice?

Certification – Equilibrium Routine Option 1

- ❑ Each test performs a set of flashes specified by the user
- ❑ Set of flashes needs to cover the basic functionality of Equilibrium Routine textual specification
- ❑ Test success requires that (for example, not an exhaustive list)
 - Results are written to the correct location
 - Unsupported flash types are correctly handled
 - Convergence failure is correctly handled
- ❑ Certification process would need to include a manual step to ensure that user provided flash specifications sufficiently test the implementation to demonstrate compliance

Certification – Equilibrium Routine Option 2

- ❑ User specifies a set of flashes
- ❑ *Test Suite automatically generates a full set of every possible flash type, with specifications derived from the results of the user specified flashes*
 - ⇒ *Including flash specifications in reverse order and all supported basis where this is relevant (e.g molar or mass volume)*
- ❑ *The automatically generated flashes are executed as an inner loop in each test, where the outer loop is the user-specified flashes*
- ❑ Test success requires that
 - ⇒ Results are written to the correct location
 - ⇒ Unsupported flash types are correctly handled
 - ⇒ Convergence failure is correctly handled
 - ⇒ *Values generated by auto generated tests are the same as the results from the user specified flash used to generate the specifications (within a tolerance)*

Comparison of Equilibrium Routine Options

- ❑ Thermo SIG have specified Option 2
 - ⇒ Very complex implementation
 - ⇒ How is a suitable tolerance specified?

- ❑ Is Option 1 sufficient for compliance?

- ❑ In Option 2, how is compliance established when there is no method to provide list of supported flash types?
 - ⇒ Vendor documentation?
 - ⇒ Vendor provided list?

Certification – How much effort will be required?

- ❑ Only open to CO-LaN members
 - ⇒ Puts a limit on number of times certification will be required?
 - ⇒ If non-members want to apply for certification, they need to join CO-LaN
- ❑ Will depend on what is compliance and how automated checking of it is
 - ⇒ Balance between cost of manual cost and cost of developing / maintaining automation

Certification - Plans for 2024 & 2025

☐ 2024

⇒ Nothing!

☐ 2025

- ⇒ Trial process on certification of one or more Property Packages
- ⇒ Using PMC Test Suite for Property Packages

How to contribute

- ❑ **Beta review of new versions of Test Suite**
 - **PMC Test Suite for Property Package**
 - **Now**

- ❑ **PMC Test Suite for Unit Operations**
 - **Sometime in (late) 2025**

- ❑ **PME Test Suite**
 - **Ultra-minimal PoC – end 2024**
 - **Release version – end 2025???**

- ❑ **Join the Interoperability SIG**

Questions & Discussion

- Questions on anything
- Discussion on what is compliance