

**Methods and Tools
Special Interest Group Report
CAPE-OPEN 2016 Annual General Meeting
Pullach/Munich, Germany**

**Bill Barrett
US Environmental Protection Agency**

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SIG Membership

Bill Barrett

U.S. EPA

Jasper van Baten

AmsterCHEM

Tony Garratt

Ansys

Daniel Wagner

DWSIM

Mark Stijnman

Shell Global Solutions

Jorge Martinis and

Michael Hlavinka

Bryan Research and Engineering

Loic d'Anterroches

Céondo GmbH

David Jerome and

Krishna Penukonda

Invensys (Schneider Electric)

Ongoing Activities

- ◆ **Common Interface conference calls**
 - ⇒ **First Wednesday of the month**
- ◆ **Flowsheet Monitoring conference call**
 - ⇒ **Second Wednesday of the month**
- ◆ **Object Model conference call**
 - ⇒ **Last Wednesday of the month**
- ◆ **Join? Please contact either SIG Leader or CTO**
 - ⇒ **Bill Barrett – barrett.williamm@epa.gov**
 - ⇒ **Michel Pons - technologyofficer@colan.org**

M&T SIG Charter

- ◆ Improve integration, and expand utilization of Computer-Aided Process Engineering (CAPE) applications within the enterprise through identification and resolution of existing cross-cutting issues with the CAPE-OPEN platform, develop mechanisms for use of CAPE within other application domains, and incorporate advances in information technology into the CAPE-OPEN platform.
- ◆ **Key responsibilities**
 - ⇒ Resolve issues with the common interface specifications.
 - ⇒ Develop and maintain standards and protocols for CAPE-OPEN implementations.
 - ⇒ Incorporate advances in information technology into the CAPE-OPEN protocols.
 - ⇒ Identify novel uses of CAPE and provide standards for utilizing CAPE within these applications.

No Change

M&T SIG 2015/2016 Activities

◆ Completed Errata and Clarification Documents:

- ⇒ Parameters (Peer reviewed and Published)
- ⇒ Persistence (Peer reviewed and Published)

◆ Ongoing Projects:

- ⇒ Type Library/.NET Primary Interop Assembly
- ⇒ Utilities Errata and Clarification Document
- ⇒ Error Handling Issues
- ⇒ Development of Flowsheet Monitoring Interface Specification
- ⇒ CAPE-OPEN Binary Interop Architecture (COBIA) Development

Type Library and .NET PIA

- ◆ **M&T SIG identified the need for the Type Library and made recommendation for development of the PIA**
- ◆ **Interoperability SIG is responsible for development**
- ◆ **Interop SIG asked M&T SIG about need for code signing**
 - ⇒ **M&T SIG recommended:**
 - All CO-LaN distributed software be code signed.
 - CO-LaN obtain a code signing certificate and develop protocols for its maintenance and use.
 - ⇒ **Current .NET Primary Interop Assembly installer is code signed.**
- ◆ **M&T SIG provided support to Interoperability SIG for the following:**
 - ⇒ **PIA .NET IPersistStream issue raised**
 - ⇒ **Deployment Issues**
 - ⇒ **Reference counting with msi/merge module**
- ◆ **Peer review of Developer Guidelines**

Published Errata and Clarifications

- ◆ **Completed Documents**
 - ◆ **Persistence**
 - ◆ **Parameter**
- ◆ **The M&T SIG followed CO-LaN's process for document review and publication.**
 - ⇒ **Request to CO-LaN membership for review comments**
 - ⇒ **Prepared responses to the review comments**
 - ⇒ **Modify document based upon comments and responses**
- ◆ **Responses are available to CO-LaN members in CAPE-OPEN RepositoryHosting idl folder.**
- ◆ **Errata and Clarifications published on CO-LaN website and included in Documentation Set zip file.**
- ◆ **The M&T SIG would like to *thank* reviewers.**

PARAMETER Common Interface

◆ Errata:

- ⇒ Real parameter upper bound is read only
- ⇒ Integer parameter default value is read only

◆ Clarifications:

- ⇒ The roles of PME, Parameter Owners, Parameter Clients
- ⇒ Parameter specification and validation
- ⇒ Dimensionality
- ⇒ Array Parameters

Persistence Common Interface

- ◆ **Background on COM Persistence**
- ◆ **Clarifications:**
 - ⇒ Use of COM persistence interfaces in the context of CAPE-OPEN applications
 - ⇒ Responsibilities of PME and PMC during persistence
 - ⇒ Enumerates what PMCs should save and restore.
- ◆ **Discusses fall-back persistence.**
- ◆ **Defines data types requirements for *IPropertyBag* implementations.**
- ◆ **Utilities Common Interface Errata and Clarification documents (in preparation) provides an overview of the object lifecycle and persistence's place in the lifecycle.**

Utilities Common Interface

- ◆ Requires Peer Review, final SIG review, and publication.
 - ⇒ **Please provide feedback!!**
- ◆ Clarifications:
 - ⇒ Identified Primary PMC Objects must implement *ICapeUtilities*
 - ⇒ Edit Method Return Value:
 - 0 = S_OK: PMC was modified
 - 1 = S_FALSE: PMC remains unmodified
 - ⇒ Simulation Context must be set prior to *ICapeUtilities.Initialize* for PMEs that provide Simulation Context.
 - *ICapeDiagnostic* to be available to PMC once Simulation Context is set.
 - ⇒ PMC Object Life Cycle steps enumerated.

Error Common Interface

◆ Issues identified:

⇒ Complexity

- CAPE-OPEN error handling not based on COM *ErrorInfo* API.
- CAPE-OPEN objects are required to expose all possible CAPE-OPEN error interfaces.
- Most CAPE-OPEN objects only expose *ECapeRoot* and *ECapeUser* and return *ECapeUnknownHR*.
- Error conditions are not transparent.

⇒ Logging tools are required to identify the cause of problems.

◆ Possible Errata and Clarification Document Pending

⇒ Looking for feedback from CO-LaN membership

◆ Some Error Handling Issues being addressed under COBIA

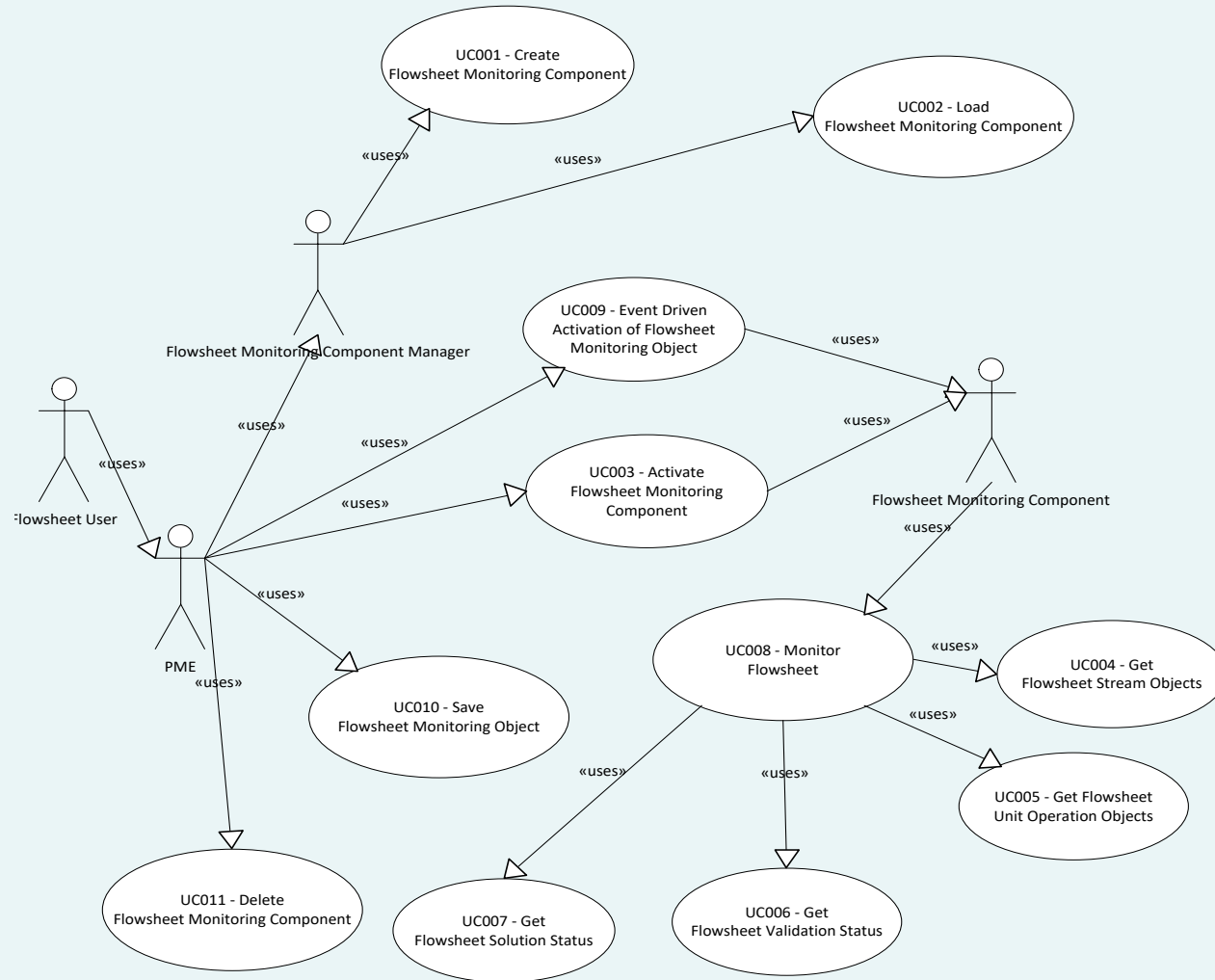
Flowsheet Monitoring Interface

- ◆ **New Interface Specification**
- ◆ **Currently under preparation by the M&T SIG**

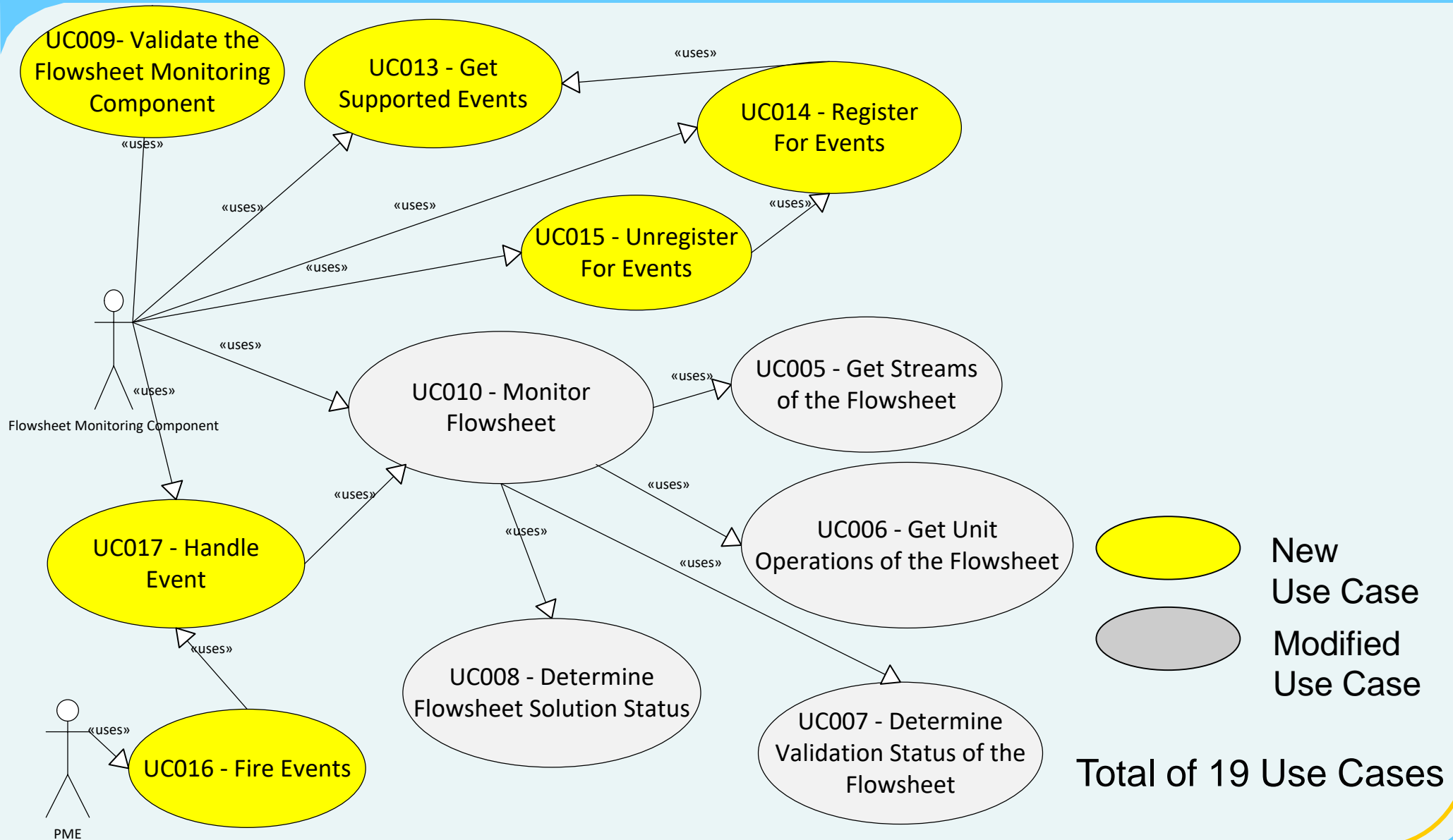
- ◆ **Formalizing Use Cases**
- ◆ **Finalizing Interface methods against Use Cases**
 - ⇒ **Check consistency with Use Cases**
- ◆ **Complete document for peer review anticipated prior to next CAPE-OPEN annual meeting.**

Flowsheet Monitoring: Use Case Map (Oct Y15)

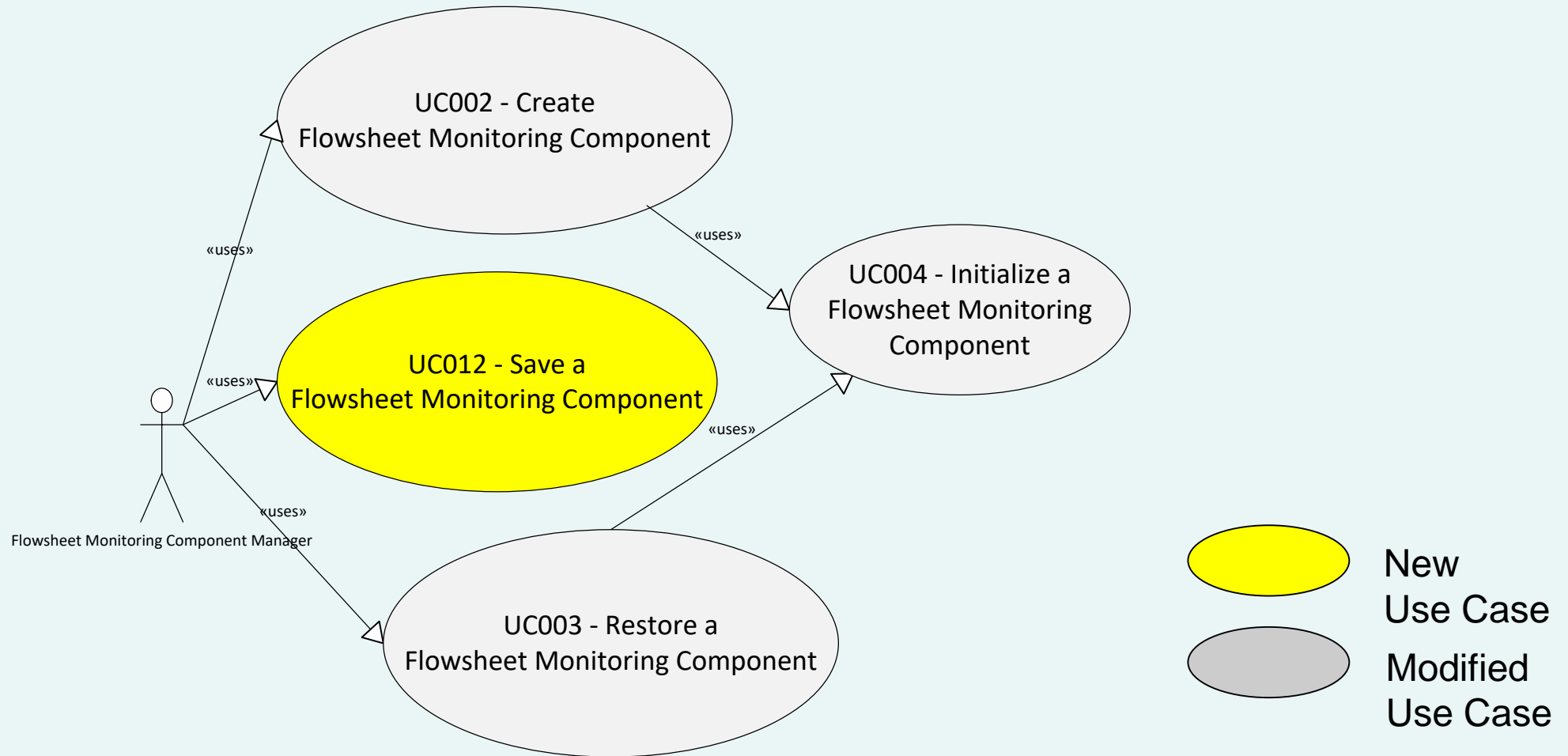
11 Use Cases



Flowsheet Monitoring: Use Cases current status



Flowsheet Monitoring: Use Cases current status



Total of 19 Use Cases

CAPE-OPEN Binary Interop Architecture (COBIA)

- ◆ **Phased Development**
- ◆ **Phase I – Proof of Concept**
 - ◆ Core technical components
 - ◆ Demonstrate COM/COBIA interoperability with Thermo 1.1 interface set.
- ◆ **Phase II – Full Windows Native**
 - ◆ Expanding COBIA to all interfaces of business value.
 - ◆ Allow development of fully functional COBIA-based PMEs and PMCs.
- ◆ **Phase III – Cross Platform Interoperability**
 - ◆ Microsoft .NET is planned.
 - ◆ Other platforms as identified by CO-LaN membership.

CAPE-OPEN Binary Interop Architecture (COBIA)

- ◆ **Phase I - (Completed, M&T Reviewed)**
 - ⇒ **COBIA Registry - register components and create instances**
 - ⇒ **Data type standardization**
 - ⇒ **Same source code compiled using:**
 - Visual C++ and Intel C++ on Windows
 - GCC (GNU Compiler Collection) C++ on both Windows and Linux
 - ⇒ **Demonstration of COBIA/COM interop using prototype property package and material object (CO-1.1)**
 - COM property package exercised by a COBIA material object
 - COBIA property package exercised by a COM PME

CAPE-OPEN Binary Interop Architecture (COBIA)

◆ Phase II - (Starting?)

- ⇒ Full set of CAPE-OPEN interfaces can be utilized in COBIA.
- ⇒ Full COBIA/COM Interop
- ⇒ Request other SIGs to review their interfaces (below).

◆ Phase III – Cross Platform Support (Future)

- ⇒ Expand language binding and interop (.NET).
- ⇒ Port to other platforms (as identified by CO-LaN members).
- ⇒ Marshaling between platforms.

CAPE-OPEN Binary Interop Architecture (COBIA)

- ◆ **Maintenance and support (CO-LaN)**
 - ⇒ Update of M&T Guidelines to include COBIA
 - ⇒ Documentation
 - ⇒ Distribution of source code and binaries
 - ⇒ Ongoing support

- ◆ **Separate COBIA technical presentation by Jasper**

Status of Interfaces

◆ Review of interfaces for COBIA Phase II

Business Specification Document	Responsible SIG
Utilities Common	Method and Tools
Collection Common	Methods and Tools
Error Common	Methods and Tools
Flowsheet Monitoring	Methods and Tools
Identification Common	Methods and Tools
Parameter Common	Methods and Tools
Persistence Common	Methods and Tools
Simulation Context COSE	Methods and Tools
Optimisation	None (Formerly Numerics)
Parameter Estimation	None (Formerly Numerics)
Partial Differential Algebraic Equations	None (Formerly Numerics)
Planning and Scheduling	None (Formerly Numerics)
Sequential Modular Sequencing Tools	None (Formerly Numerics)
Solvers	None (Formerly Numerics)
Chemical Reactions	Thermodynamics
Petroleum Fractions	Unit Operations
Physical Properties Data Bases	Thermodynamics
Thermodynamics 1.0	Thermodynamics
Thermodynamics 1.1	Thermodynamics
Unit Operation	Unit Operation

- ◆ Typically, interfaces without a SIG find limited or no use.
- ◆ Next slide provides recommendations for specific interfaces.

Interface Recommendations

- ◆ **Need a Numerics SIG to support (or retire)**
 - ⊃ Solvers
 - ⊃ Optimization
 - ⊃ Partial DAE
- ◆ **Thermo SIG update and replace (current activity)**
 - ⊃ Physical Property Database (PPDB)
 - ⊃ Chemical Reactions
- ◆ **Unit + Thermo SIGs update and replace (current activity)**
 - ⊃ Petroleum Fractions
- ◆ **M&T SIG update**
 - ⊃ Parameters
 - ⊃ Persistence
 - ⊃ Error
- ◆ **Evaluate need for, and assign to SIG**
 - ⊃ Parameter Estimate and Data Reconciliation (PEDR)
 - ⊃ Planning and Scheduling
- ◆ **Deprecate unused interfaces**
 - ⊃ Sequential Modular Sequencing Tools (SMST)
 - Limited number of methods
 - Unique solution for partitioning.
 - Most PME's handle internally.

COBIA Roadmap

◆ 2015/6

- ⇒ Complete Phase I development.

◆ 2016/7

- ⇒ Complete Phase II and Phase III development.
- ⇒ **Revise M&T SIG Common Interface Specifications to the COBIA.**
 - This will incorporate issues raised in the Errata and Clarifications documents published.
- ⇒ **Work with other SIGs to transition to COBIA.**
 - Likely minor modifications to interface specifications documents.
 - Will require COBIA IDL for the interfaces.

◆ 2017/8

- ⇒ Roll-out COBIA.
- ⇒ CO-LaN will maintain COBIA codebase and provide updates as needed.

2016/7 Deliverables

- ◆ **Errata and Clarifications Documents**
 - ⇒ **Utilities – Finalize peer review and publish.**

- ◆ **Flowsheet Monitoring interface:**
 - ⇒ **Finalize Document**
 - ⇒ **Peer Review**
 - ⇒ **Publish**

- ◆ **COBIA:**
 - ⇒ **Complete Phase II and III development.**
 - ⇒ **Update Error Common Interfaces.**
 - ⇒ **Update Parameter Common Interfaces.**
 - ⇒ **Update Persistence Common Interfaces.**

Disclaimer

The views expressed in this presentation are those of the authors and do not necessarily reflect the views or policies of the U.S. Environmental Protection Agency.