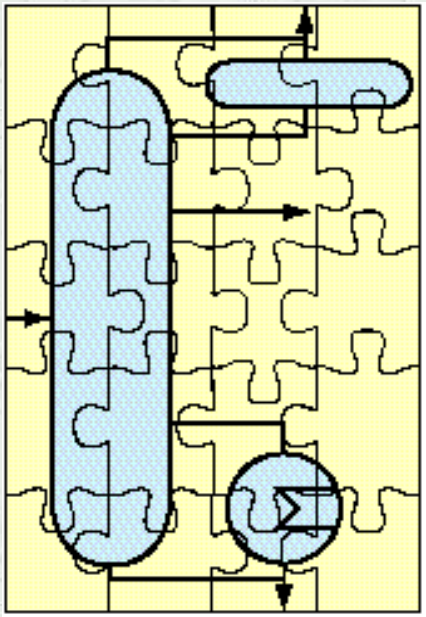
The CAPE-OPEN Standard and CO-LaN



Michel Pons
TotalFinaElf & CO-LaN

What CAPE-OPEN permits
What the standard is
What is CO-LaN
How you can use CAPE-OPEN
Conclusion

CAPE-OPEN Vision

CAPE-OPEN COMPLIANT SOFTWARE

UNITS'Я'US®

α–olefins reactor v12.3

Interface Specifications

www.colan.org

Software Download

The CAPE-OPEN Standard: What it permits

Demos of CAPE-OPEN Interoperability

- **Interoperability of Open Software Components in Commercial Simulator Executives**
  - Aspen Plus
  - HYSYS.Process
  - gPROMS
- **"Clean Build" BP PC**
  - No fixes
- **CAPE-OPEN Interfaces for:**
  - Unit Operations
  - Thermodynamics

The Flowsheet

- **Implemented in:**
  - HYSYS.Process
  - Aspen Plus
- **HDA (Hydrodealkylation) Model**
  - Industrially significant
  - Multiple distillation columns
  - Multiple recycles
  - Warning - Exhibits retrograde condensation
    - Some flash calculations (including TP and PV) can have multiple solutions!

Aspen Plus

HYSYS.Process

Example of use 1

- **A physical and thermodynamic properties calculations PMC** developed by a supplier**, can be used the same way within several CO-PMEs**.
- e.g. Infochem's Multiflash, can be used the same way in Aspen Plus, gPROMS or HYSYS.
- The user saves the time needed to configure the properties calculations parameters for those environments, and gets consistent results by using the same methods and data.
- This is simply obtained by wrapping the thermo server with CAPE-OPEN standard interfaces.

Example of use 2

- A CO-compliant PME **can transparently use several physical properties and thermodynamic servers** for one model.
- e.g. HYSYS can be configured to use Hyprotech ’s COM Thermo, or AspenTech’s Properties Plus, or Infochem’s Multiflash, or IFP’s SPIP proprietary thermo.
- This can be through replacing a single thermo server for the whole flowsheet, or even by combining different servers for different sections of the flowsheet (with precautions on the enthalpy basis).
- Thus, the modeler can easily try out diverse methods and choose the best.
- This is obtained by **introducing the CO « Thermo » API** in the PME.

Example of use 3

- **A Unit Operation model** such as a proprietary chemical reactor model, developed by an operator or a process licensor, **can be used transparently in CO-compliant PMEs**.
- e.g. IFP ’s FIBER (FIxed BEd Reactor) generic reactor model can be used the same way in most commercial PMEs without any change, without any coding or compiling.
- The process licensor can easily serve clients who demand the use of a specific PME in their contracts.
- This is obtained from putting the reactor model to the Unit Operation standard: introduction in a flowsheet, connection of input-output ports, specification of parameters, validity checking, calculation, publication of results.

Example of use 4

- Reciprocally, a modeler who uses a PME with CO Unit Operations « sockets » can **seamlessly include foreign unit operation models** by selecting from a list of available CO-compliant Unit Operations.
- This, the model designer can easily test several equipment models and choose the best equipment (a compressor, a heat exchanger, a pump etc.) for a specific process.
- This imposes that all equipment models are available on the user ’s machine. In the future, this will be possible thanks to the component identification services being developed for the internet.
- Equipment manufacturers should take advantage of this facility.

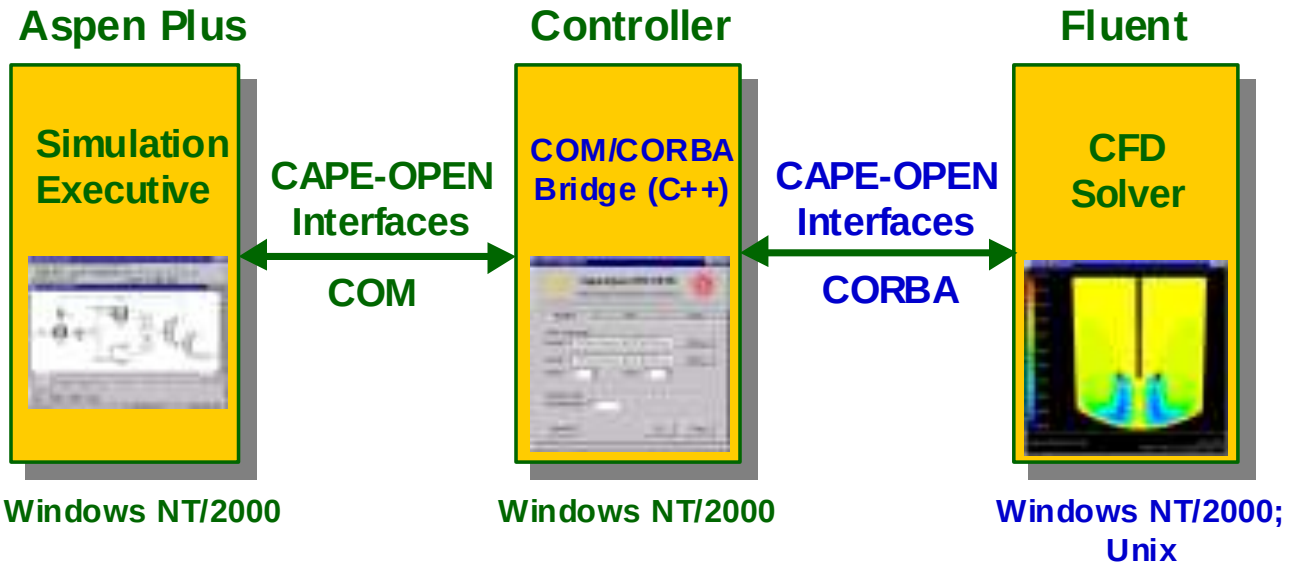
Example of use 5: gO:CAPE-OPEN

gO:CAPE-OPEN overview

- Introduce advanced gPROMS models within CAPE-OPEN compliant steady-state flowsheeting packages e.g.
  - ASPEN PLUS™
  - HYSYS™
- Use consistent physical properties throughout
- No programming required
  - retain advantages of gPROMS-based modelling

Example of use 6: Fluent-Aspen

COM/CORBA Bridge



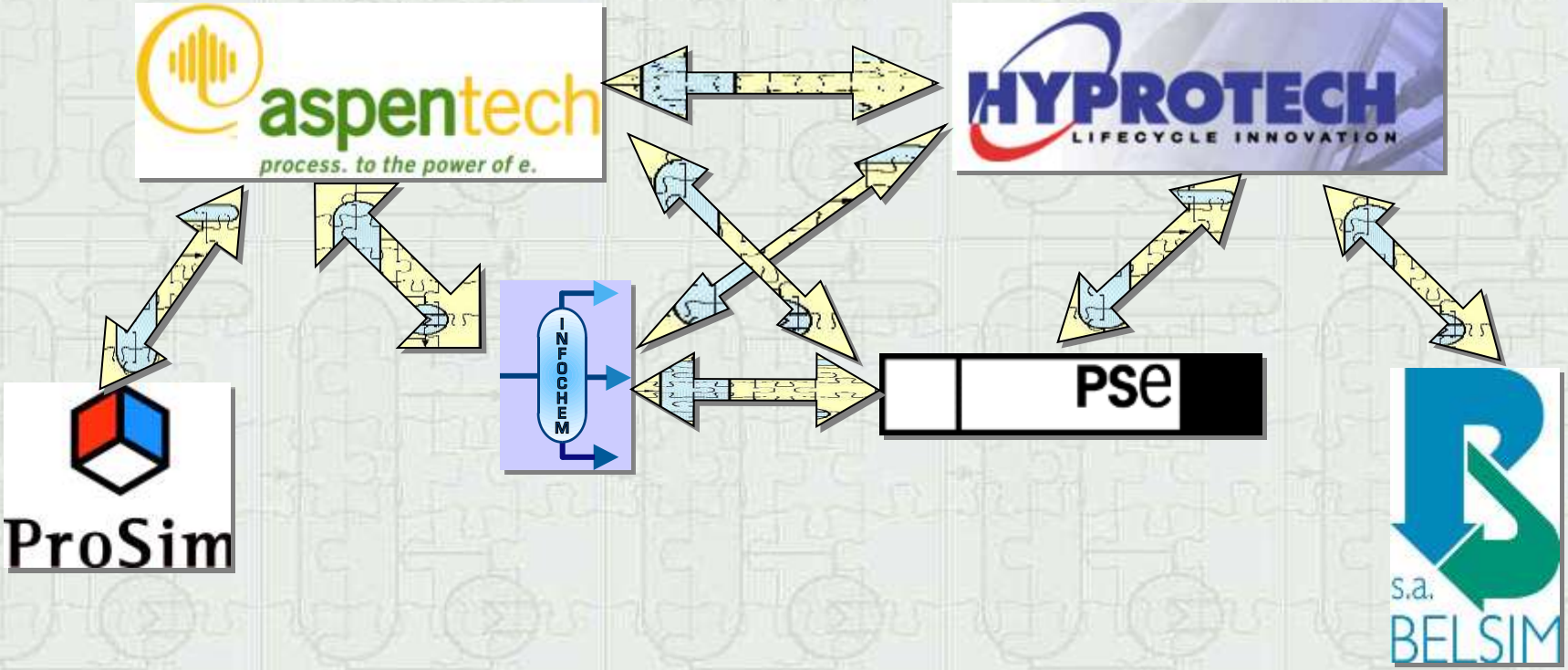
Advantages

- Fast bi-directional data exchange using inter-process communication
- Fluent process starts up and remains active
- Fluent runs on Windows and Unix systems

Other uses

- More than 10 published interfaces
  - Numerical solvers
  - Chemical reactions
  - Physical Properties Data Banks
  - Etc…
- Same kind of facilities as presented in other examples

Commercial Interoperability of Unit and Thermo

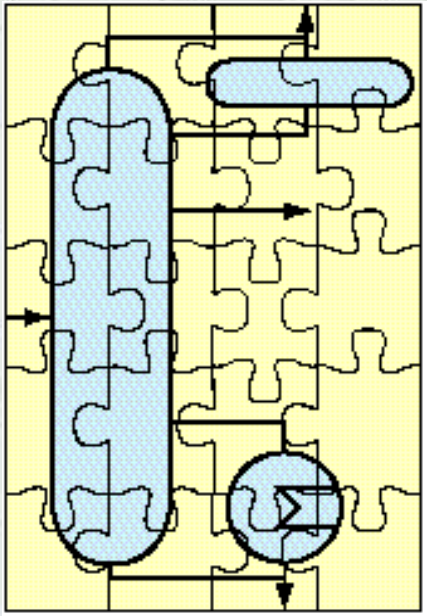


- Many combinations tested (not all)
- As well with some operating companies legacy software
- Almost no performance degradation in best case

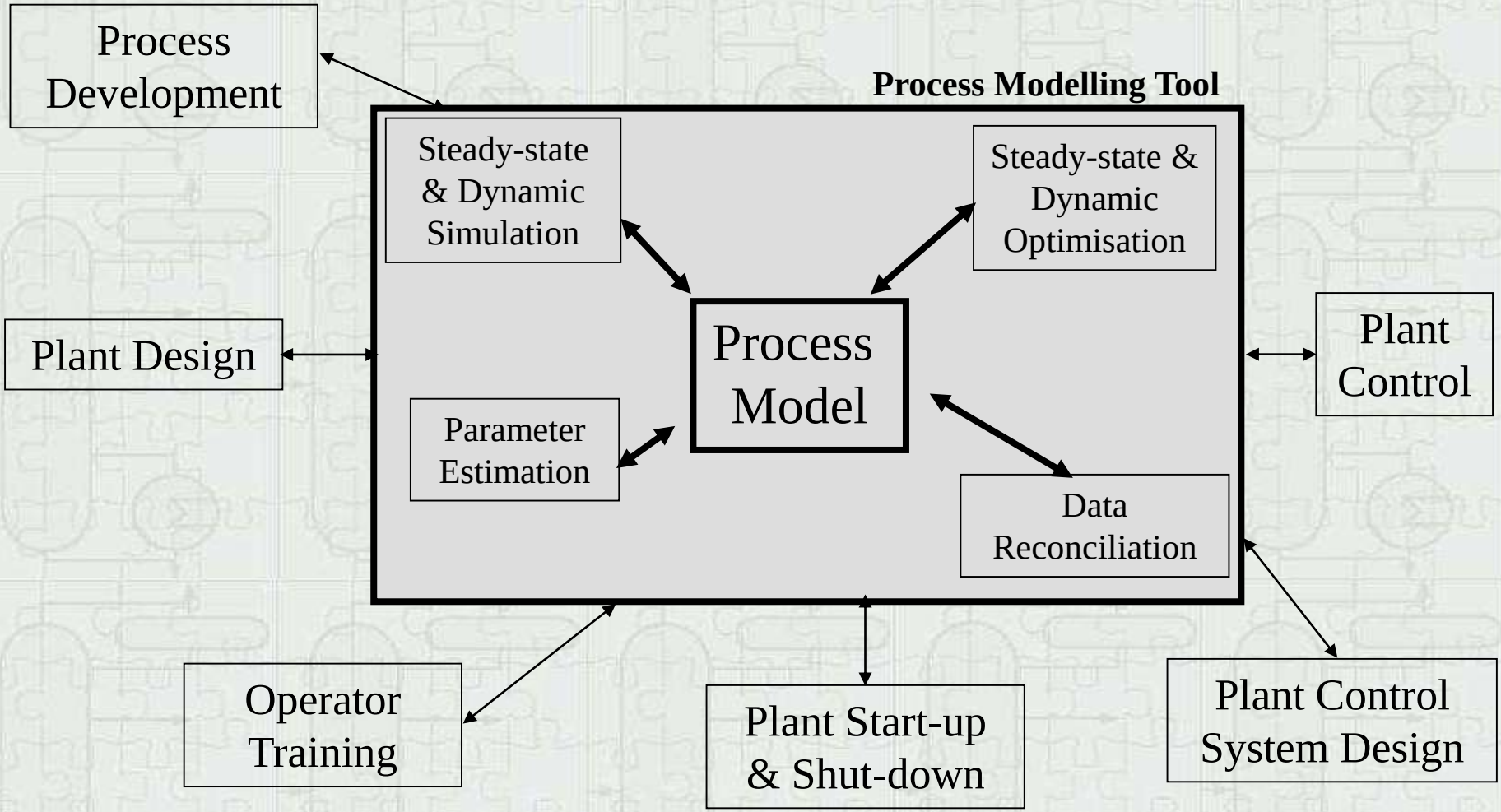
Available CO-compliant software

- **AspenTech - Hyprotech**
  - Aspen Plus 10.2, 11.1 & 12, Aspen Properties
  - HYSYS 2.4, 3.0, COM Thermo, Distil
- **Other Software providers**
  - SimSci: Pro/II v6 (1T03)
  - Dechema: DETHERM
  - Belsim, Infochem, ProSim, PSE, RSI, HTRI, Fluent...
- **Operating companies**
  - IFP, TotalFinaElf, BASF, Norsk Hydro, Shell…
- **Universities**
  - DTU, INPT, UPC, RWTH.LPT
- **CO-LaN**
  - Tester Suite

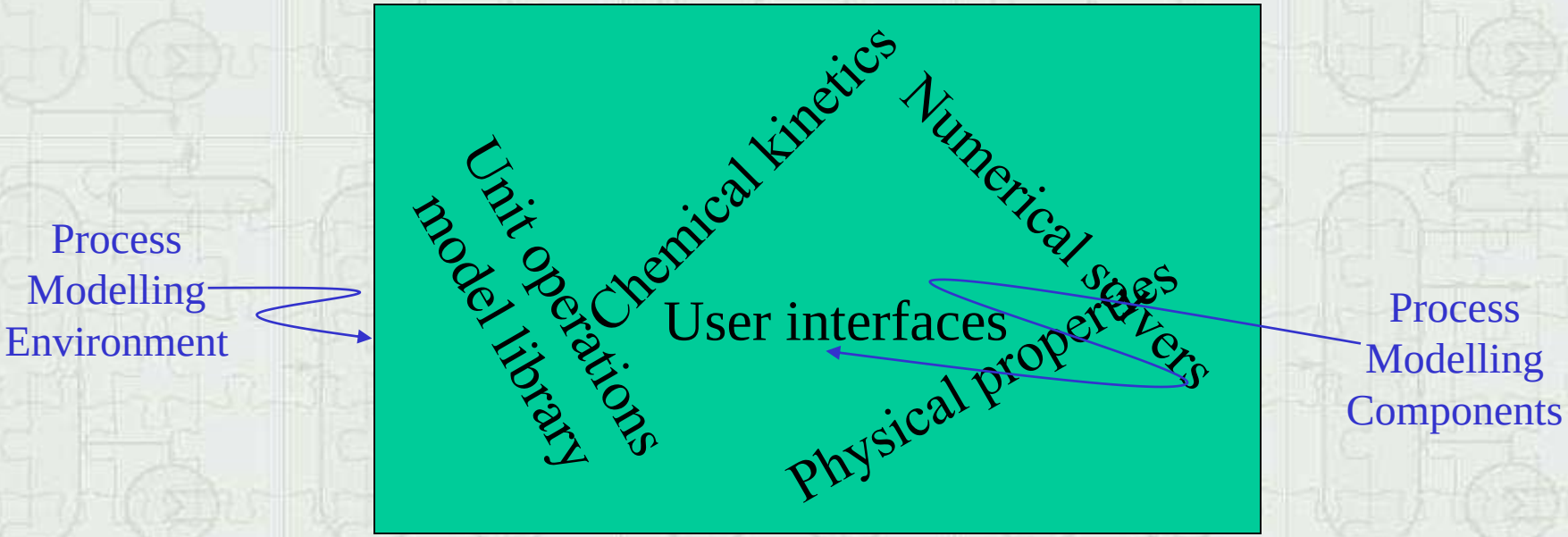
The CAPE-OPEN Standard
What it is



General-purpose process modelling tools



The anatomy of process modelling tools – a (somewhat) confusing reality



- Many interacting components…
- …all tightly coupled with each other
- Component boundaries not always clearly delineated

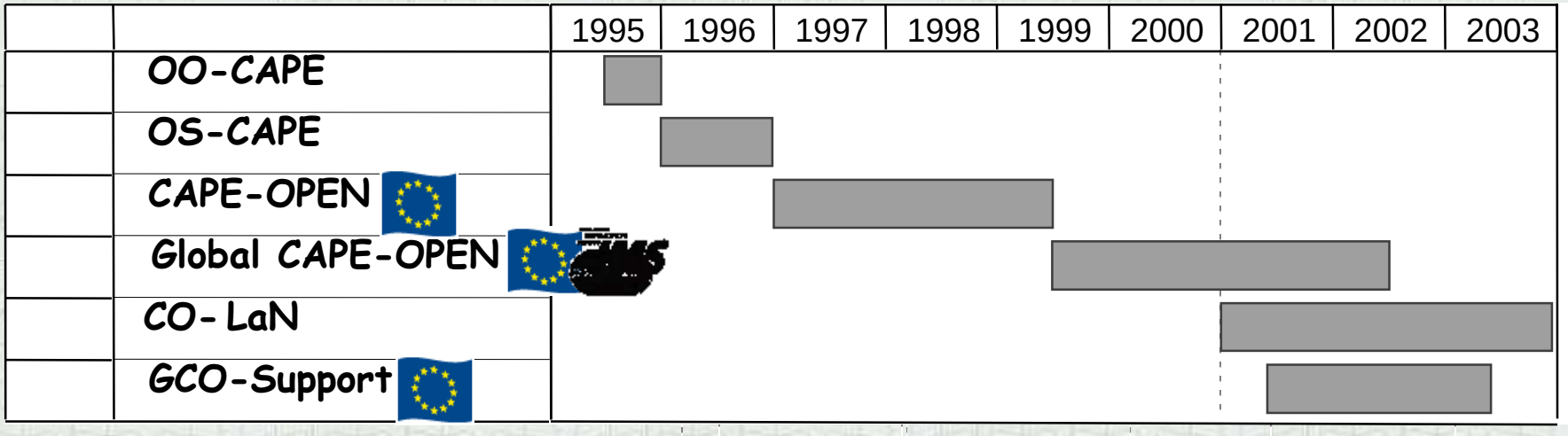
Process modelling: components & environments

- **Process Modelling Components (PMCs)**
  - Well-defined pieces of software, relatively narrow function
  - Wide range of applications
    - Physical properties
    - Unit operation modules
    - Numerical solvers
    - . . . . . .

Process modelling: components & environments

- Process Modelling Components (PMCs)
- Process Modelling Environments (PMEs)
  - Support construction of process model
    - From first-principles and/or library of unit operation models
  - Support a number of model-based applications
    - Simulation, optimisation, …
  - May make use of one or more PMCs

CAPE-OPEN projects



Users

IFP
TotalFinaElf
BP
Bayer
Dow
BASF
DuPont
Norsk Hydro

ICI
Shell
Air Products
UOP
Air Liquide
Mitsubishi
JGC

Suppliers

Honeywell
AEA
Aspentech
SimSci
QuantiSci
RSI

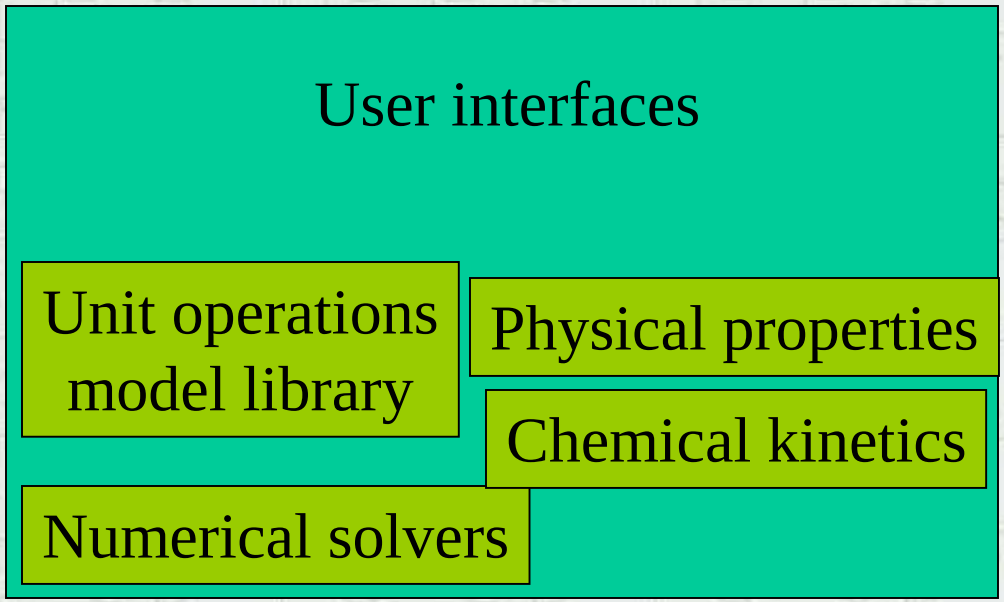
ProSim
Infochem
PS Enterprise
Belsim
Dechema
Protesoft

Academics

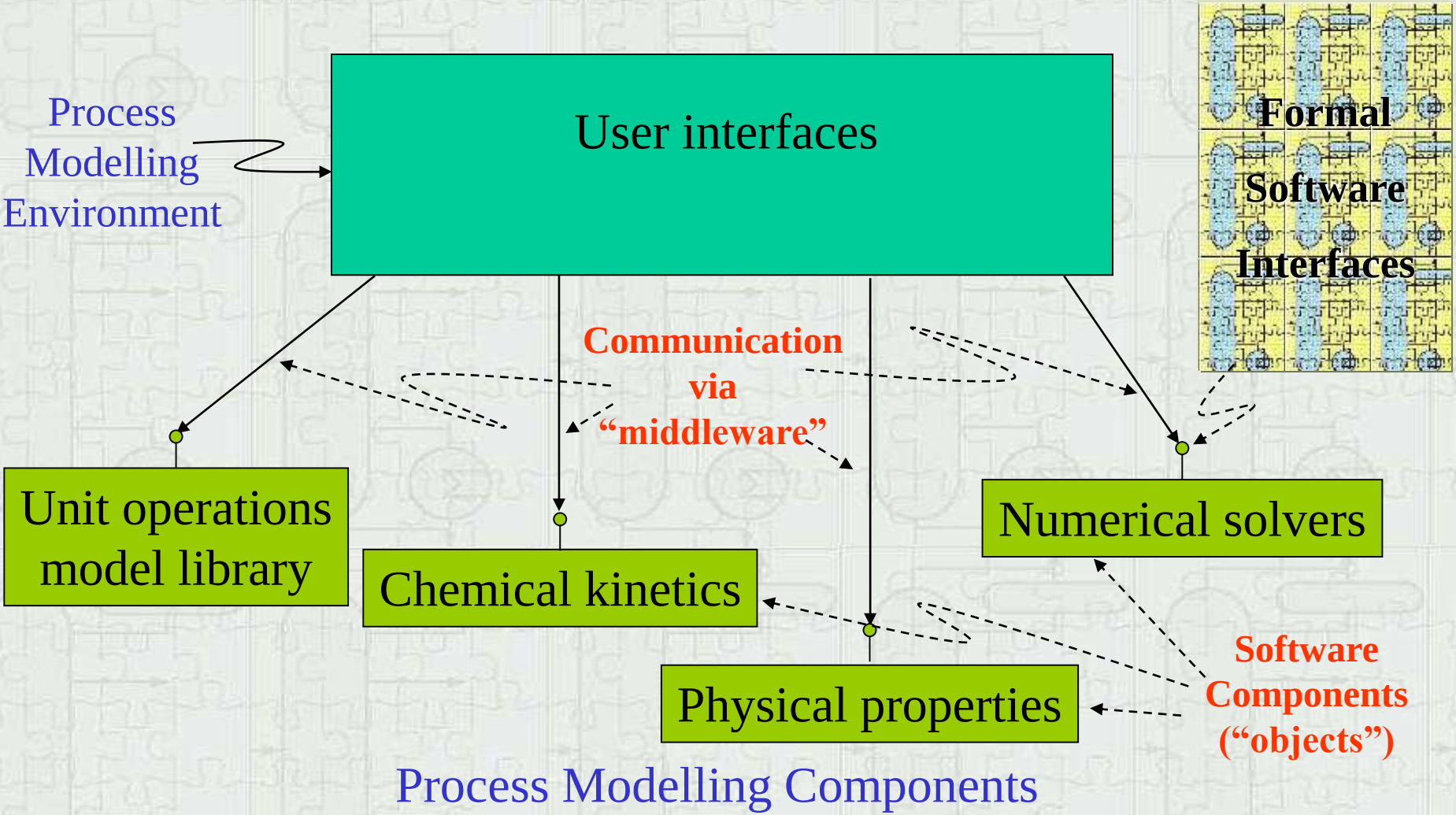
INPT
RWTH.LPT
RWTH.I5
Imperial Coll.
NTNU
Univ. Virginia

DTU
UPC
TITech
Kyoto Univ.
CMU
UMass

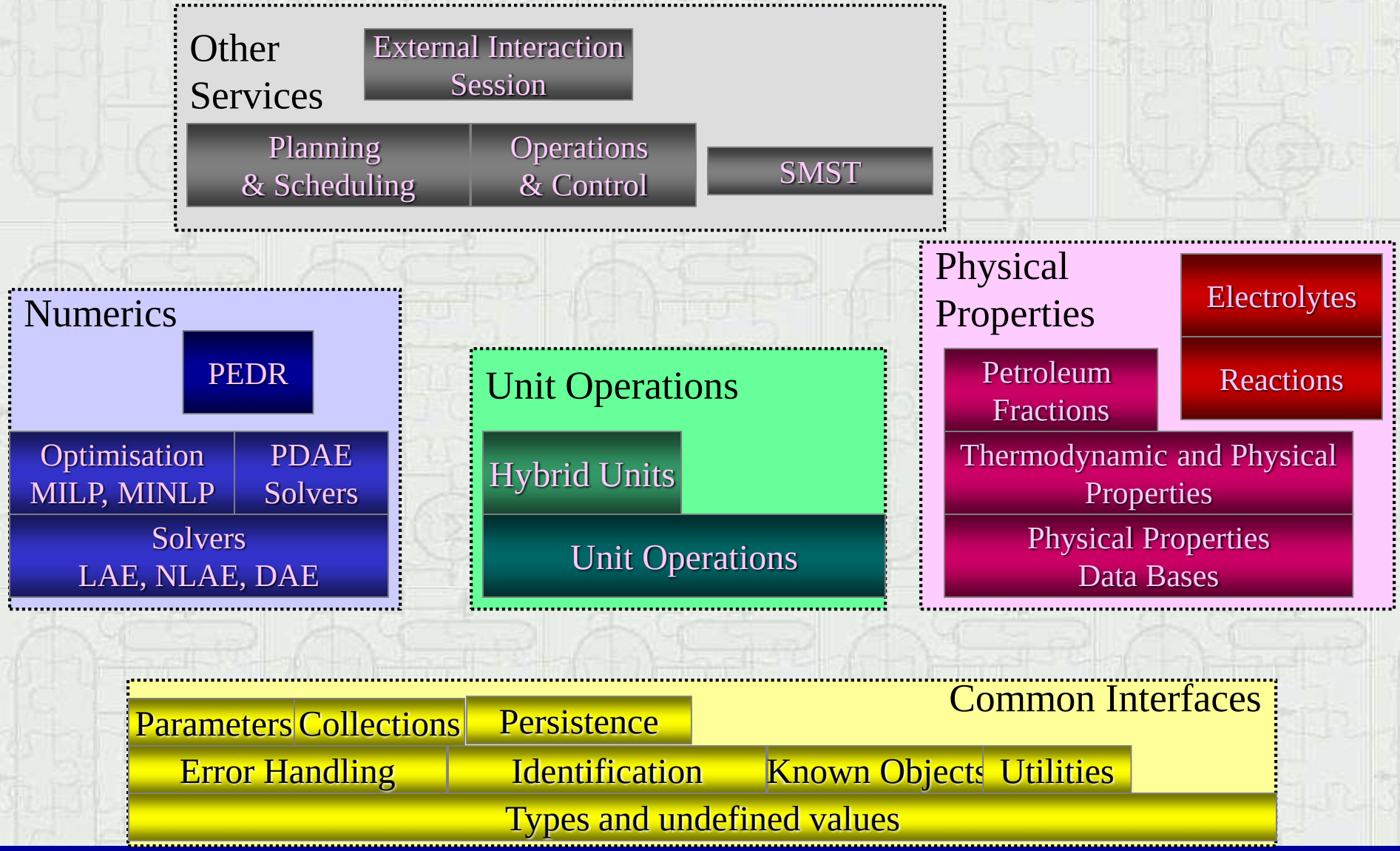
Clarify boundaries between key components



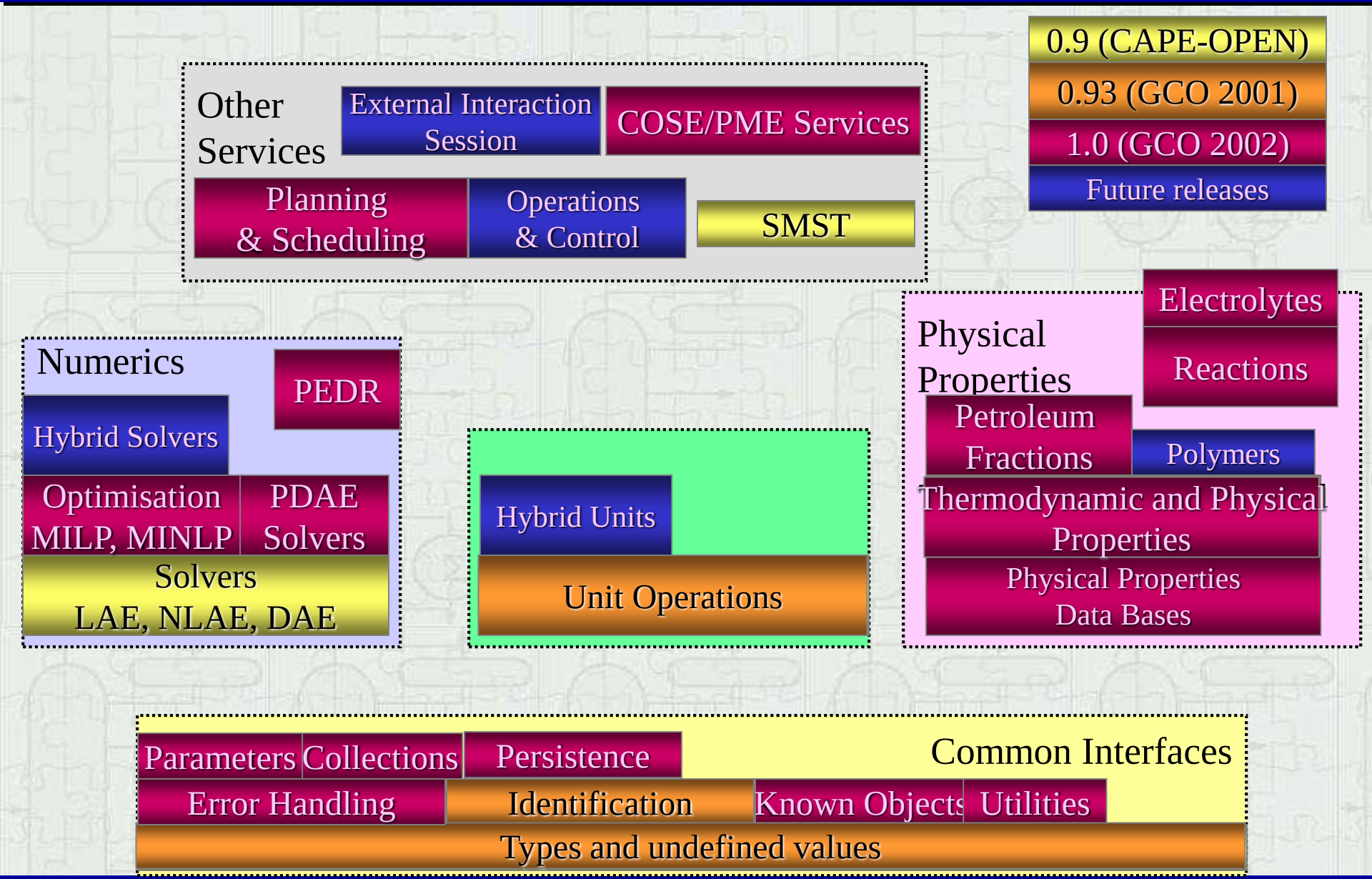
…and break tool into 1 PME & multiple PMCs



The BIG PICTURE : PMCs



The BIG PICTURE: releases



The CO-LaN
CAPE-OPEN Laboratories Network

A group of end users putting resources together to support ongoing work on the standard, taking responsibility for it

Need for an organization

- A standard needs to be
  - Distributed
    - Dissemination, free distribution, accompanying software, training programs
  - Supported
    - Information, documentation
  - Maintained
    - Corrections, debugging
  - Improved
    - Upgrade, extensions
- A standard can’t live by itself

The CO-LaN

- Non for profit organisation open to all CAPE players
- Established on February 8, 2001 (*www.colan.org*)

- Full members, pay fees
  - End user organisations: operating companies, process licensing companies, engineering companies
- Associate members, no fees
  - All others: software suppliers, universities, government, other non for profit institutions

Members (as of Jan. 2003)

- **Full**
  - Air Liquide
  - BASF
  - BP
  - Dow
  - IFP
  - JGC
  - Norsk Hydro
  - Shell
  - TotalFinaElf
- **Associate**
  - Infochem
  - UPC
  - ProSim SA
  - HTRI
  - Fantoft Process
  - SIMSCI
  - RWTH LPT and I5
  - DIPPR
  - University of Maribor
  - Dechema e.V.
  - AspenTech
- **Associate**
  - EPCON
  - CPERI
  - COSMOlogic
  - CAPEC-DTU
  - PSE Ltd
  - Virtual Materials Group
  - Fluent
  - TUV NEL Ltd
  - INP Toulouse

CO-LaN missions 1/2

- **User priorities for CAPE-OPEN standard**
  - Work with software vendors to clarify user priorities for process modelling software component/environment interoperability and also to promote communication and co-operation among CAPE software vendors to insure that the CAPE-OPEN standard actually translates into commercially valuable interoperability.
- **Exploitation and dissemination**
  - Promote the CAPE-OPEN standard to end-users and distribute CAPE-OPEN information and technology internationally.

CO-LaN missions 2/2

- **CAPE-OPEN specifications life cycling management**
  - Organise the maintenance, evolution, and expansion of the specifications following user priorities.
- **Testing, interoperability facilitation**
  - Supply compliance testers to support development of components, organise interoperability tests between suppliers of Process Modelling Components and Process Modelling Environments.
- **Training/Migration facilitation:**
  - Ensure that training modules guidelines and tools to facilitate component wrapping are developed and available.

Activities

- **Dissemination**
  - Web site, documents, CO Update Newsletter
  - Organize « CAPE-OPEN Tour » days
- **Develop independent testers and software**
  - CO-LaN Tester suite, wizards
- **Interoperability facilitation**
  - Organize & sponsor meetings
- **Organize SIGs on standards**
  - Trigger projects
  - Anyone can participate
  - CO-LaN might partially sponsor

SIGs

- The SIG is the typical approach that CO-LaN uses for CO standards development or revision.
- A SIG is composed of the appropriate representatives of CO-LaN full members and associate members, and is chartered by the CO-LaN Management Board (MB) with a specific task of CO standard development or revision …
- … As required and agreed upon by the SIG members, a SIG can involve participants who are not representatives of CO-LaN members to insure successful and timely accomplishment of the SIG charter.
- …

The CO-LaN SIGs as of Jan. 2003

- **THRM specification upgrade**
  - Leader: Werner Merk, DOW
  - Recent improvements worked with AspenTech / Hyprotech + others as well as extension to non molecular species
- **Unit Operation extension**
  - Leader: Knut Wiig Mathisen, Norsk Hydro
  - Dynamic simulation
- **SOLVER specification update**
  - Leader: Michel Pons, TotalFinaElf
  - Review current version in the light of recent prototyping and MINLP interface specification
- **Interoperability support**
  - Leader: Peter Banks, BP
  - Further progress on interoperability
- **Methods and Tools (in 2003)**

What does CO-LaN bring?

- **CO-LaN members are at the "learning edge", acquiring the ability to create business and technology architectures that take full advantage of transparent access to CAPE resources.**
  - **Web site with public and private access**
  - **Repository of specification documents**
    - **Supports standards dissemination and development**
  - **Repository of component information**
    - **Supports market for software components**
  - **CO Tester Suite for validation and testing**
  - **CO wizards (link or download)**

How you can use CAPE-OPEN

Specifications

Cookbook

Software testers

Wizards

Newsletter

Component Catalogue

Network of Experts

Specifications

- Published on www.colan.org
- Documents
- CORBA IDL
- COM Type Library

- You can use CAPE-OPEN specifications at no charge for any kind of use
  - Commercial, research, education…

Cookbook

- How-to document with examples
- Downloadable from www.colan.org

Software Testers

- The CO-LaN testers suite
- Binaries freeware downloadable from www.colan.org
- Will help you to develop CO-compliant PMCs and PMEs
- Use them as screening tools (prior to interop' checking)
- Demo

Software Wizards

- Automated generation of CO wrapper code
  - AspenTech's Unit Wizard
  - Hyprotech's Thermo Wizard
- Available on www.colan.org
- Demo

CAPE-OPEN Update

July 2002

CAPE-OPEN Update

an information service provided by the CO-LaN

Issue n°03 — *CAPE-OPEN: Ask for Help, Get Help, and Get Going!*

Editorial

Page 2

CAPE-OPEN: Ask for Help, Get Help, and Get Going!

CO-LaN means CAPE-OPEN Laboratory Network : use it!

Hot topics

Page 3 to 4

Latest News

- AspenTech/Hyprotech merger
- Connecting to www.colan.org is the best way to get informed (CO tour, ...)
- GCO summary
- A look into the future : COGents.

Page 4

Current Issues

Find out the CO-LaN SIGs (Special Interest Goups) and their leaders..

The user room

Page 5

User tips (software wizards)

read the technical article in this newsletter - it is a sort of «how to» for software component migration and more tips !

The technical room

Page 6 to 16

The Migration Cookbook

a paper to assist with migration of legacy software to the CO standard

Component directory (soon…)

- List of available CO compliant components
- Information on components
  - Vendor information:
    - Name, contact, vendor description (free text)
  - Technical description of the component (categorization):
    - IDL version, middleware technique, implemented interfaces
  - Metadata about the component
    - Component name, version, description, help (free text)
  - License information
  - Availability information
    - Where to get the component/download/request, object references
- Interoperability test report

Network of Experts

- The best CAPE-OPEN Experts contribute to CO-LaN SIGs
- Meet in CO-LaN activities
- Meet at CAPE Conferences and Software vendors Users meetings
- Ask any question!

Steps towards CO compliance

- Go to www.colan.org, learn about CO standards
- Download the latest version of the specification that you intend to implement
- Obtain a sample implementation
  - From CO-LaN or vendor's web site
- Wrap an existing component to be CO-Compliant
  - Possibly using wizards
- Download the CO Tester Suite for help and quick test
- Evaluate your software component with the Tester
- Network with CO experts for advice
- Conduct interoperability testing with PMEs in the CO-LaN Interoperability support SIG

Summary and conclusion

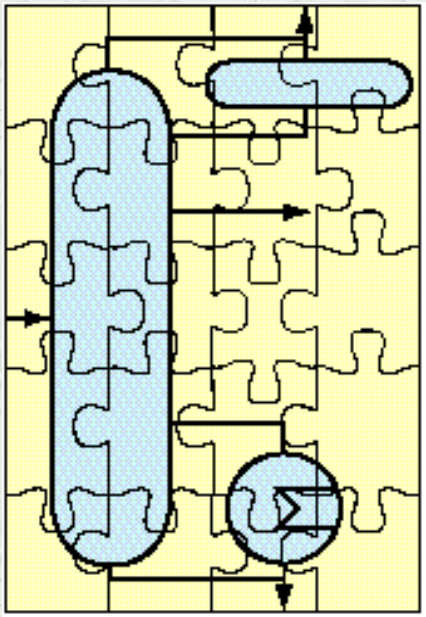
What you should do ?

- Request CO compliance from your PMC/PME providers
- Make use of best in class components
- Migrate your valuable components to CO compliance

Conclusion

- Significant results obtained
- Commercial implementations available
- Proven technology
- Major benefits already from Unit and Thermo
- Use it!

The CAPE-OPEN Standard and CO-LaN



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