

An Industrial Validation of SMP



The Actors



- CNES (Prime)
 - Bernard Delatte



- Spacebel
 - Rachid Atori, Hien Thong Pham



- Thales Alenia Space
 - Franck Maingam, Gilles Mesiano



- EADS Astrium
 - Claude Cazenave, Pierre Guillet



- Ellidiss
 - Pierre Dissaux, Arnaud Schach

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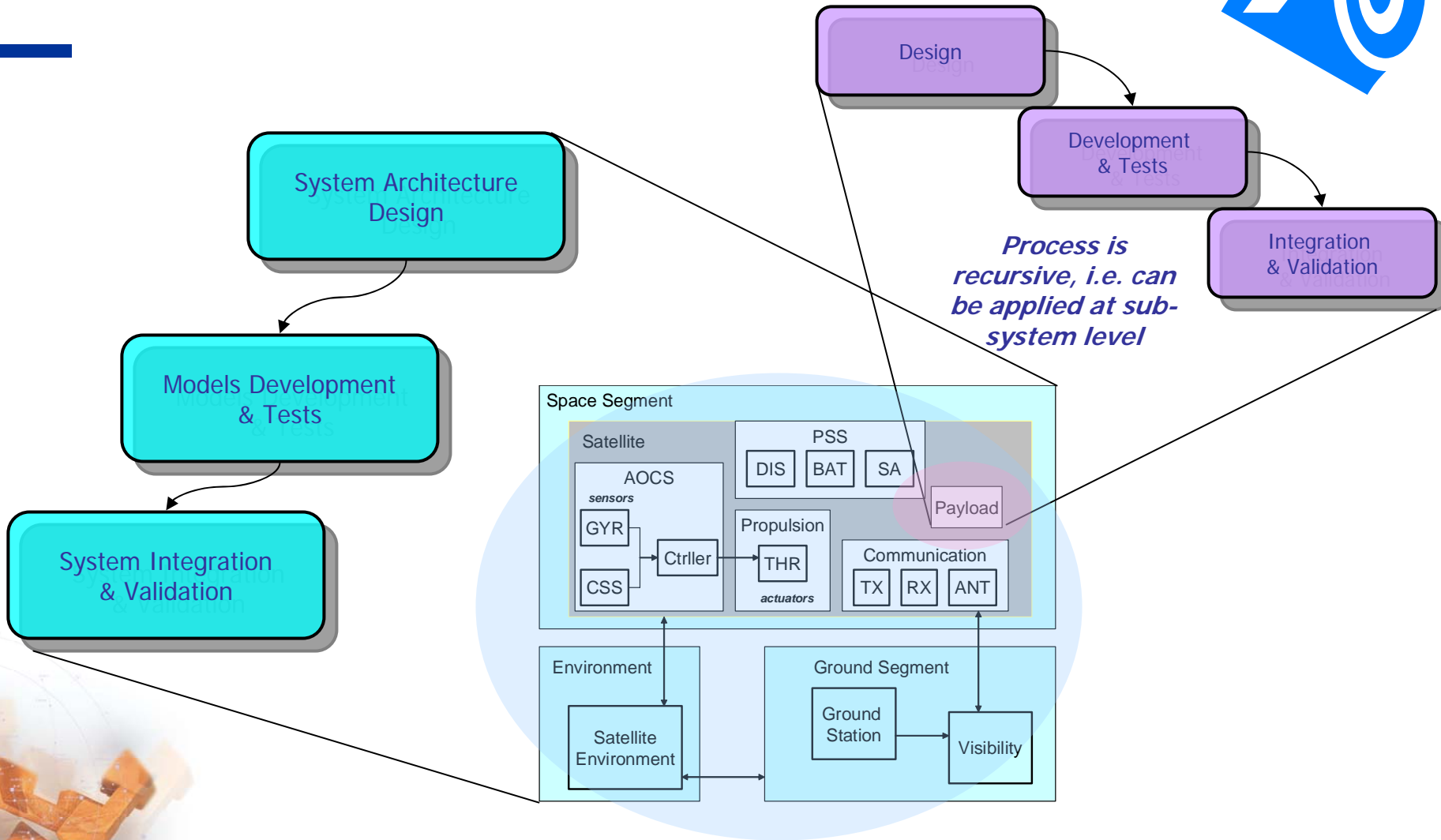
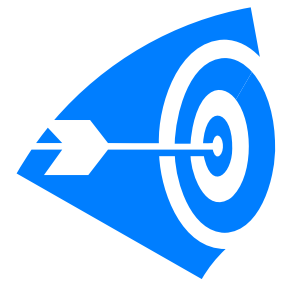
What were the objectives?

- Validation of SMP2 in an industrial process
 - Simulation of a representative satellite
 - Distributed development locations (multi-sites) taking into account
 - Different roles in the process
 - Information sharing via the SMP2 artefacts (catalogues & assemblies)
 - Source & binary code sharing
 - Provide inputs to the ECSS E40-07 SMP2 WG
- Validation on multiple simulator infrastructures
 - SIMSAT4 (ESOC)
 - BASILES Kernel (CNES/Spacebel)
 - SIMTG (Astrium)
- Validation of tooling user needs through the use of SMP2 tools
 - SIMSAT4 MIE (ESOC)
 - STOOD (Ellidiss)

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Process – Principles



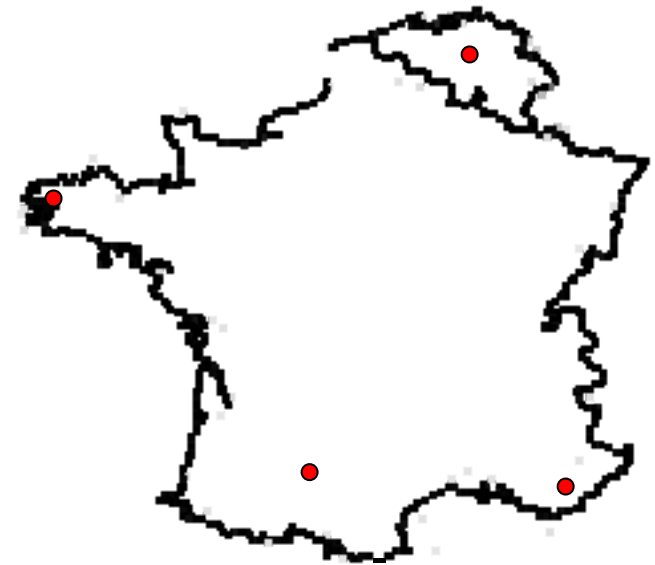
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Process – Work Breakdown & Roles

Phase	Role	Responsible Actor
System Architecture Design	Main	Spacebel
	Contributors	Thales, Astrium & CNES
Models Development & Test	Main	Spacebel, Thales & Astrium
System Integration & Validation (BASILES Kernel & SIMSAT)	Main	Spacebel
	Contributors	Thales & Astrium
System Integration & Validation (SIMTG)	Main	Astrium
STOOD Support	Main	Ellidiss



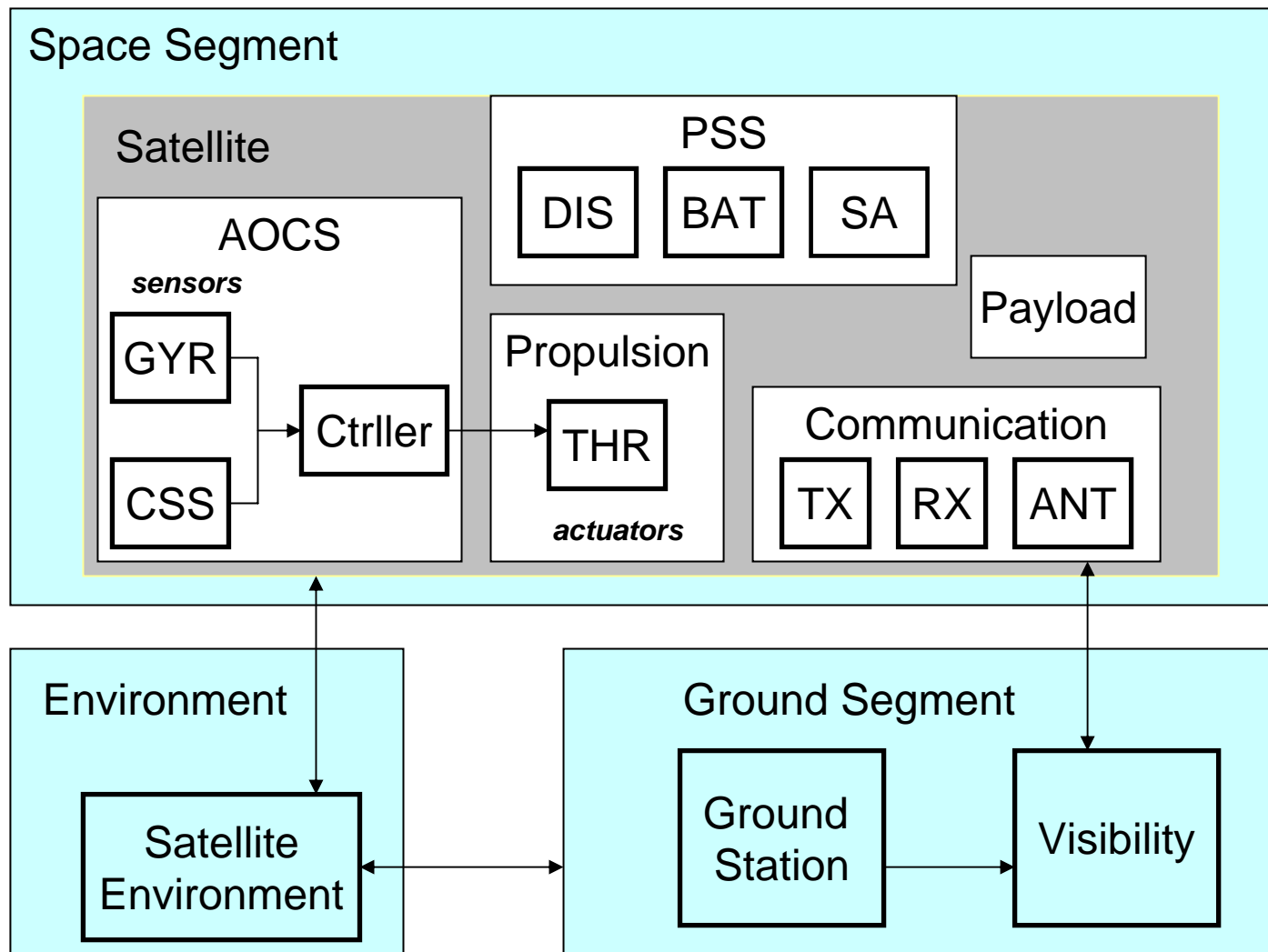
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Simulator Overview

FES type simulator



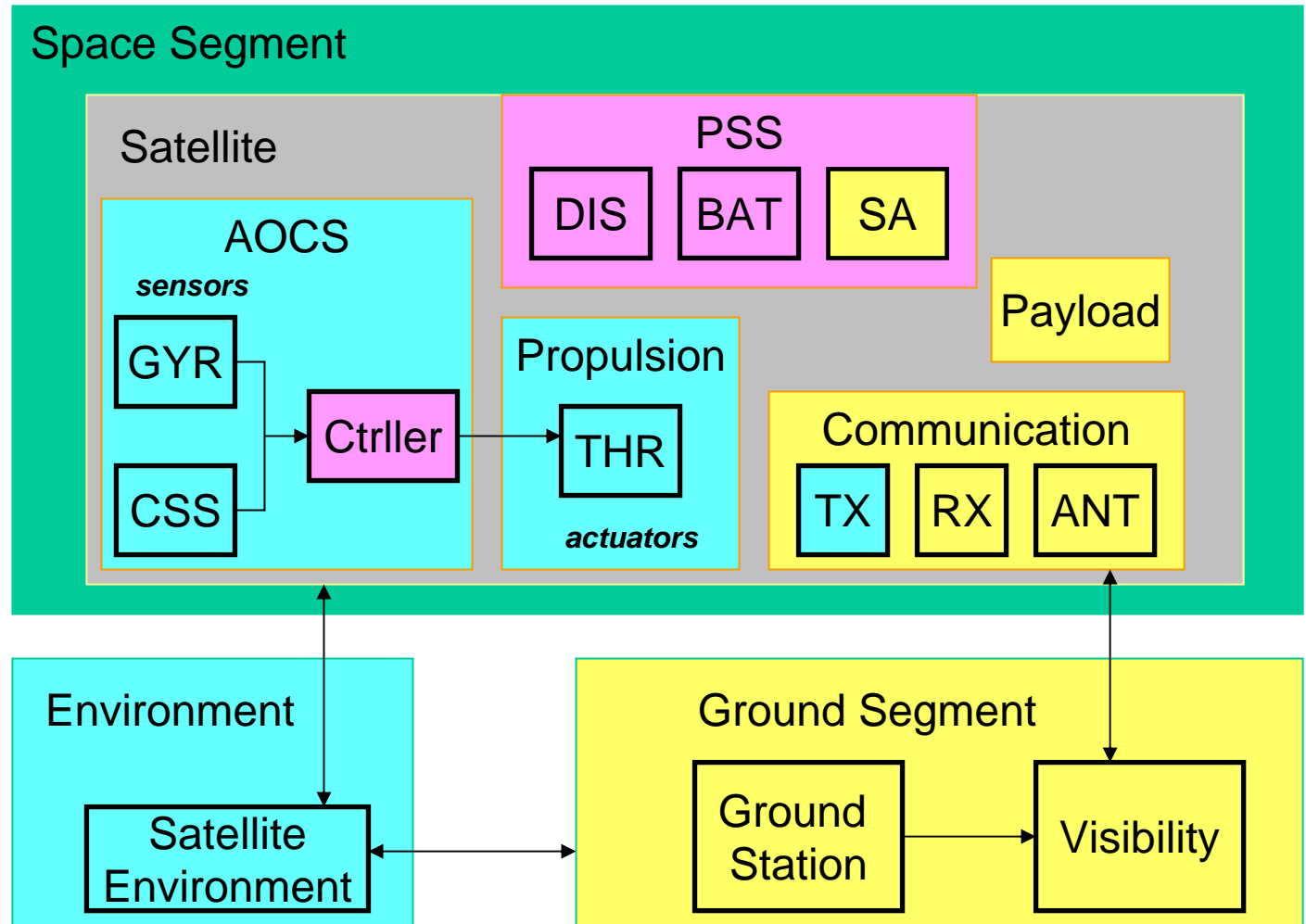
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What about Work Distribution?

FES type simulator



THALES

ASTRIUM

SPACEBEL

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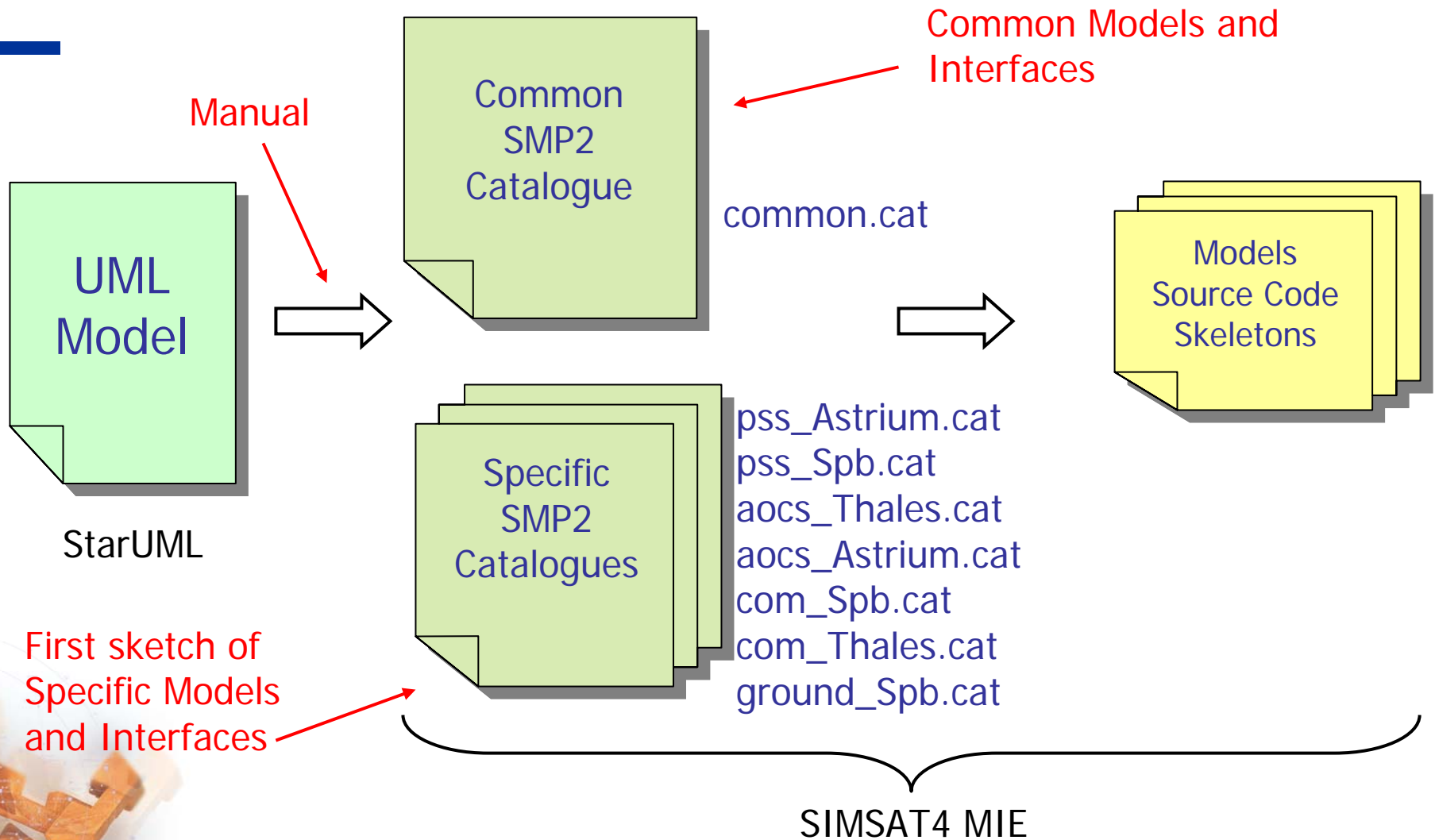
Detailed Work Distribution

- Work distribution takes into account multi-site development
- Promotes a maximum of information exchange between the participants:
 - each participant is in charge of
 - a sub-system (development & integration)
 - and one model belonging to another sub-system (development)
- Sub-system SMP2 artefacts are delivered to the integrator

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System Architecture Design



First sketch of Specific Models and Interfaces

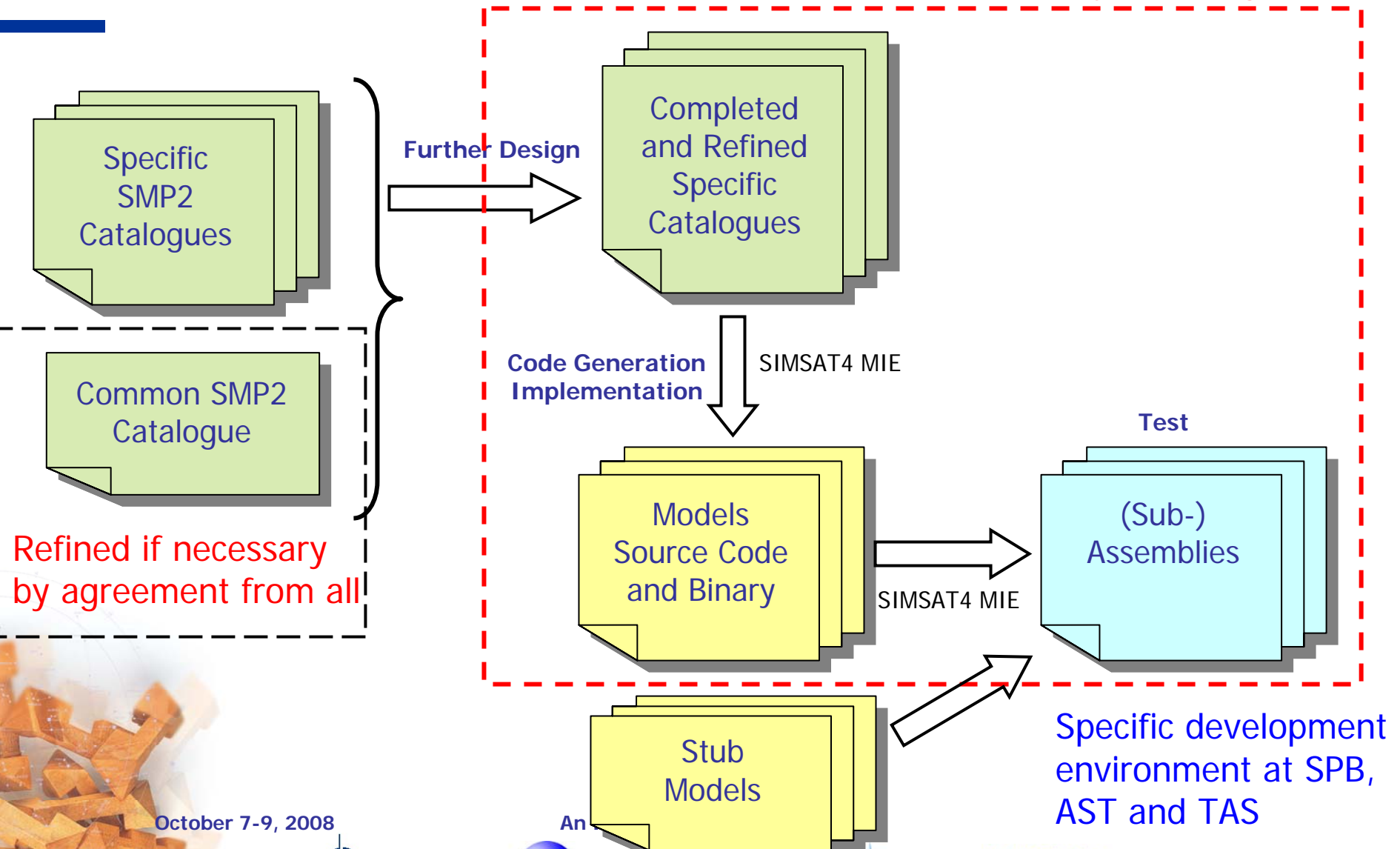
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Models Development & Test

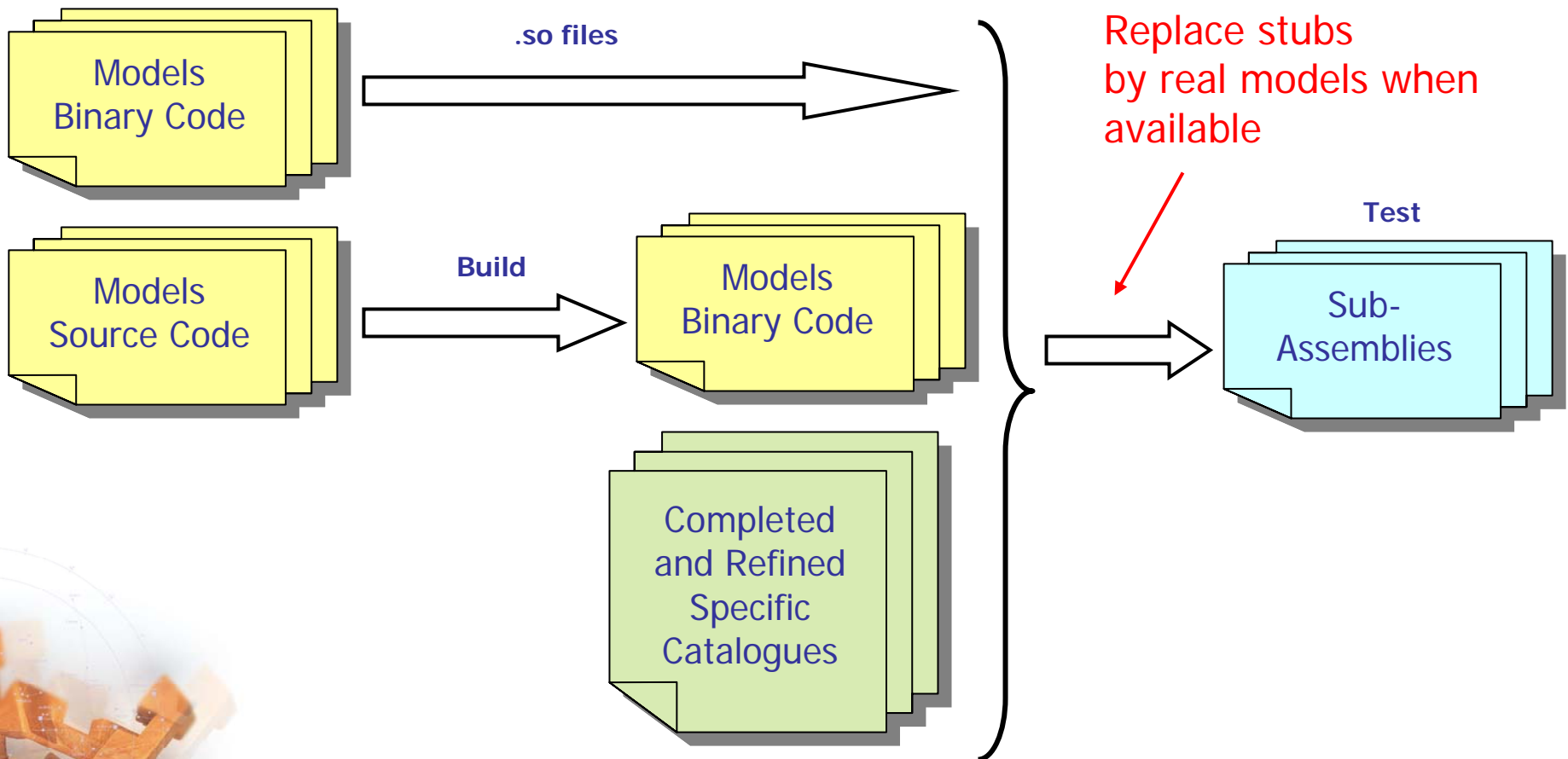
Delivery for Integration



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Sub-System Integration & Validation

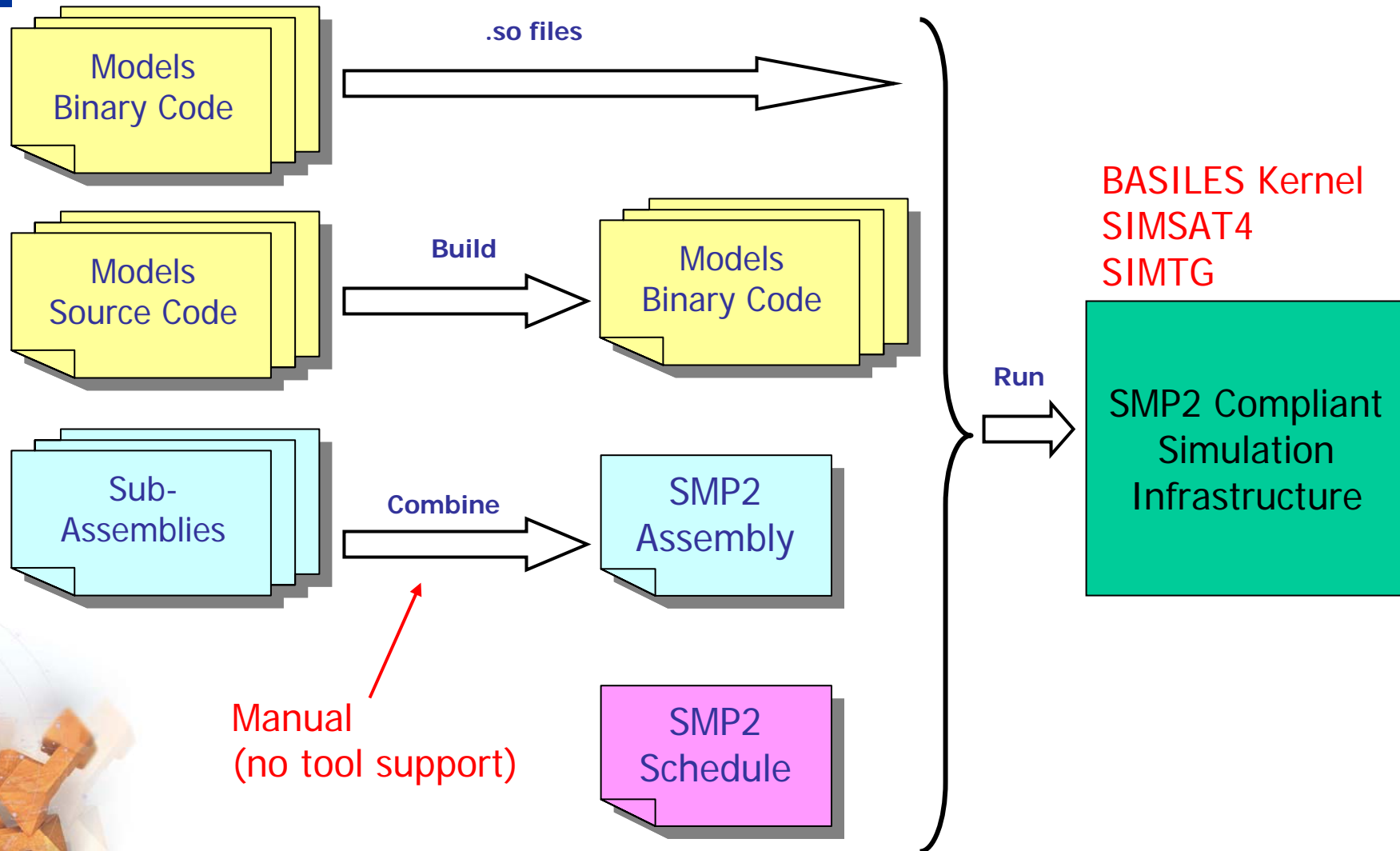


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System Integration & Validation



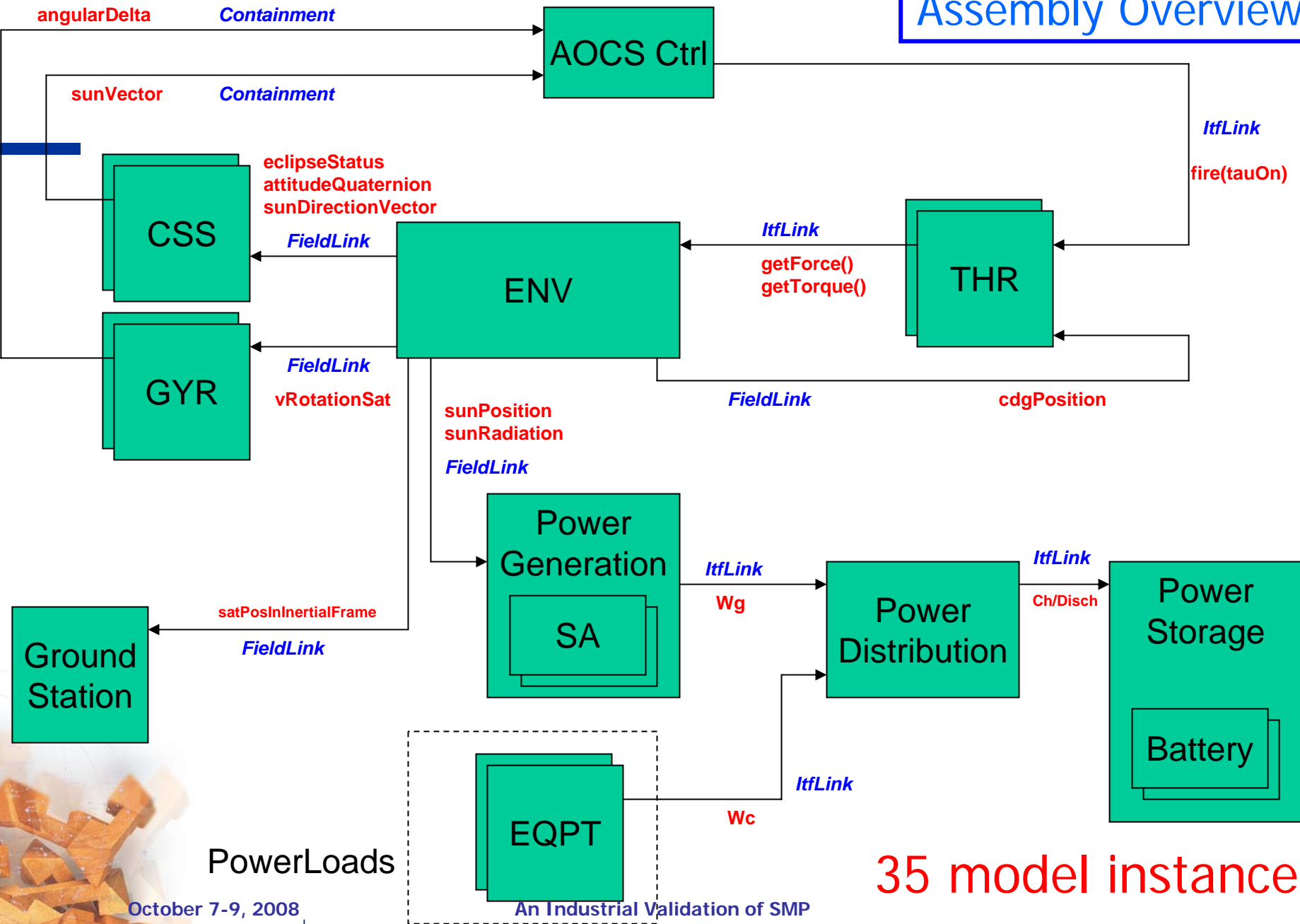
Manual
(no tool support)

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Assembly Overview



35 model instances

PowerLoads

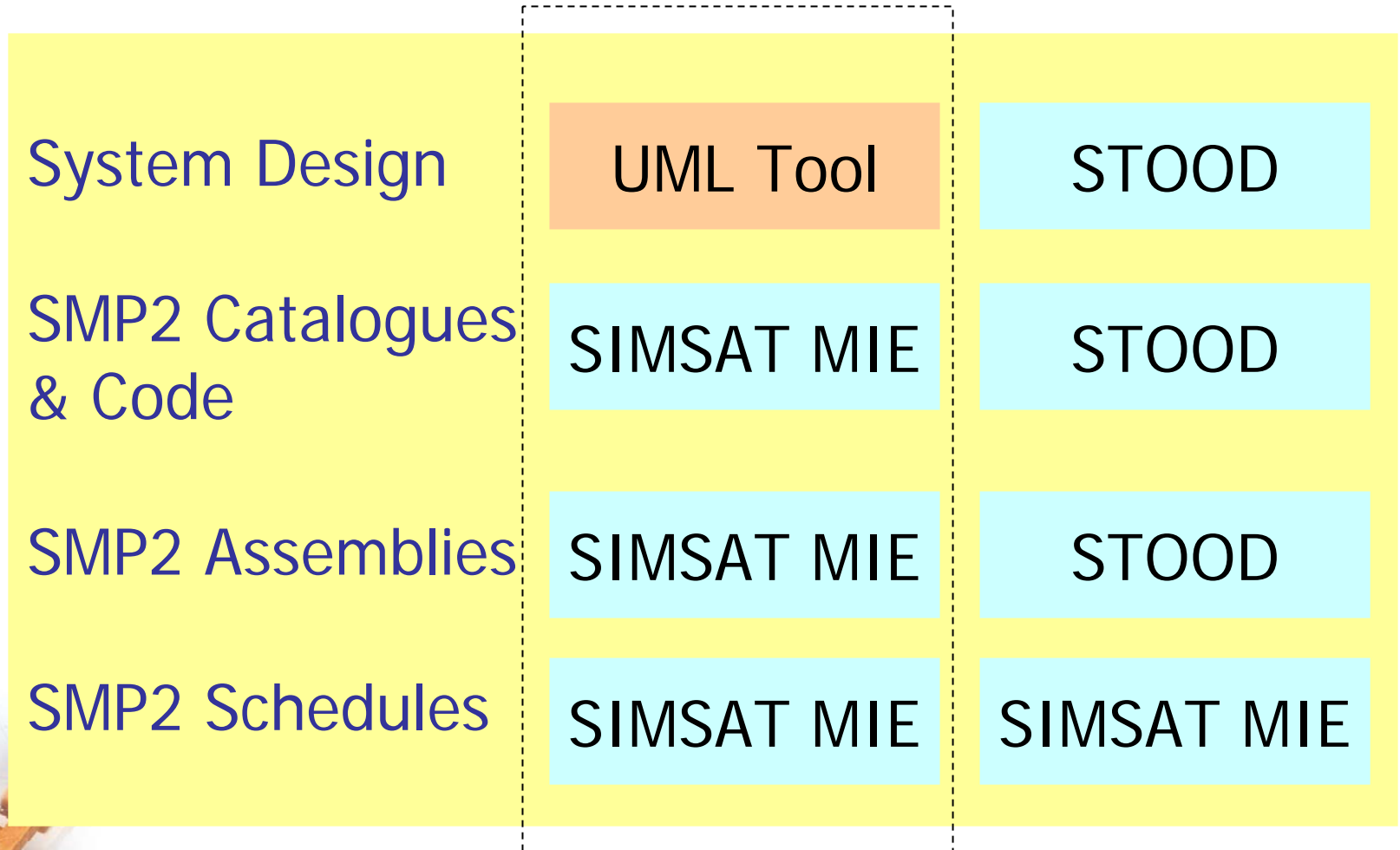
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Tools Support

Process

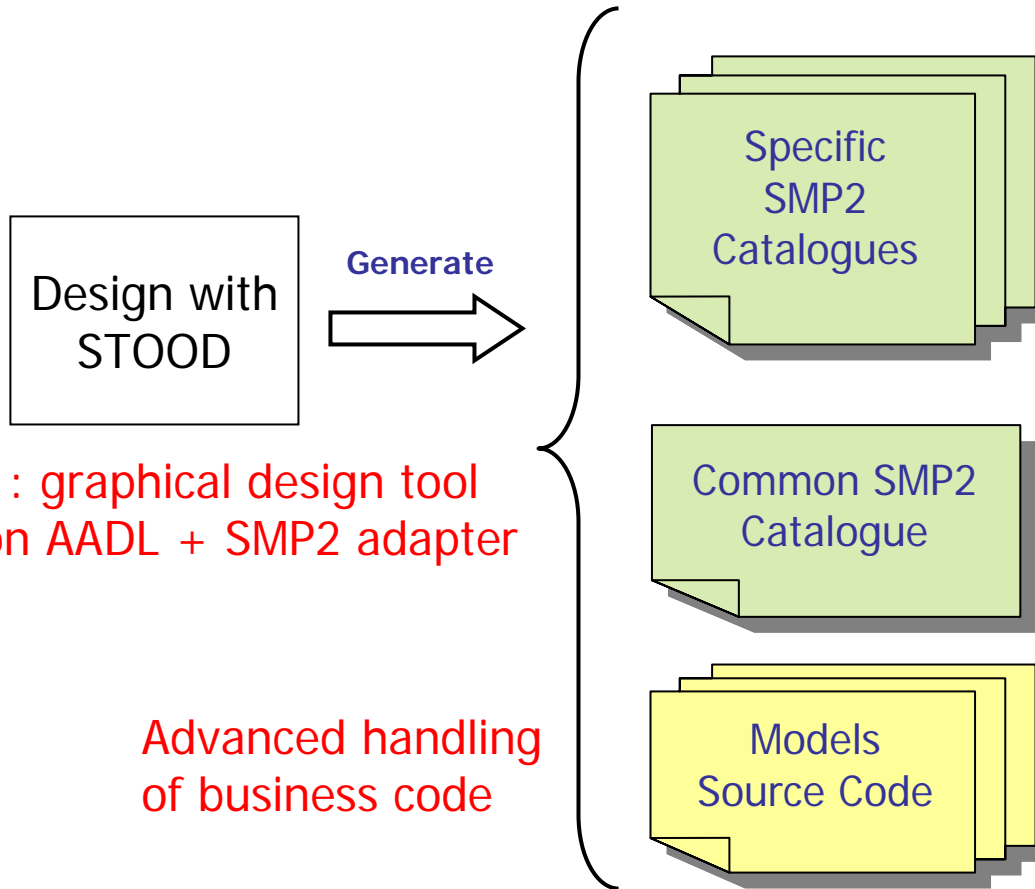


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Designing with STOOD



STOOD : graphical design tool based on AADL + SMP2 adapter

Advanced handling of business code

For comparison with the artefacts generated with the SIMSAT4 MIE

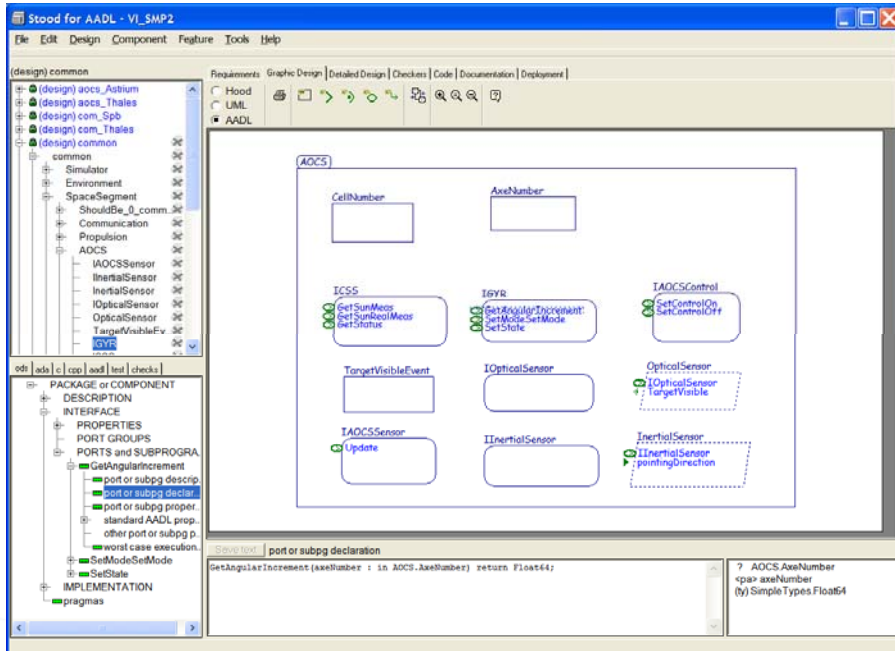
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STOOD – Towards SMP2 modelling

Graphical Design Tool & SMP2 Code Generation



The screenshot shows the STOOD graphical design tool interface with the generated C++ code for the `OpticalSensor` class. The code is as follows:

```
cc
// BODY OF MODULE : OpticalSensor
// ----- visibility on specification file :
#include "OpticalSensor.h"
namespace SpaceSegment
{
    namespace AOCS
    {
        // ----- Component constructor and destructor -----
        OpticalSensor::OpticalSensor()
        {
            TargetVisible = new Hdr::EventSource<AOCS::TargetVisibleEvent> ("TargetVisible", "Event indicating that
the target with the given index has just become visible.", this);
            this->AddEventSource(TargetVisible);
        }
        OpticalSensor::~OpticalSensor()
        {
            delete TargetVisible;
        }
        // -----
        // -- ManagedModel interface implementation --
        void OpticalSensor::Publish(Smp::IPublication* publication) throw (Smp::IModel::InvalidModelState)
        {
            if (m_state == Smp::MSK_Created)
            {
                if (publication)
                {
                    m_publication = publication;
                    m_state = Smp::MSK_Publishing;
                }
            }
            else
            {
                throw Smp::IModel::InvalidModelState(m_state, Smp::MSK_Created);
            }
        }
        void OpticalSensor::Configure(Smp::Services::ILogger* logger) throw (Smp::IModel::InvalidModelState)
        {
            if (m_state == Smp::MSK_Publishing)
            {

```

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Results

- Simulation implemented and run successfully on SIMSAT4, BASILES Kernel, SIMTG
 - Test using source code OK
 - Test using binary code **NOK**
 - reason – code linking with the MDK
 - reason – infrastructure dependent

how dynamic/static libraries are handled and how they are linked together is crucial

→needs to be further investigated

- AOCs control convergence obtained
- STOOD SMP2 generated artefacts files are syntactically the same as those from SIMSAT4.

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Conclusions

- This VISMP2 activity has allowed demonstrating a cooperative and efficient development of a simulator thanks to the **SMP2 standard**



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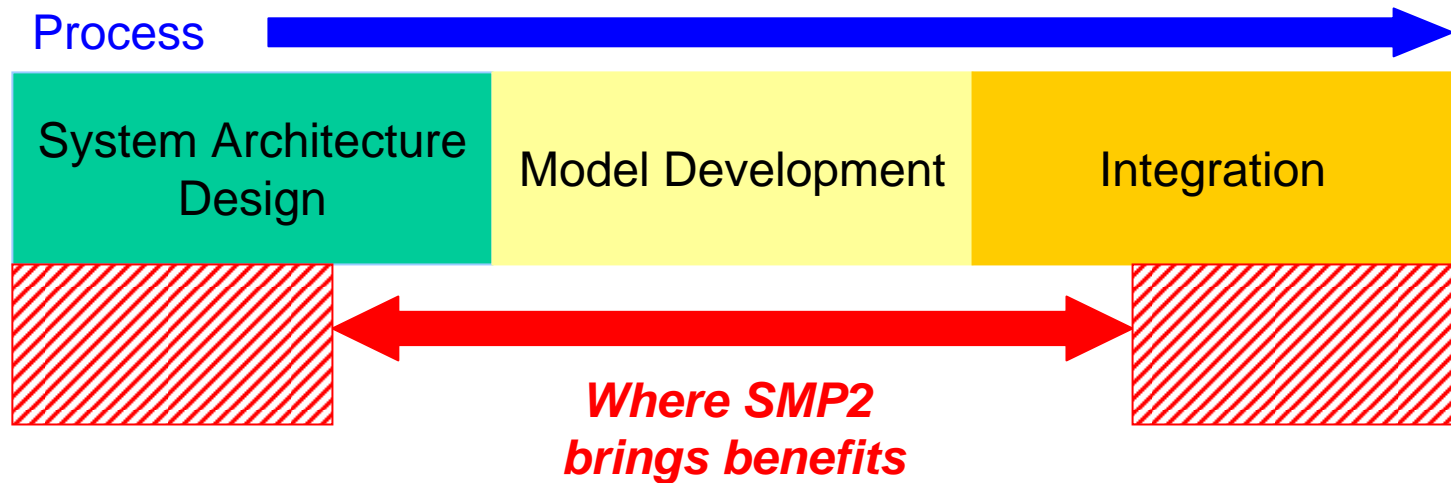
Conclusions (cont'd)

- SMP2 is a valid approach for development
- SMP2 allows focusing on engineering rather than on infrastructure
- Process using SMP2 at system & sub-system level → recursive process

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Conclusions – SMP2 vs Industrial Process



- System Architecture Design:
 - needs support from non SMP2 tools (e.g. UML/STOOD based)
- Models Development & Test:
 - real benefit (SMP2 serves as a common language among all development parties)
- System Integration & Validation:
 - needs more support from SMP2 (sub-assemblies, units, binary exchange, etc)

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Conclusions – Need to be done ...

- Share of binary code: additional investigations need to be performed to better address the binary portability
- Investigate in order to address:
 - Design of complex models or interfaces (e.g. on board computers)
 - Hardware in the Loop simulators

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Conclusions – About the Tools ...

- Tools need further improvements for industry adoption
 - Problems with SIMSAT4 (using a pre-release version) → it is now a lot more stable. However they are still some issues to be addressed.
 - STOOD needs further improvements for completing the SMP2 support
- Lack of a graphical visualization of models and assemblies
 - Exists in STOOD but to be further developed and improved

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Recommended Evolutions

- Graphical notation for SMP2
- Improve support of sub-assemblies
 - Possibility to create links between assemblies → now taken into account in the upcoming ECSS E40-07 standard
- Add recommendation for infrastructure development (i.e. verify unit compatibility between model fields)

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Demonstration

- Demonstration including a 3D animation of the VISMP2 simulation at the Astrium booth



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Thank you for your attention.

Questions?

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