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Generating a User-Friendly SimEvents Model from a Capella Physical Model

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1-Thales

(Short) Corporate Presentation

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Profile

Collective intelligence for a safer world

Whenever critical decisions need to be made, Thales has a role to play.

In all its markets (aerospace, space, ground transportation, defence and security)

Thales solutions help customers to make the right decisions at the right time and act accordingly.

World-class technology, the combined expertise of **64,000 employees** and operations in **56 countries** have made **Thales a key player in keeping the public safe and secure**, guarding vital infrastructure and protecting the national security interests of countries around the globe.



Employees

64,000



Global presence

56 countries



Self-funded R&D*
2016

731 million euros

* Does not include therefore R&D undertaken with external funding.

A balanced revenue structure

Defence
50%

Civil
50%

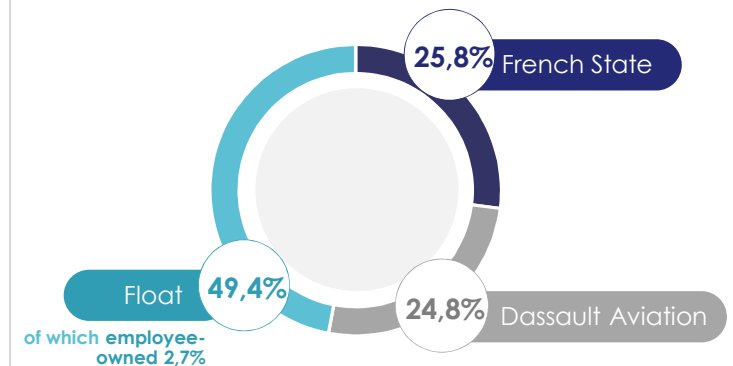


Revenues in 2016

14.9 billion euros

Shareholders

(at 31 December 2016)



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Mission Statement



**WHEREVER SAFETY AND SECURITY ARE CRITICAL, THALES DELIVERS.
TOGETHER, WE INNOVATE WITH OUR CUSTOMERS
TO BUILD SMARTER SOLUTIONS. EVERYWHERE.**

Réf. : TRT-Fr/STI/LISL/EDU.18 /0021 – 25/05/2018

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Markets we serve

DUAL MARKETS Military & Civil



AEROSPACE



SPACE



**GROUND
TRANSPORTATION**



DEFENCE



SECURITY

TRUSTED PARTNER FOR A SAFER WORLD

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Zoom on Optronics for Airborne Applications

The **European leader**
in airborne optronics

- Integrated optronic equipment onboard on more than **20 types of aircrafts, helicopters and unmanned airborne systems**
- **Reconnaissance and targeting pods** operating in 12 countries



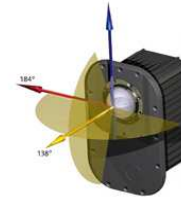
Situational awareness and reconnaissance



Weapon engagement



Protection of platforms and pilot assistance



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2 - Goals and Principles

« Estimate the Performance of Video Processing Chains
in a Few Clicks »

Supporting the Architecture of Video Chains

Architecting optronics systems is a work of expertise



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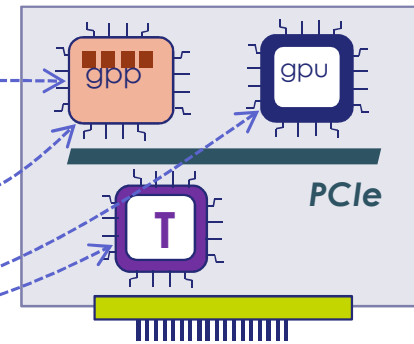
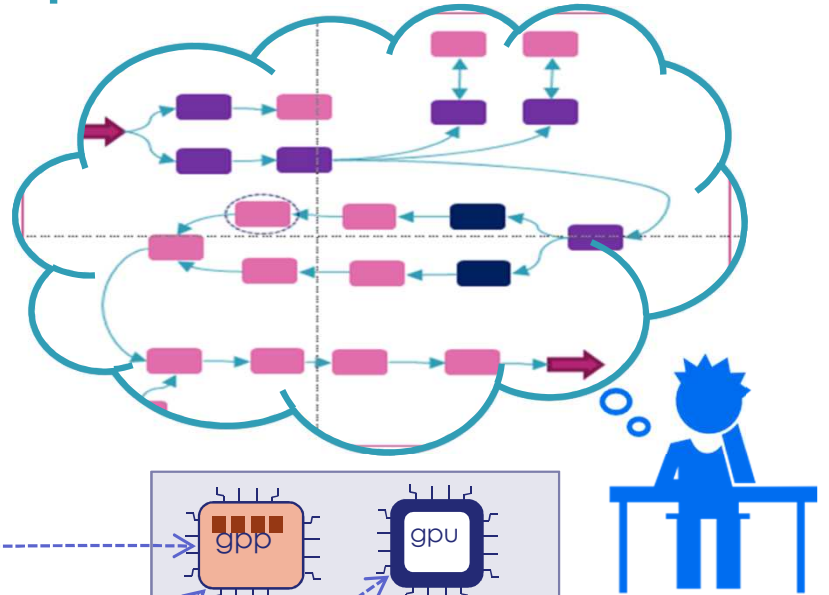
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Supporting the Architecture of Video Chains

Architecting optronics systems is a work of expertise

Optronics systems are chains of image processing functions

- More and more complex
- To be optimized in many dimensions



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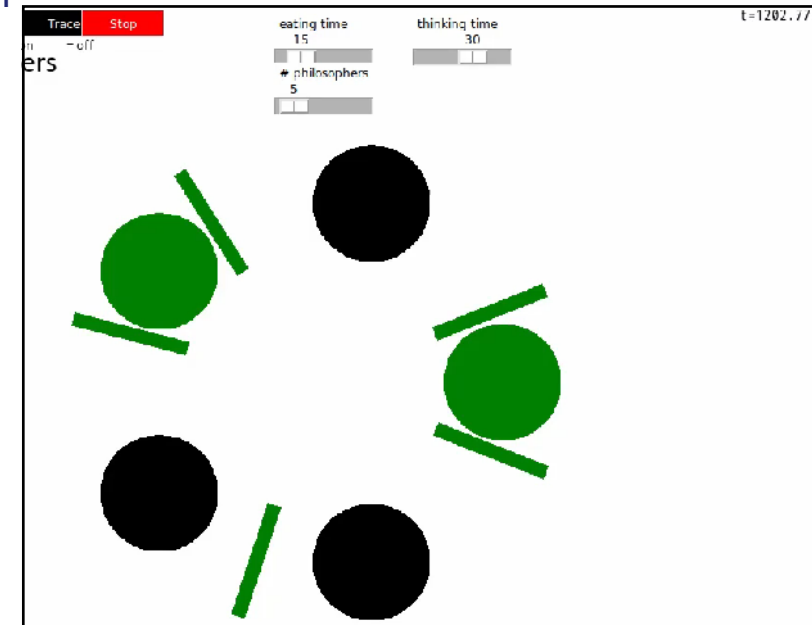
Problem Statement: time performance prediction of these systems

Predicting the time performance of these chains requires tools

- Discrete-Event Simulation (DES) software is the state of the art technique
- It simulates interactions and accounts the time spent

D.E.S. is not used as of today

- Delay and cost of developing a simulation
- Architects just rely on standard office tools

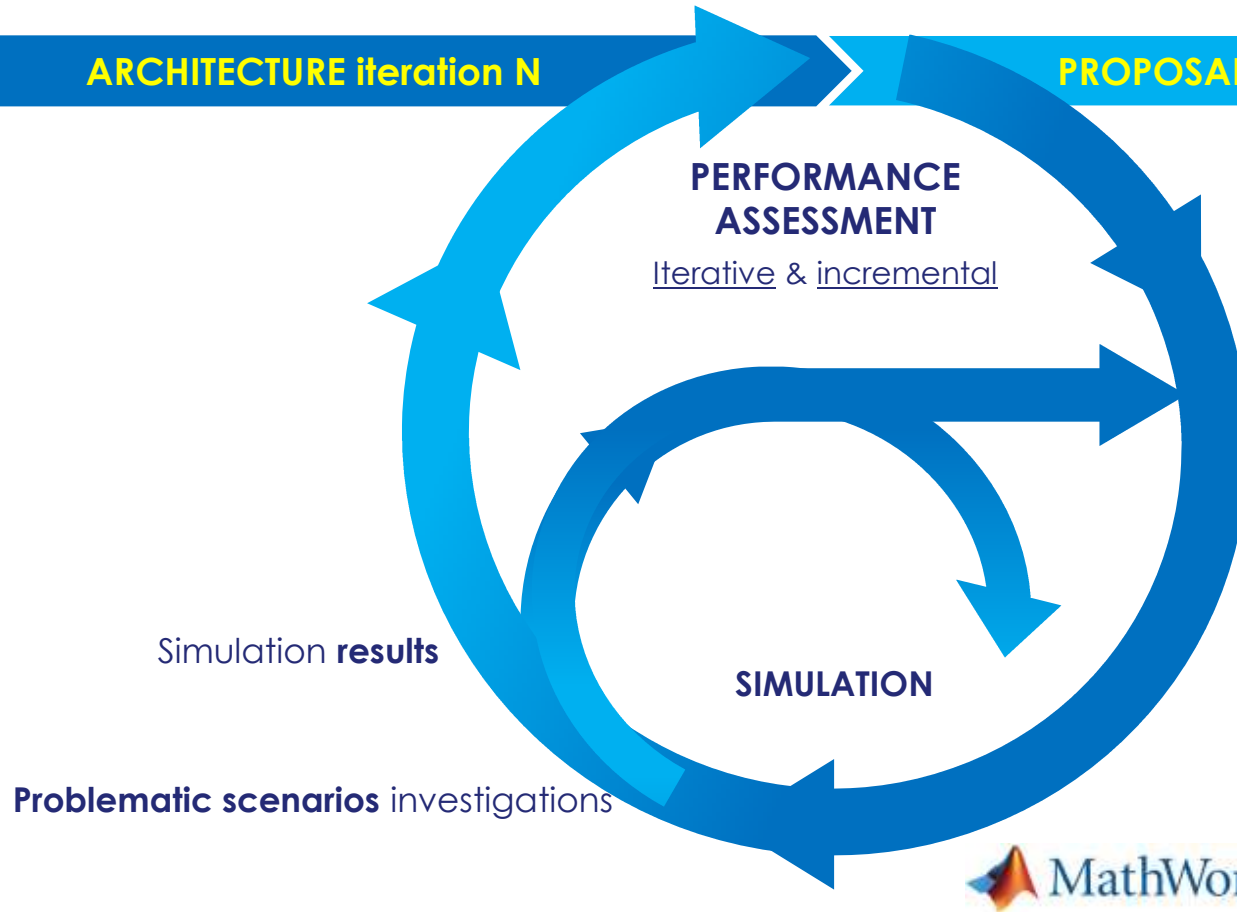


➔ **Challenge: how to enable the use of DES for Optronics Systems ?**

Engineering Process: Architecting Video Chains

ARCHITECTURE iteration N

PROPOSAL FOR ARCHITECTURE N+1



Capella

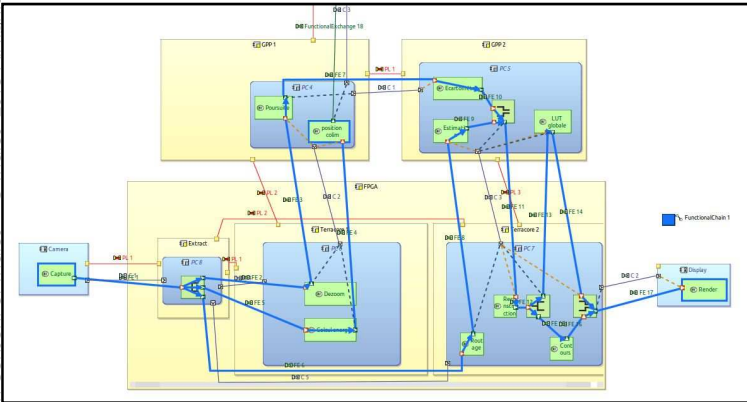
- The architecture is defined with Capella
- The simulation runs on Matlab Simulink
- It has to be easy to use

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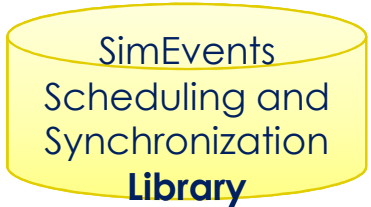
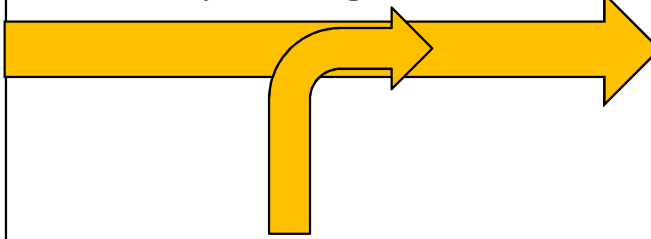
Our solution: automatic generation of the simulations

Capella

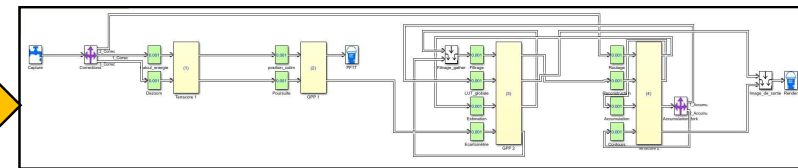


System architecture: nodes, functions, data Flow(s) and critical functional chain(s)

1. EXPORT
2. IMPORT

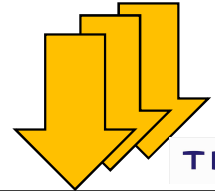


MathWorks®



Editable simulation model

3. RUN SIMULATION
4. DISPLAY RESULTS



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Simulation chronogram

Authored within Thales with significant support from MathWorks France

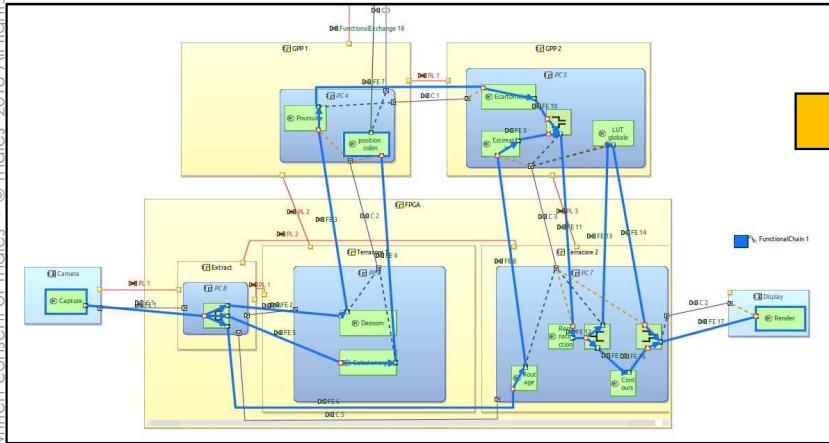
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Demonstration

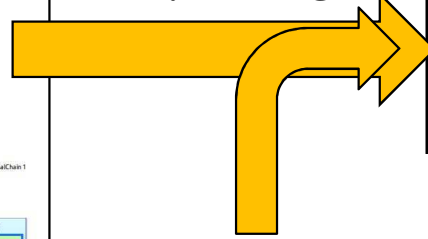
Capella



System architecture

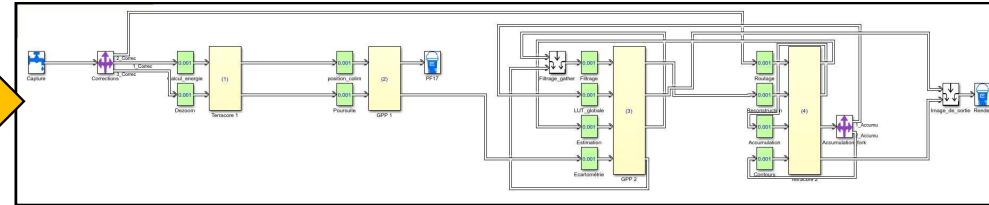


1. EXPORT
2. IMPORT



SimEvents
Scheduling and
Synchronization
Library

MathWorks®

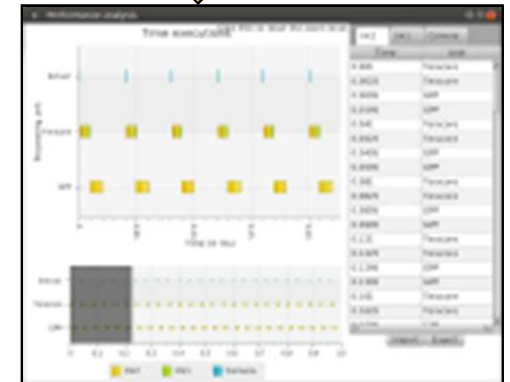


Simulation

3. RUN SIMULATION
4. DISPLAY RESULTS



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Simulation chronogram



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3 - Simulation Principles

Mapping Capella → SimEvents

Scheduling

Simulates a processing resource shared between several functions

➤ Parameterized with policy, number of functions, etc.

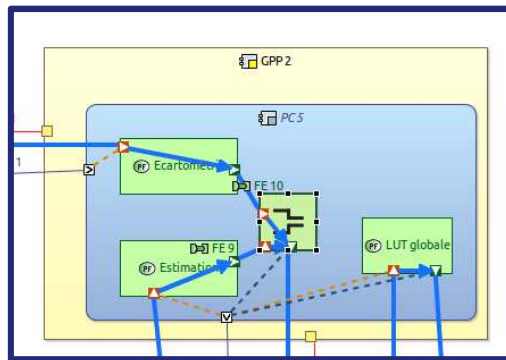
In Capella: functions are allocated on the physical resources

In SimEvents:

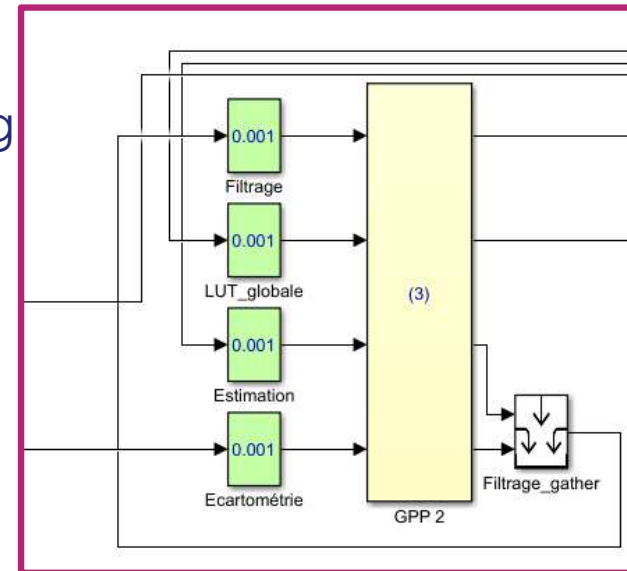
➤ The **Job** entity models one run through the chain

➤ The **Step** block models the entry in the function

➤ The **Scheduler** block models the resource sharing

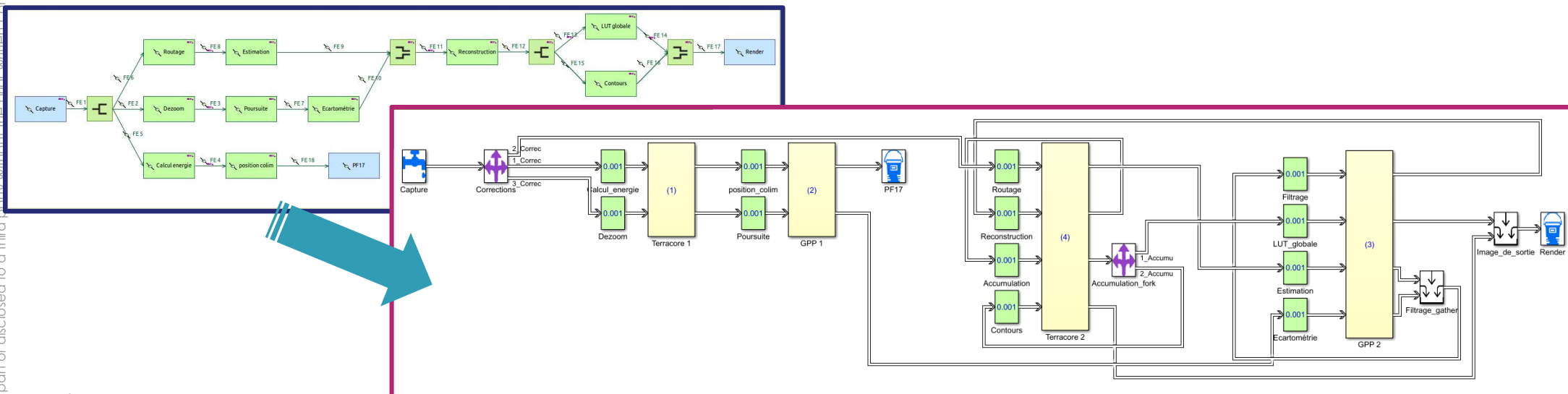


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Function Chaining

- Simulates the flow of data through the functions on the processors
- In Capella: functional chains order function involvements
- In SimEvents: the same order applies between Steps
 - Job entities flow from Schedulers to Steps in the order of the chain
 - Schedulers are laid out in this order



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4 - Implementation

SimEvents & Matlab

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Main Features

Some Numbers

- Approx. 6 eng.mths + MathWorks support
- Library of 12 SimEvents blocks
- 10 classes, 166 functions, 3000 lines of Matlab code

Main components

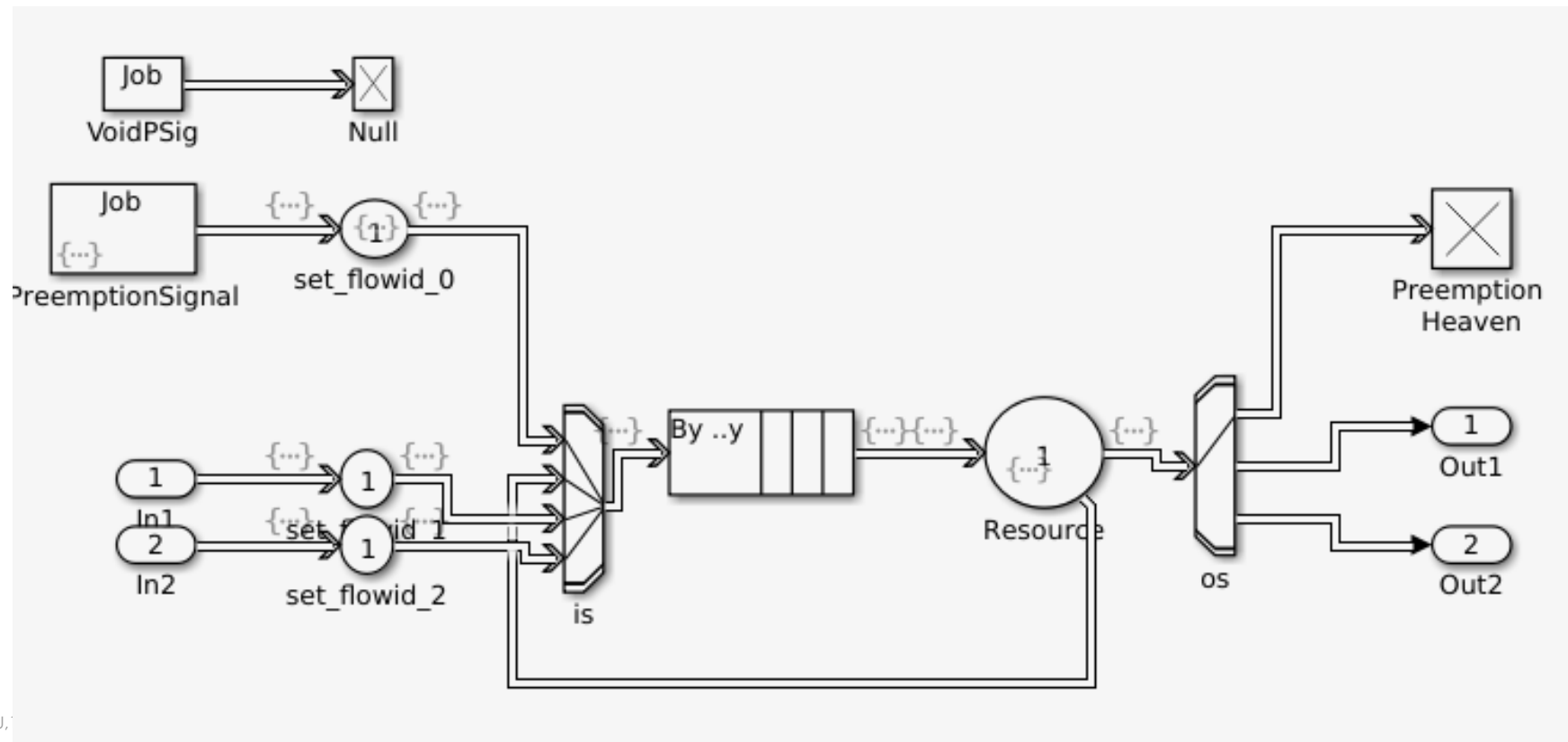
- Loader
 - XML parser
 - Model reduce
 - Model save & restore
- UI
 - AppDesigner-based menu
 - Mask-based block options, callbacks
- Generation
 - Chain-based Ordering
 - Block production
- Simulation
 - Block inner design
 - Event capture
- Chronogram display
 - external, JavaFX based

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Example: Scheduler in SimEvents

- Internal view of the block (Unknown to the user)
- Automatically tailored based on block parameters



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Conclusion

Initial objective

- Very early estimate of the processing chains performance

An appropriate tool for the targeted purpose

- Discrete-Event Simulation gives the expected estimates
- Generation approach gives good correctness guarantees
- Ease of use for video chain architects
- Added benefits: dynamic view of the system, architecture exploration

An appropriate platform

- Visual programming with SimEvents
- Efficient UI-building tools
- The Matlab API can edit and instrument all blocks