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MECHATRONICS
Technology Centre
www.fmtc.be

OROCOS, the open source reference when it comes to real-time and control

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22 March 2006
Embedded Systems in Robotics and Automation

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FMTC 2006

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Outline

KATHOLIEKE UNIVERSITEIT LEUVEN PMA

1. Introduction
   - Problem Domain
   - Orocos' Solution
   - Orocos History
2. Orocos Framework
   - Building Applications
   - Component API
   - Component Development
3. Demo
   - Application Setup
   - Interfacing a Single Machine Controller

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Orocos in one-liners

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- *Open Robot Control Software*
  $\Rightarrow$ *Open Source* machine control and interfacing
- Real-time Software Toolkit in C++
  $\Rightarrow$ Developer's tool
- Tool for developing components for control
  $\Rightarrow$ Real-time, thread-safe, interactive
- Offers common component implementations
  $\Rightarrow$ Optional

Freely available on:

http://www.orocos.org

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Rapid Software Development

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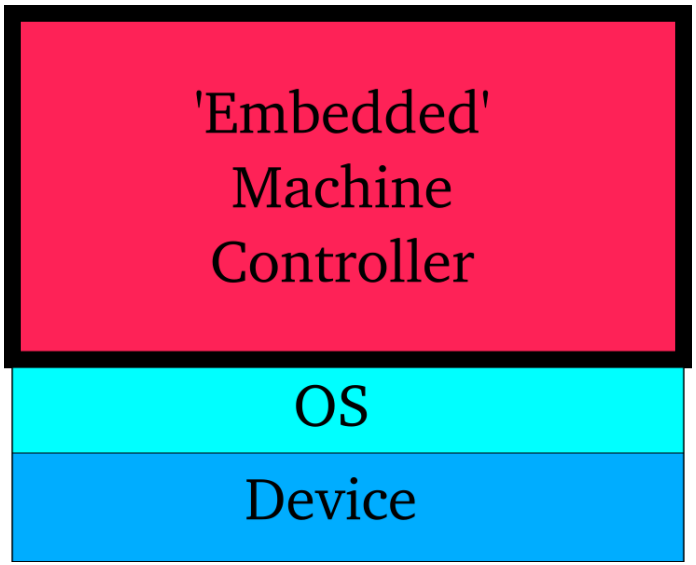
Consider solving. . .

More products $\Rightarrow$ Much more software

With monolithic software.

- New devices, same problems to solve
- More software and features
- Device connectivity and networking



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Safe Software Development

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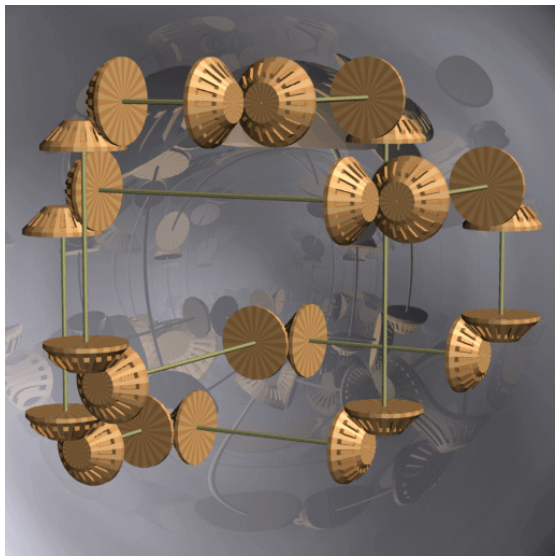
Consider solving. . .

More threads $\Rightarrow$ Much more trouble

With bare threads and locks as tools.

- Deadlocks, thread races, data corruption
- Synchronisation between threads ?
- Communication between threads ?



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Flexible Software Development

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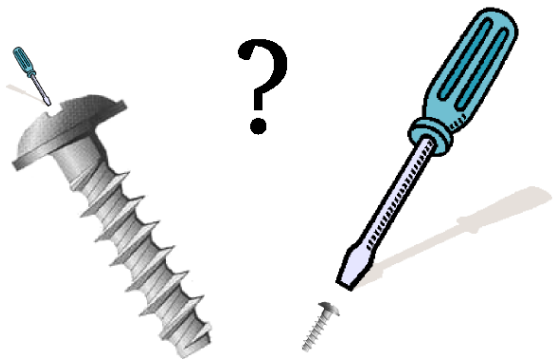
Consider solving. . .

More layers $\Rightarrow$ Less control

With closed toolkits.

- 'Solutions' restrict the solution
- Software interaction ?
- Dead vendor products ?



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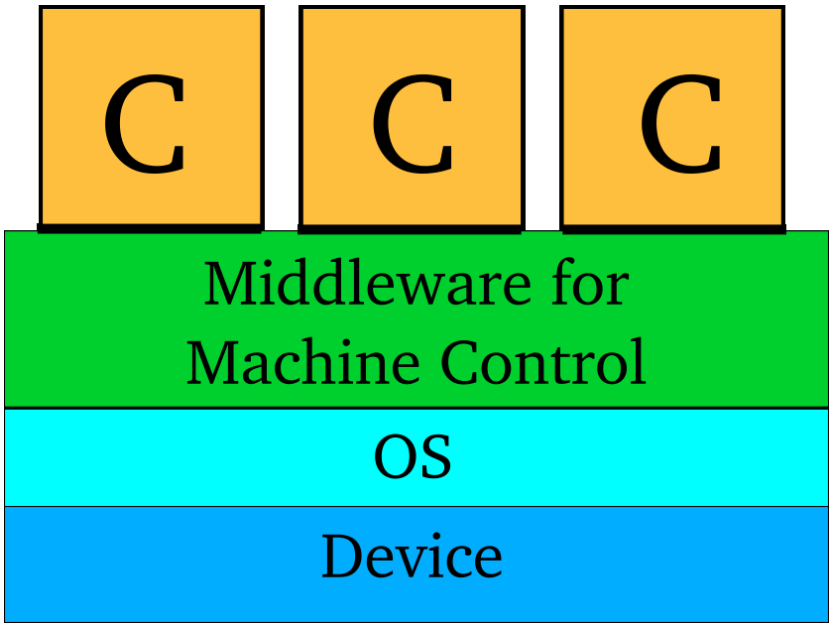
Rapid Software Development

Orocos provides . . .

Middleware for Machine Control

$\Rightarrow$ Software Component deployment *and* interconnection



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Safe Software Development

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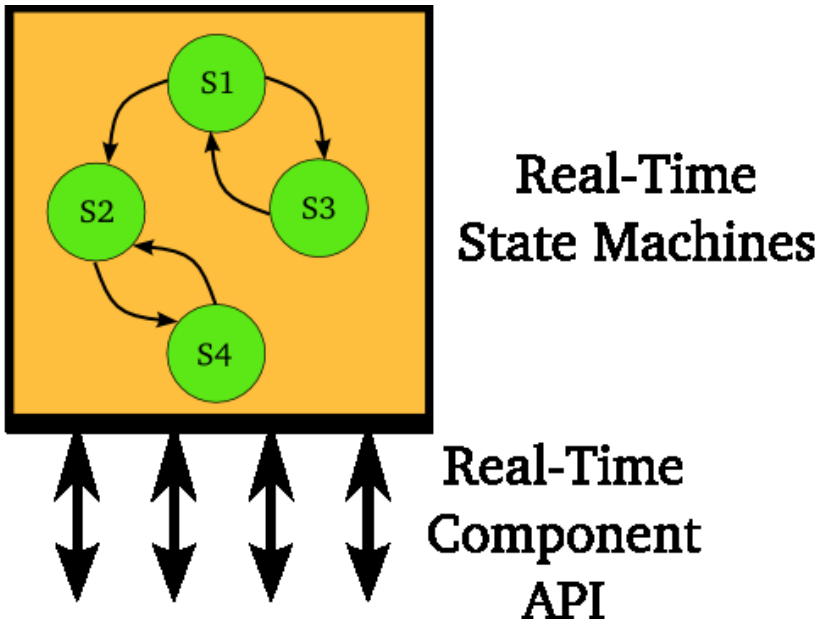
Orocos provides . . .

Tools for Communication $\Rightarrow$ Thread-safe and Real-Time



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Flexible Software Development

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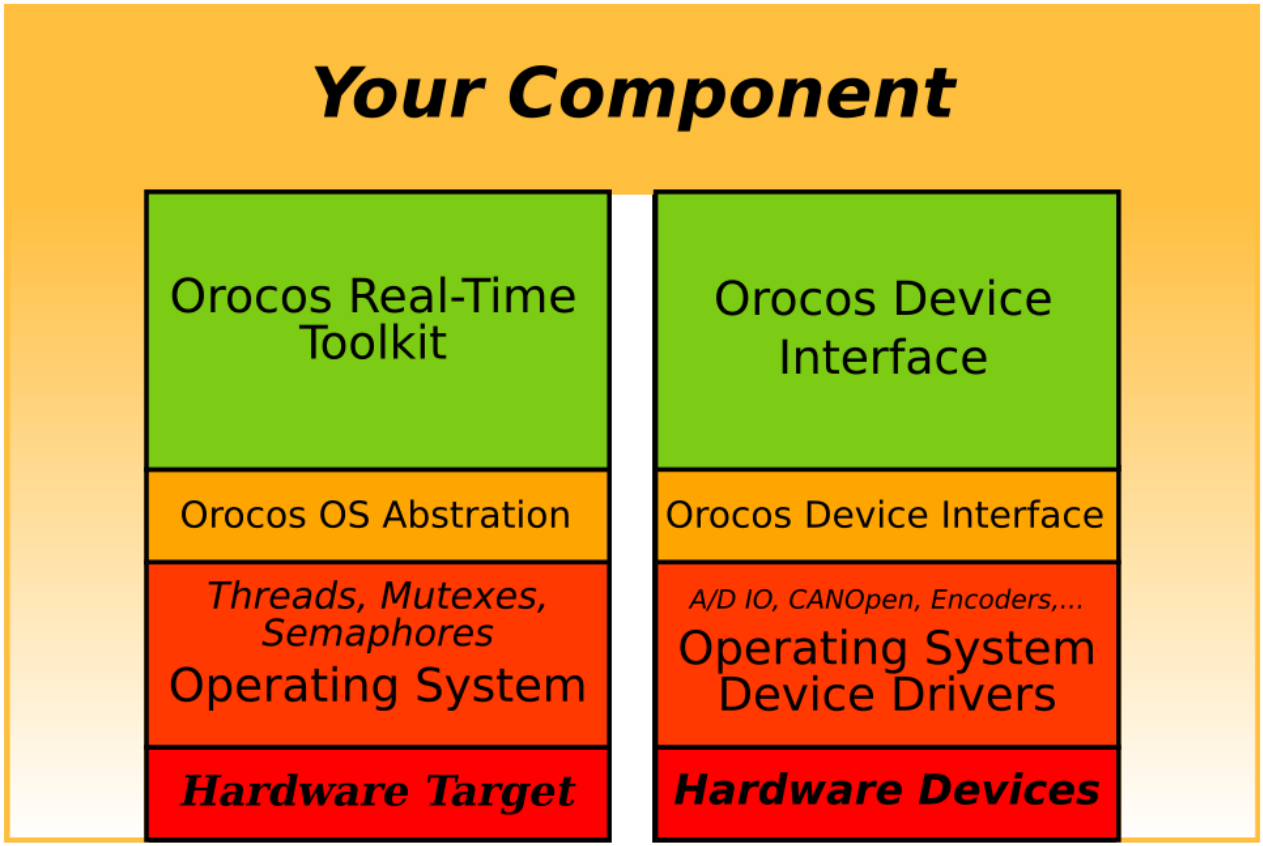
Orocos is . . .

Free Software $\Rightarrow$ Open Infrastructure with ∞ lifetime



Orocos Application Stack

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History

- 2001: Started as a 'small' research project
  - Founded by Prof H. Bruynickx, KU Leuven
- 2001-2005: Developed during the PhD of Peter Soetens
  - Sponsored by the EU IST "Orocos", "Ocean" and "Open Machine Controller" projects and FMTC.
- 2005-. . . : Maintained by the FMTC.
  - 'Modular Machines Group'

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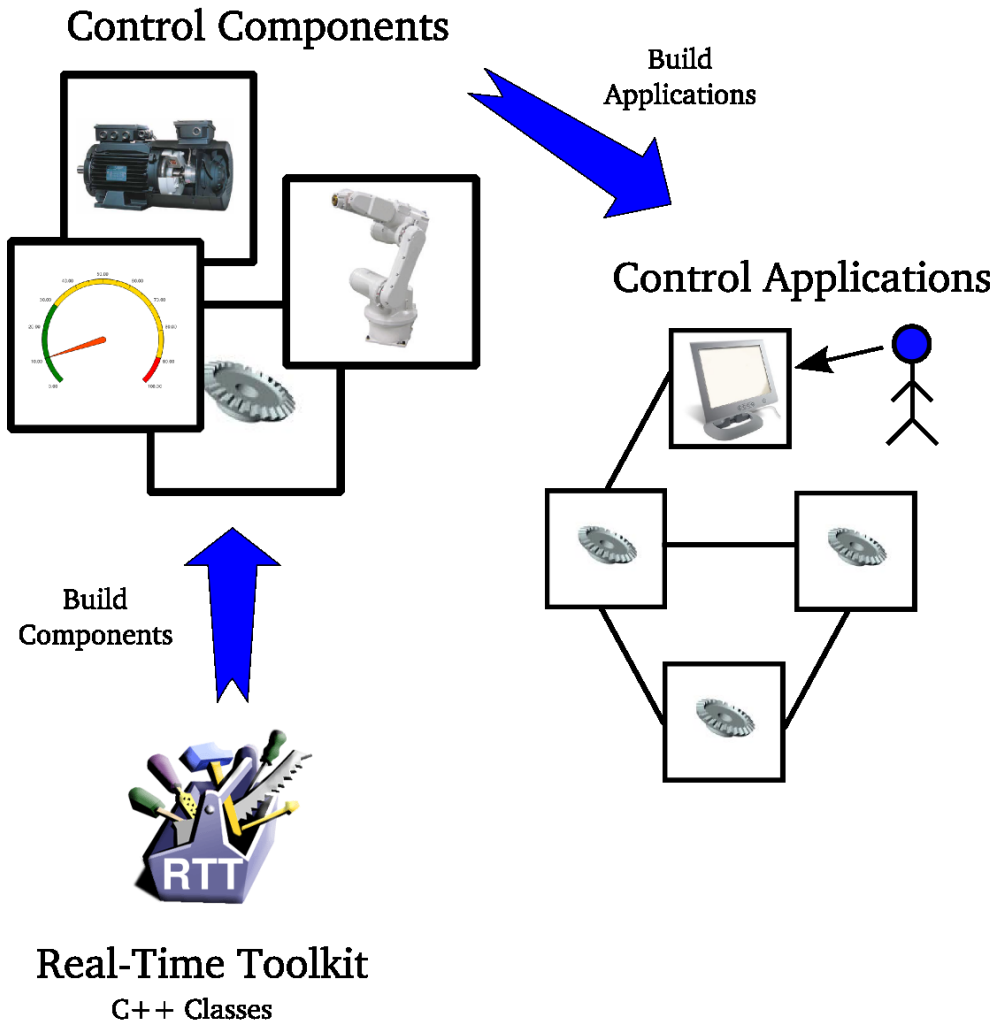
The Real-Time Toolkit



Components

Self-made or community contributions

Applications

'Templates' select and connect Components

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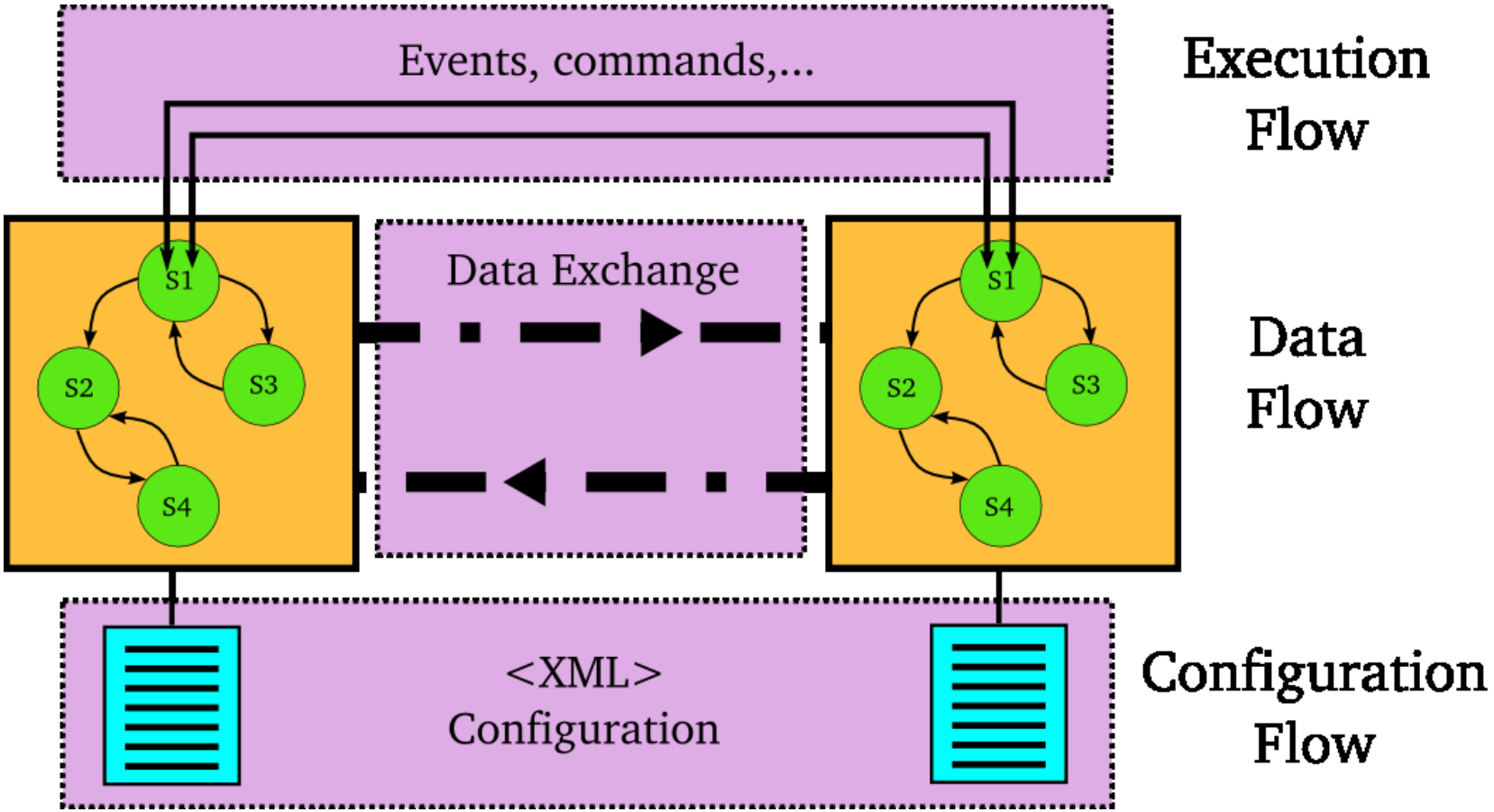
Component Model



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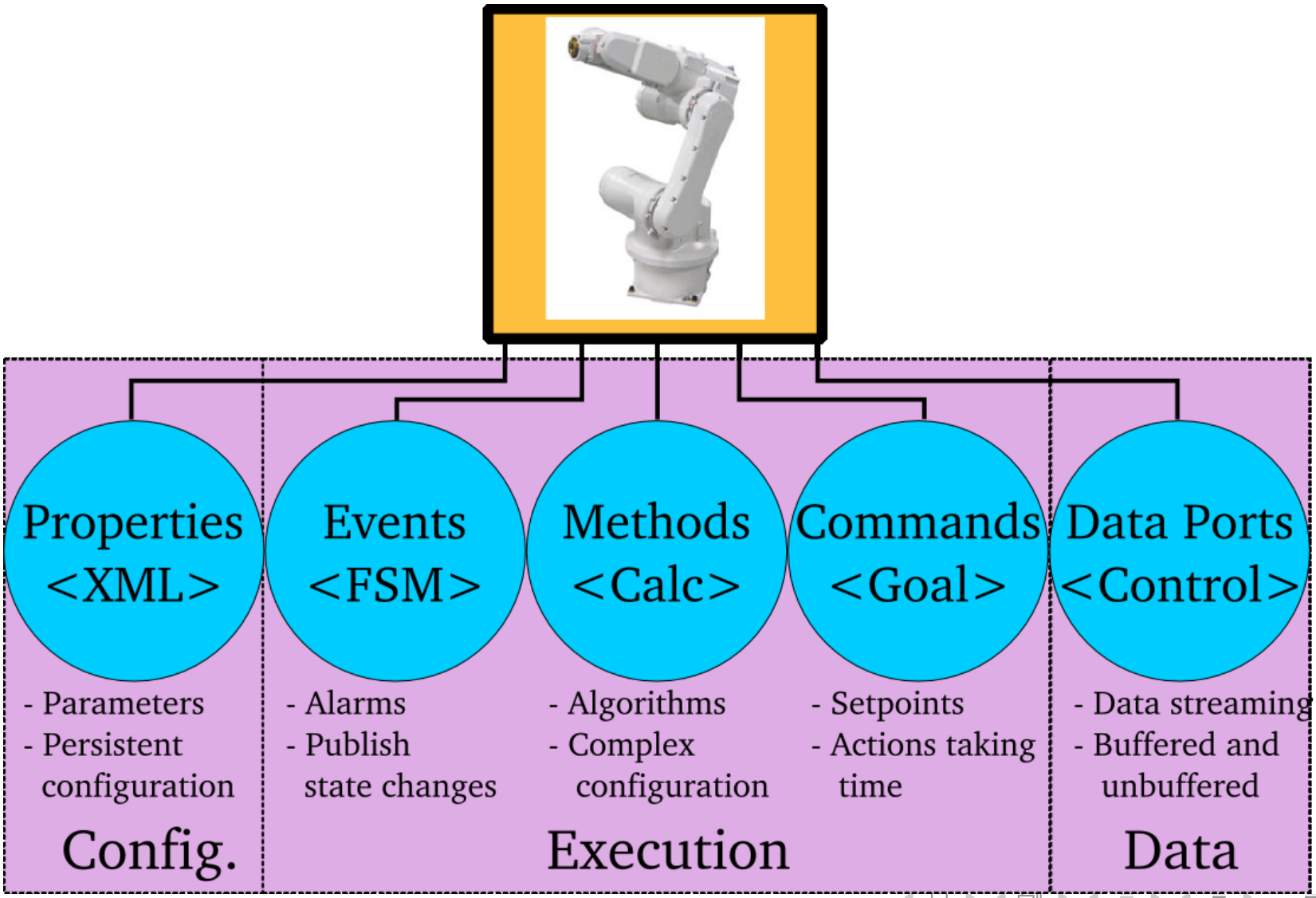
Component Interface



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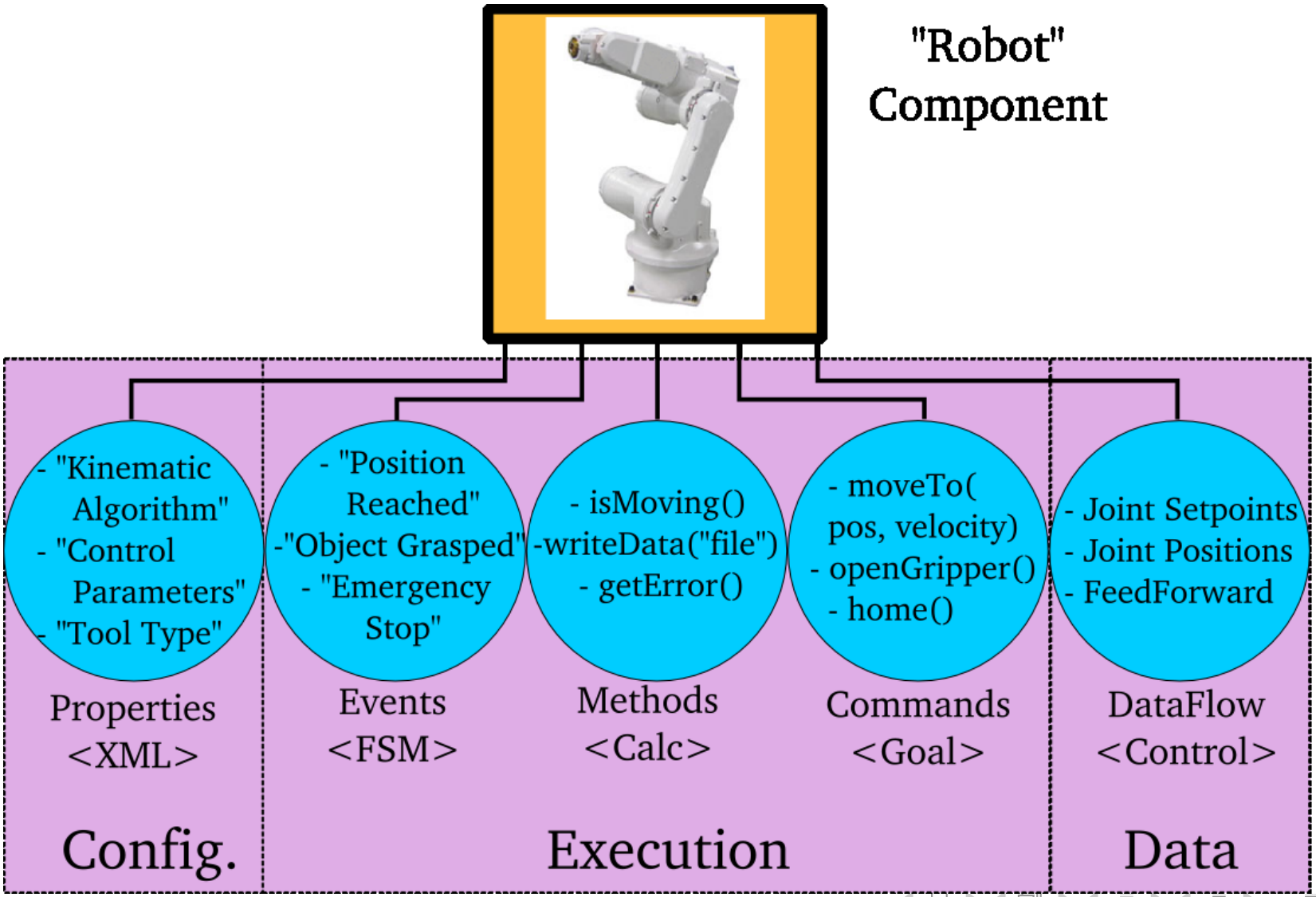
Component API Example



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Component Implementation

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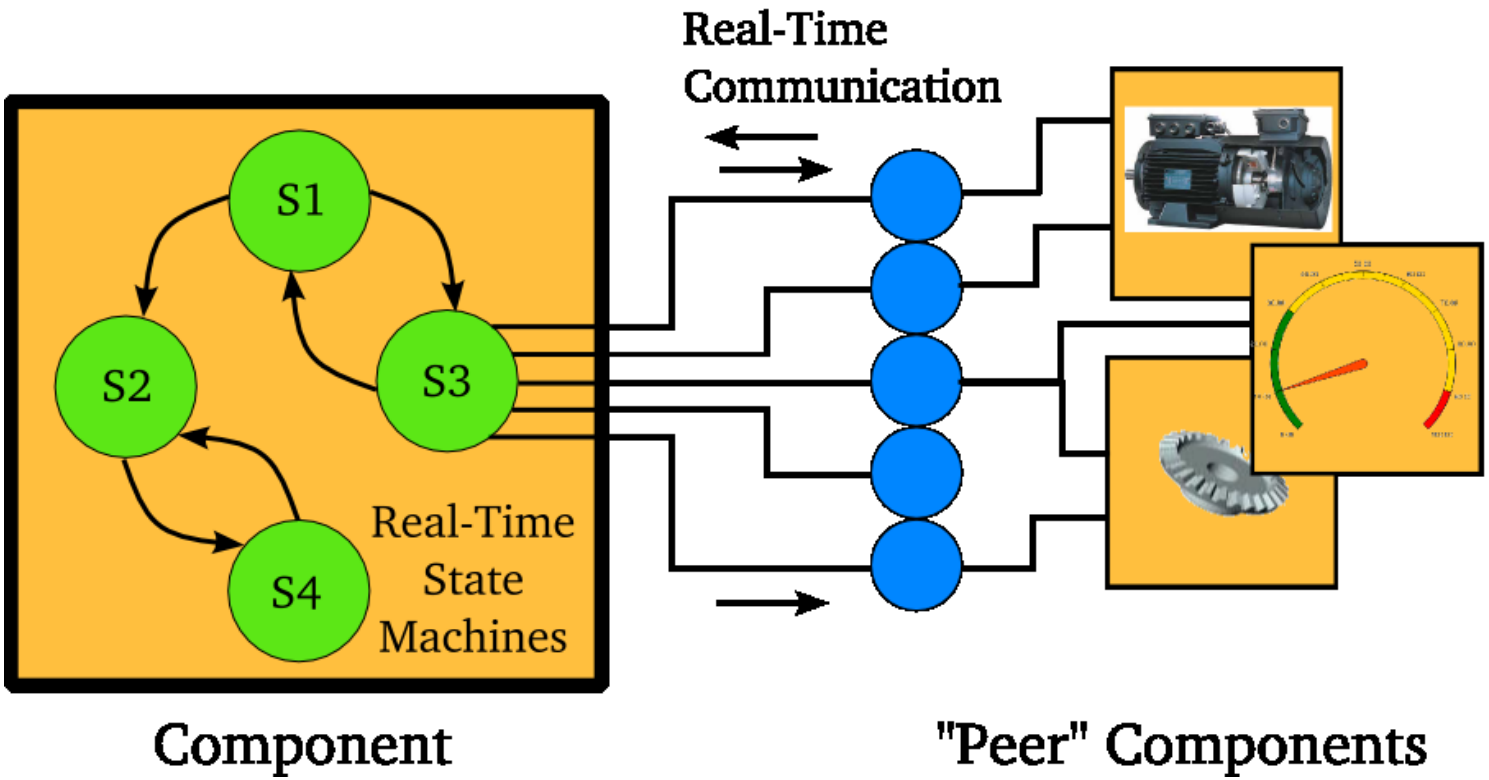

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State Machine Example

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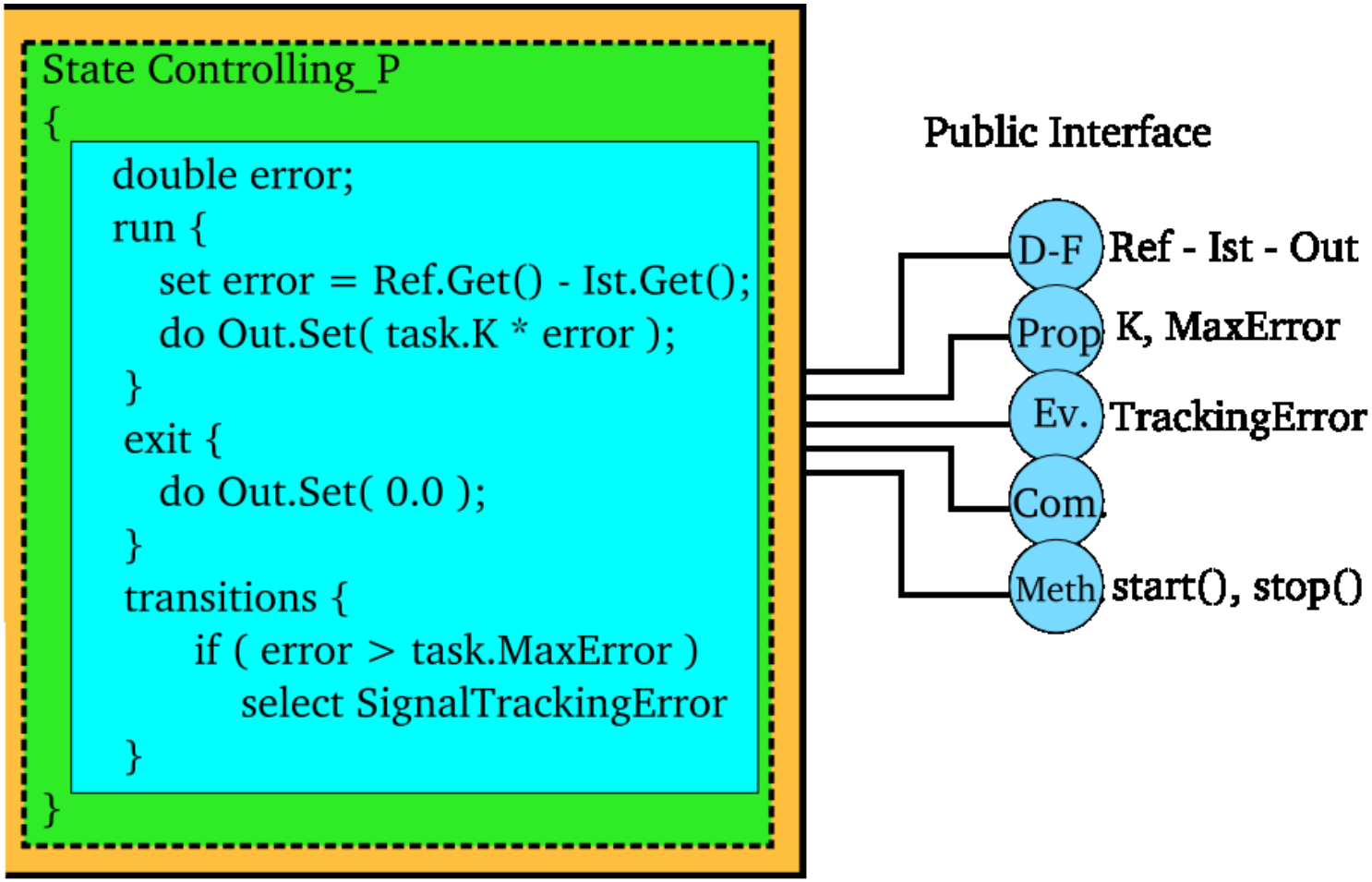

"P Controller Component"

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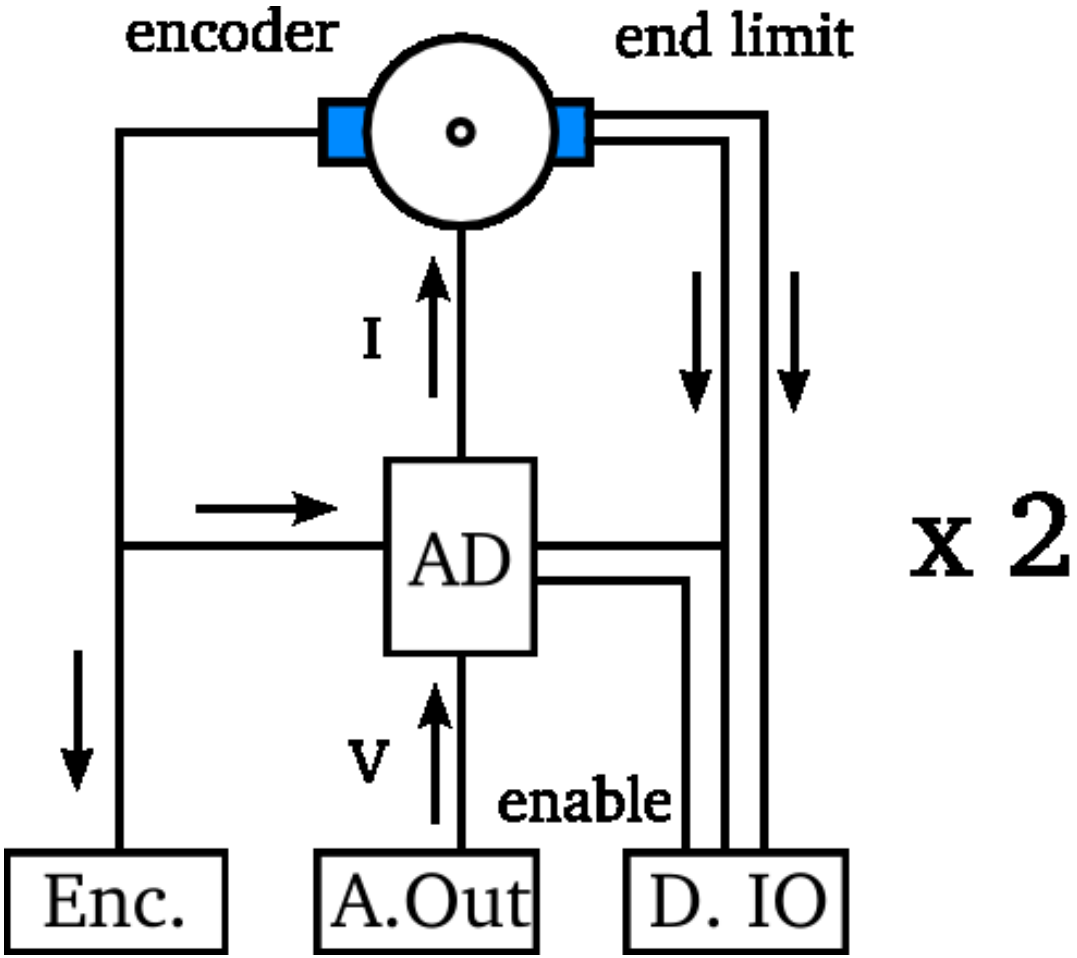
Demo Machine Hardware



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Components

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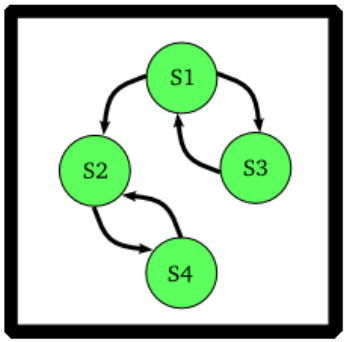
The basic building blocks . . .

Joint Level Interpolator Component

PI Controller Component

Hardware Component



Control Kernel Process

User Interface

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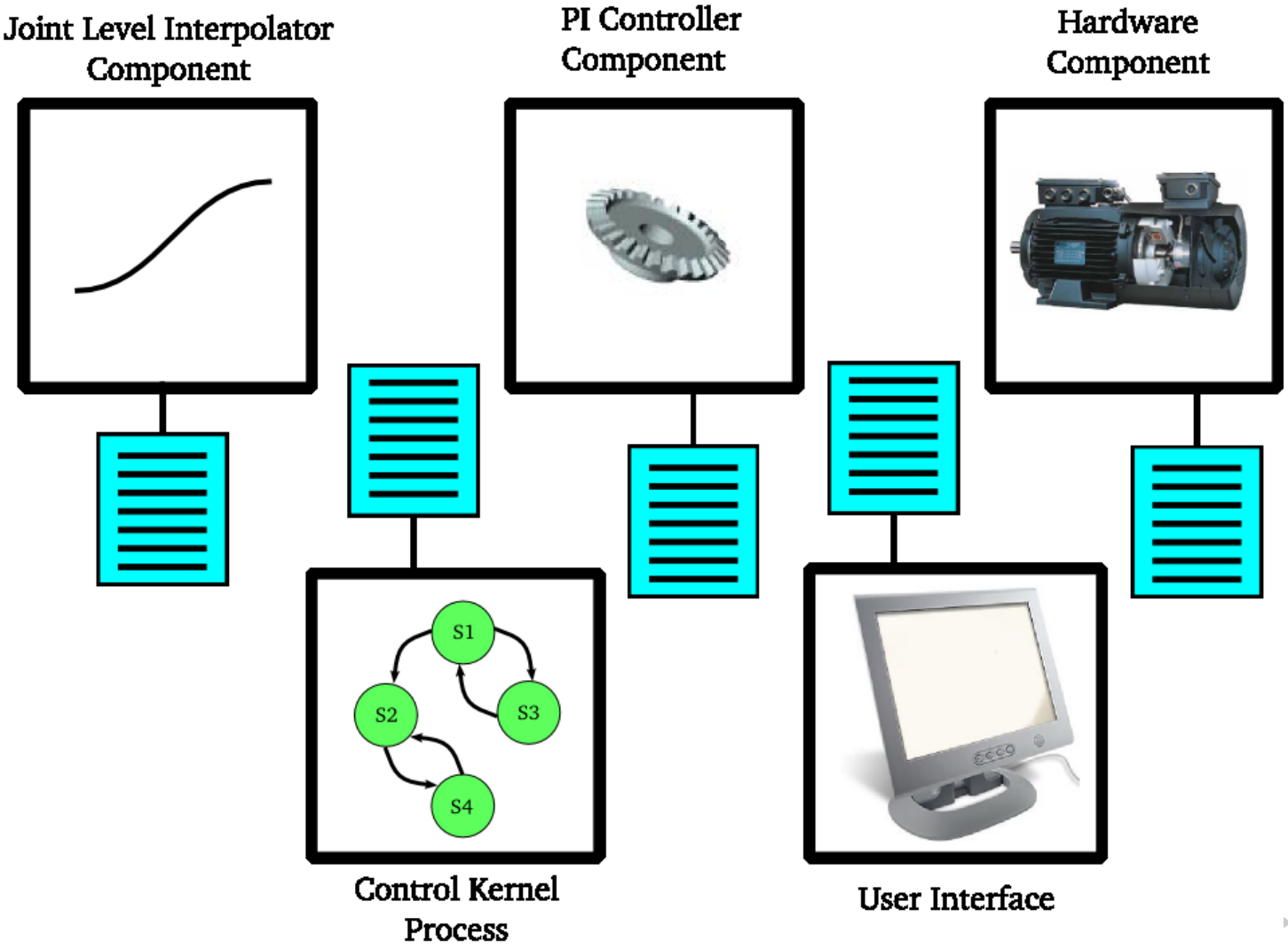
Components : Configuration

With properties . . .



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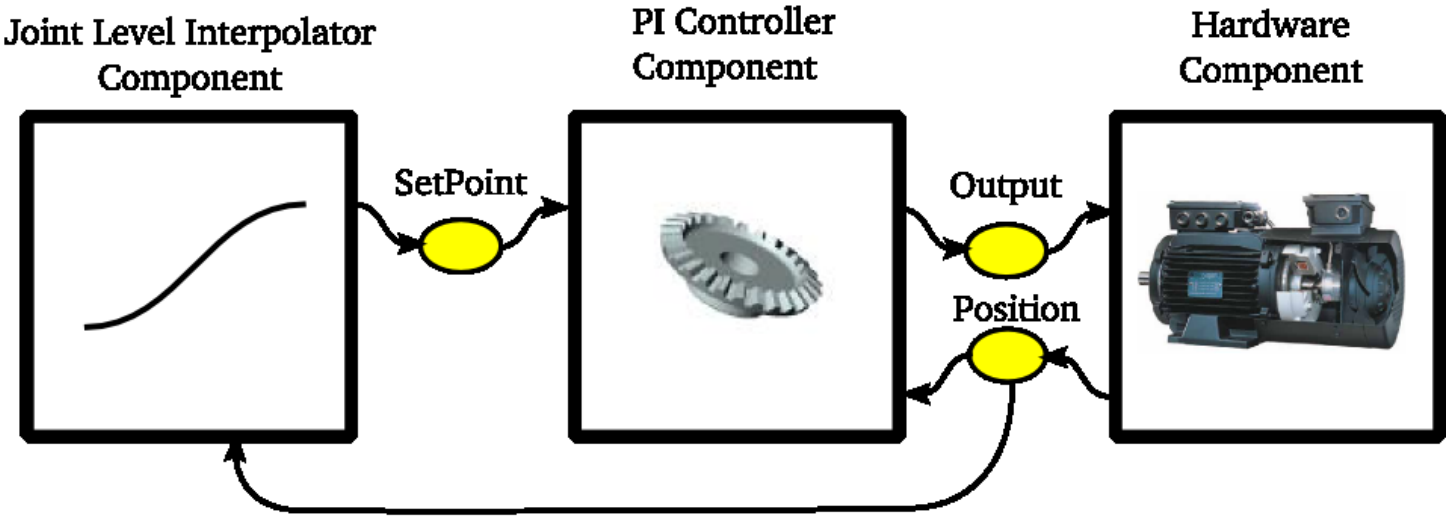
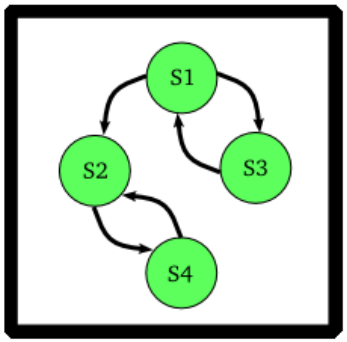
Components : Data Flow

Connecting data ports . . .



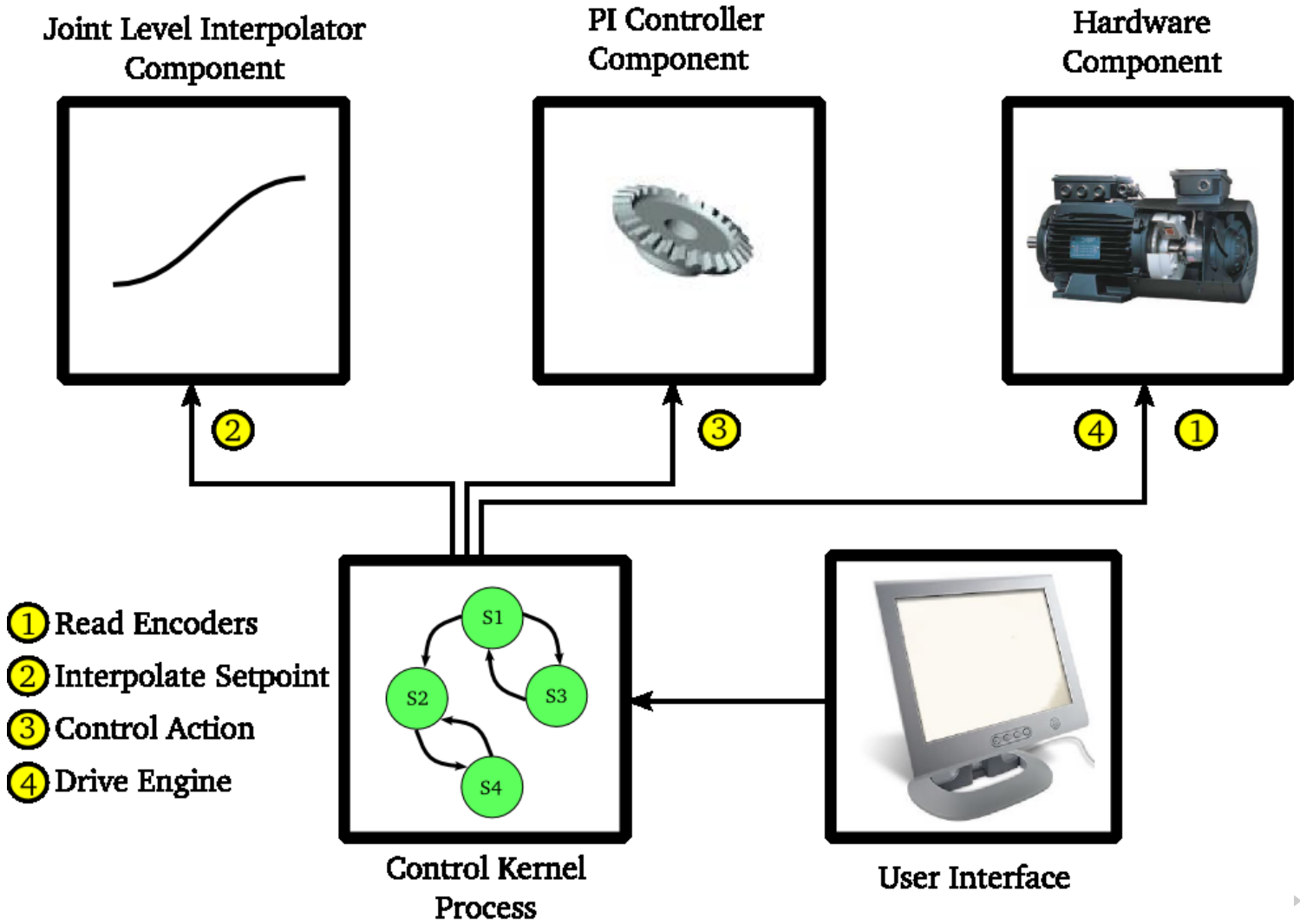


Control Kernel Process

User Interface

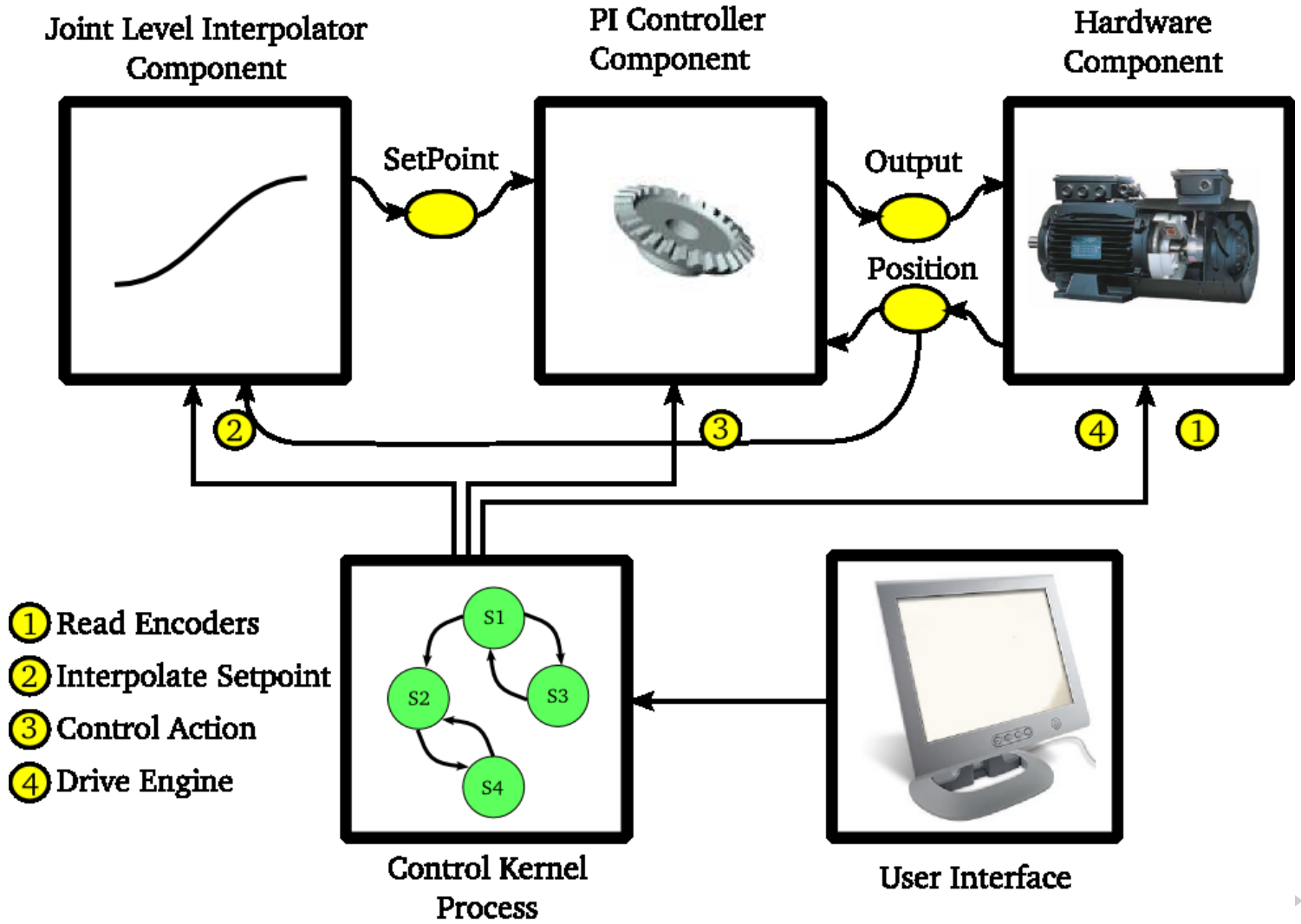
Components : Execution Flow

Executing application logic . . .



Components : Application

Putting it all together . . .



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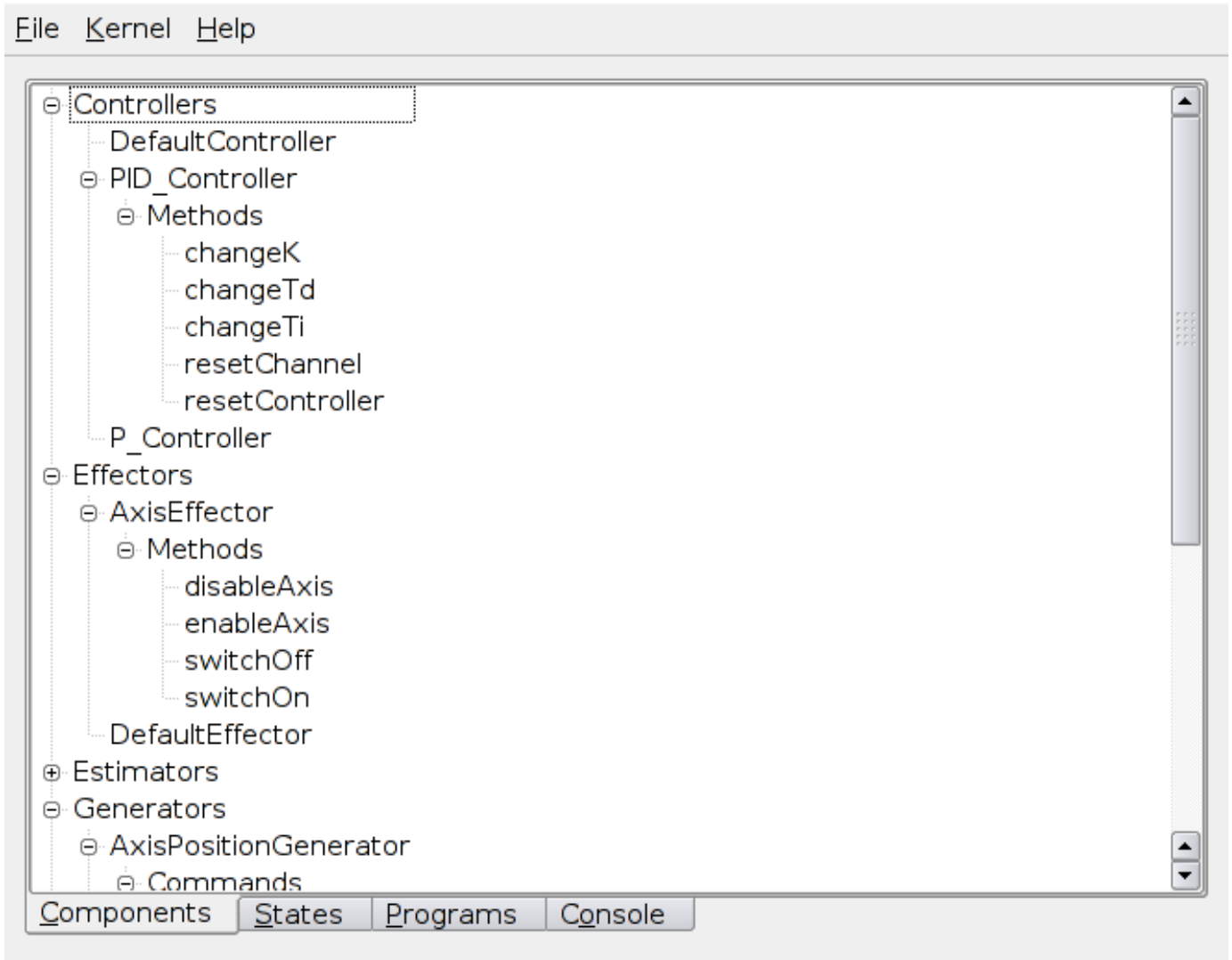
Demo



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Conclusion

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Orocos offers

- a software toolkit for building real-time components
- rich online browsable component interface
- user defined real-time state machines

Further Reference:

http://www.orocos.org