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INSTITUT FÜR AUTOMATISIERUNGS-
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Vienna University of Technology

Supervisory Control of an Injection Molding Machine

2nd 4DIAC Users' Workshop
ETFA , Toulouse, France
September 9, 2011

Alois Zoitl

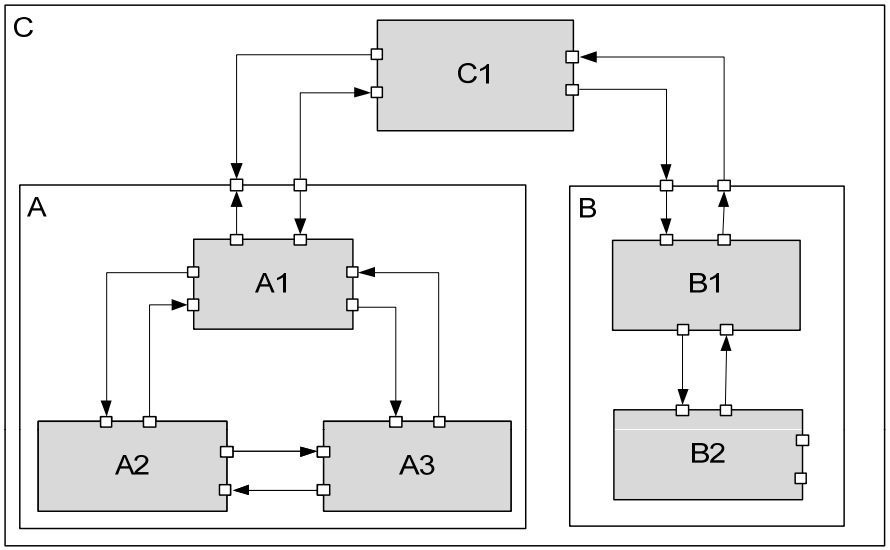
Content

- Introduction
- Modeling hierarchical control systems in IEC 61499
- Resulting Design Guidelines
- Application to Injection Molding Machine
- Conclusion / Next Steps

Introduction

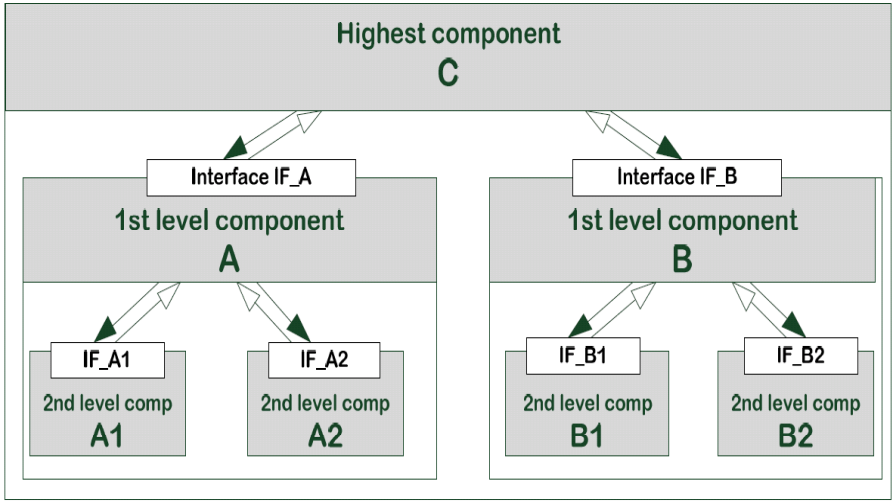
Hierarchically structured components

- hierarchical component structure
- hierachical coupling



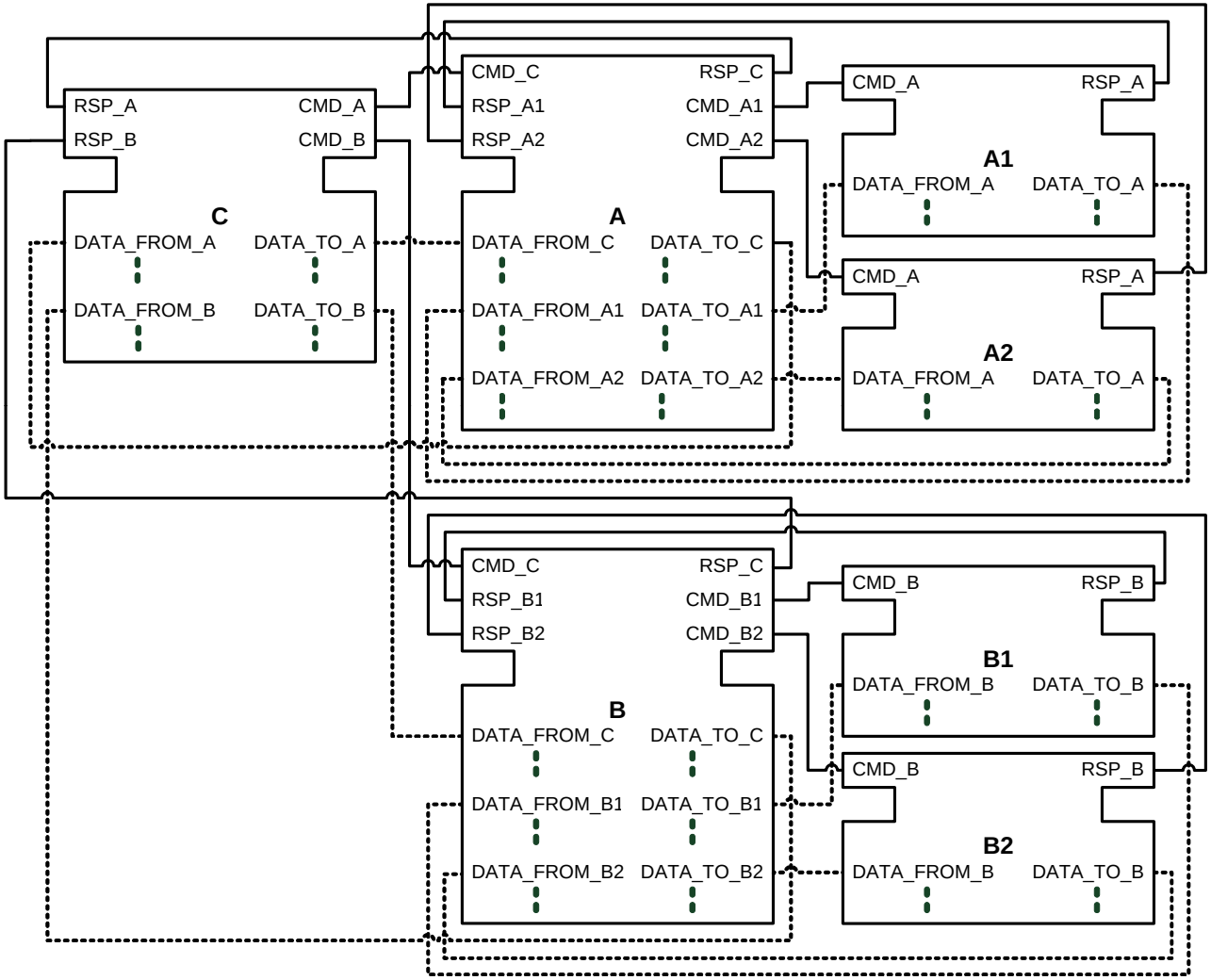
Hierarchical control solutions

- hierarchical master-slave arrangement of components
- higher-level and lower-level components

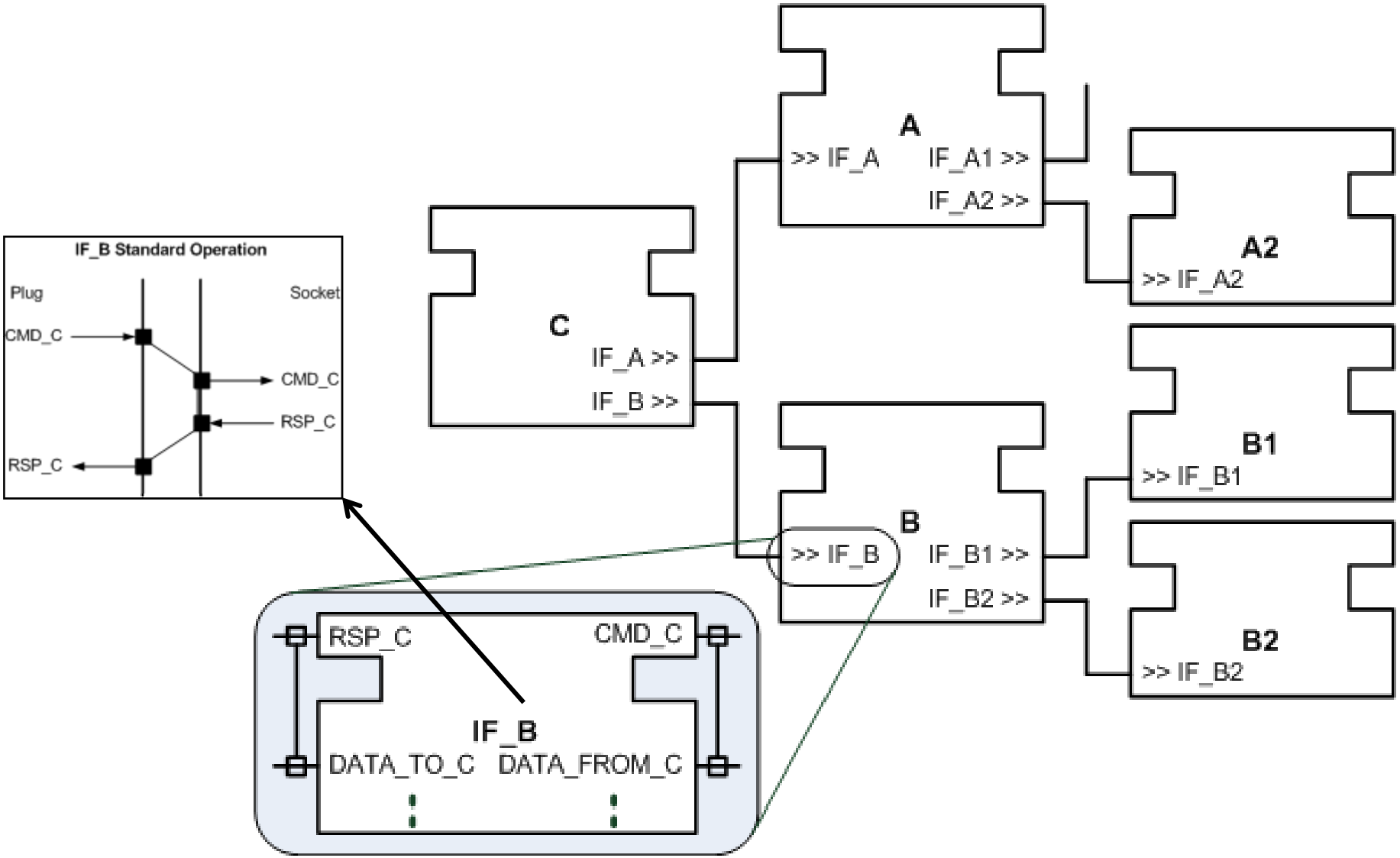


Straight Forward Solution in IEC 61499

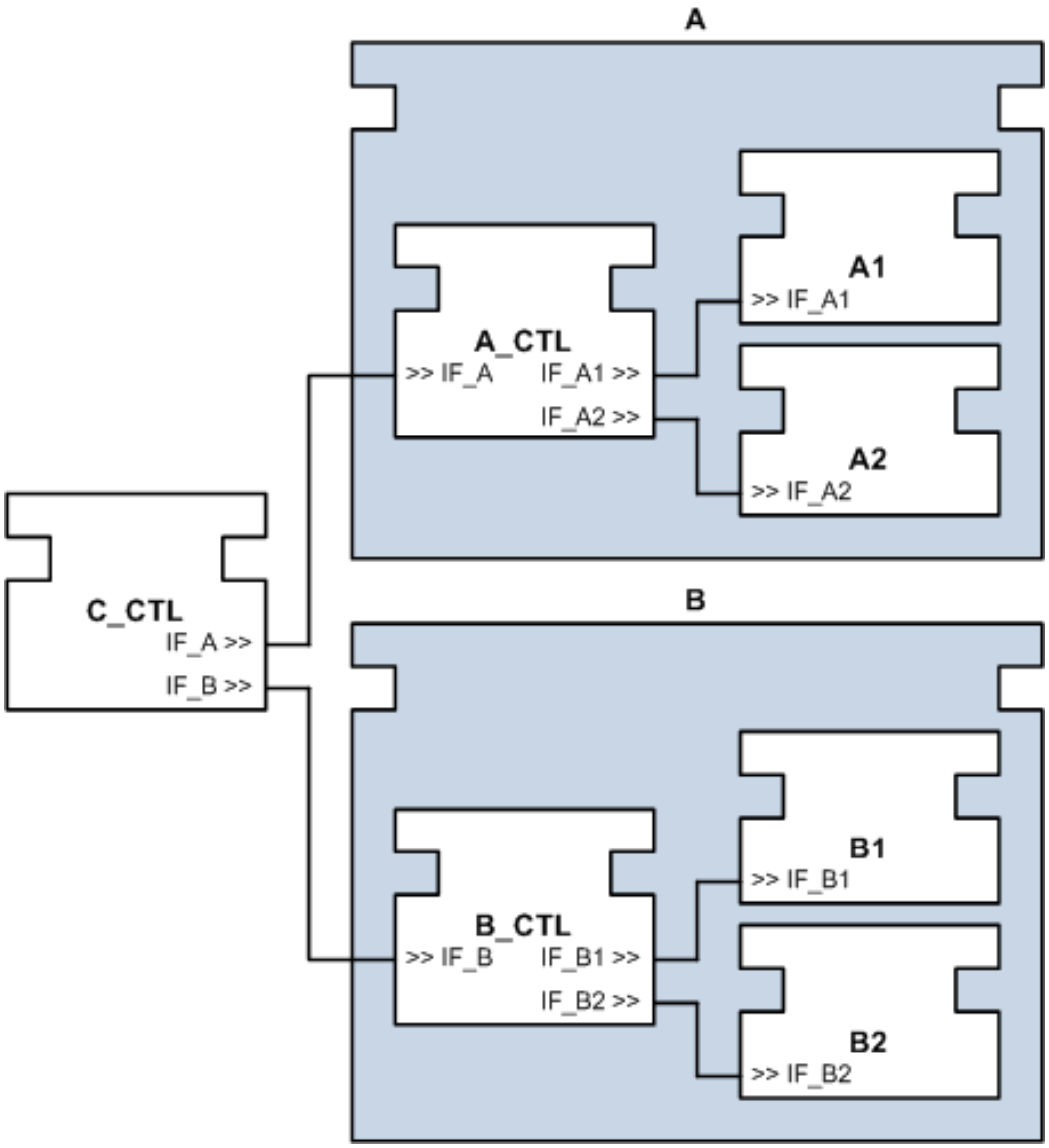
Hierarchically structured components



Component Decoupling with Adpaters



Hierarchization with Sub-Applications



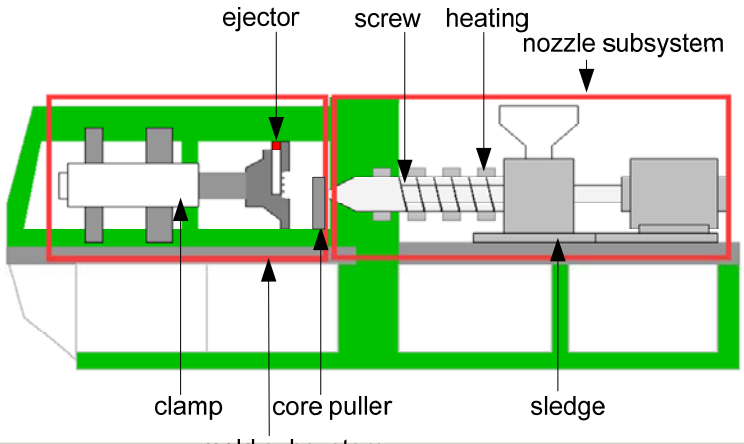
Resulting Design Guidlines

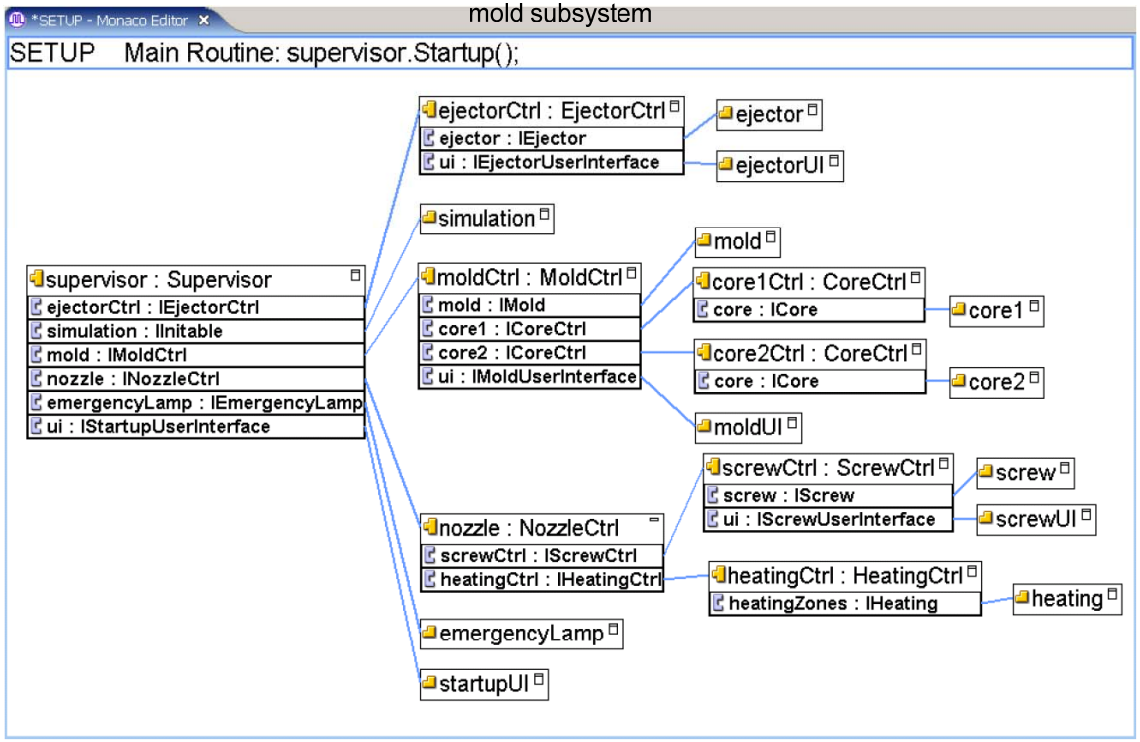
- Adapter for component decoupling
  - Sockets → Component Provider
  - Plugs → Component Requester
- Sub-Applications for the system hierarchy
- Composite FBs for component encapsulation
- Lowest level components are Service Interface Function Blocks

Starting-Point Supervisory Control in Monaco

Monaco:

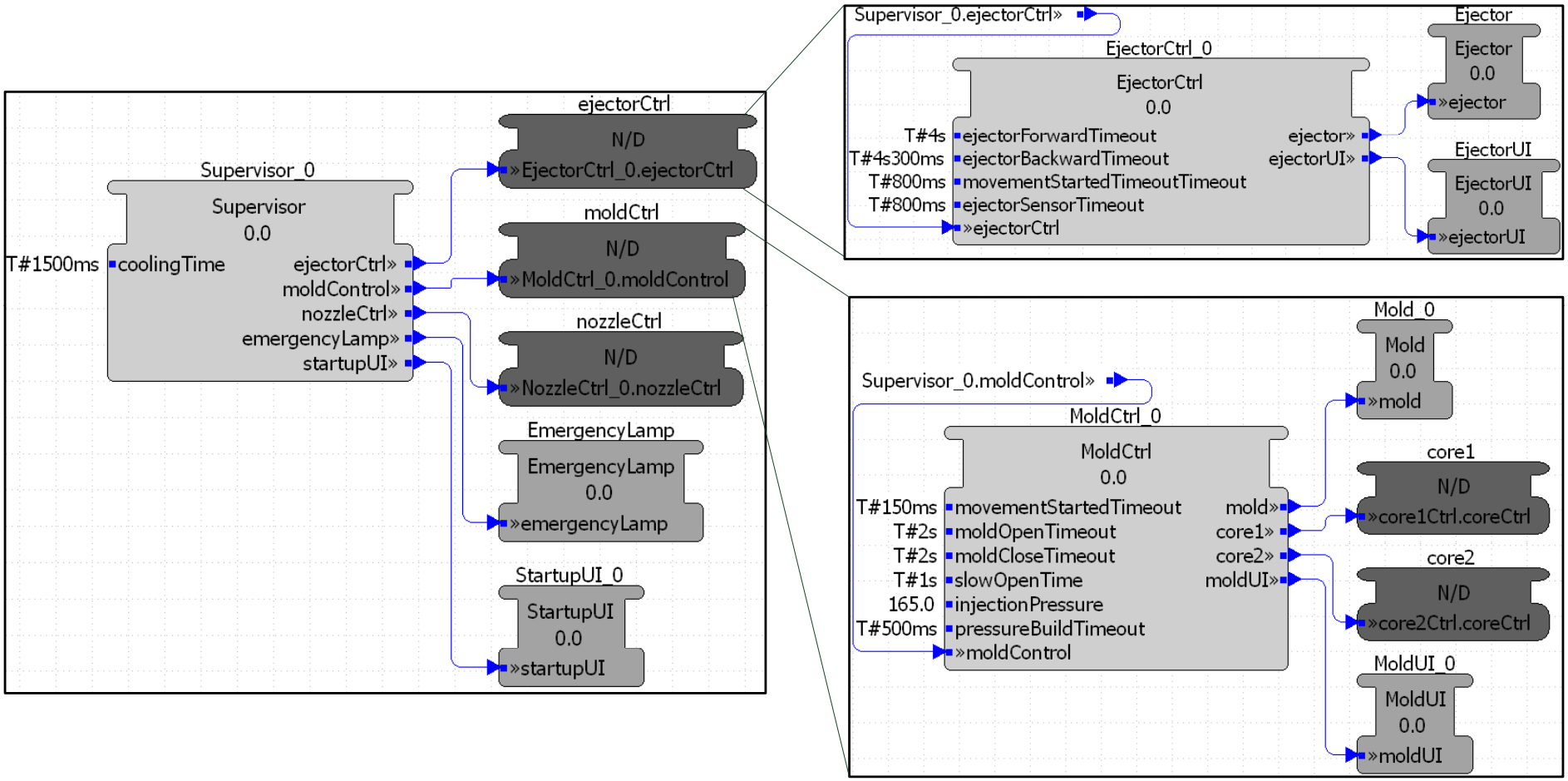
- Domain specific language for supervisory control
- Devloped at Christian Doppler Laboratory for Automated Software Engineering, Johannes Kepler University, Linz



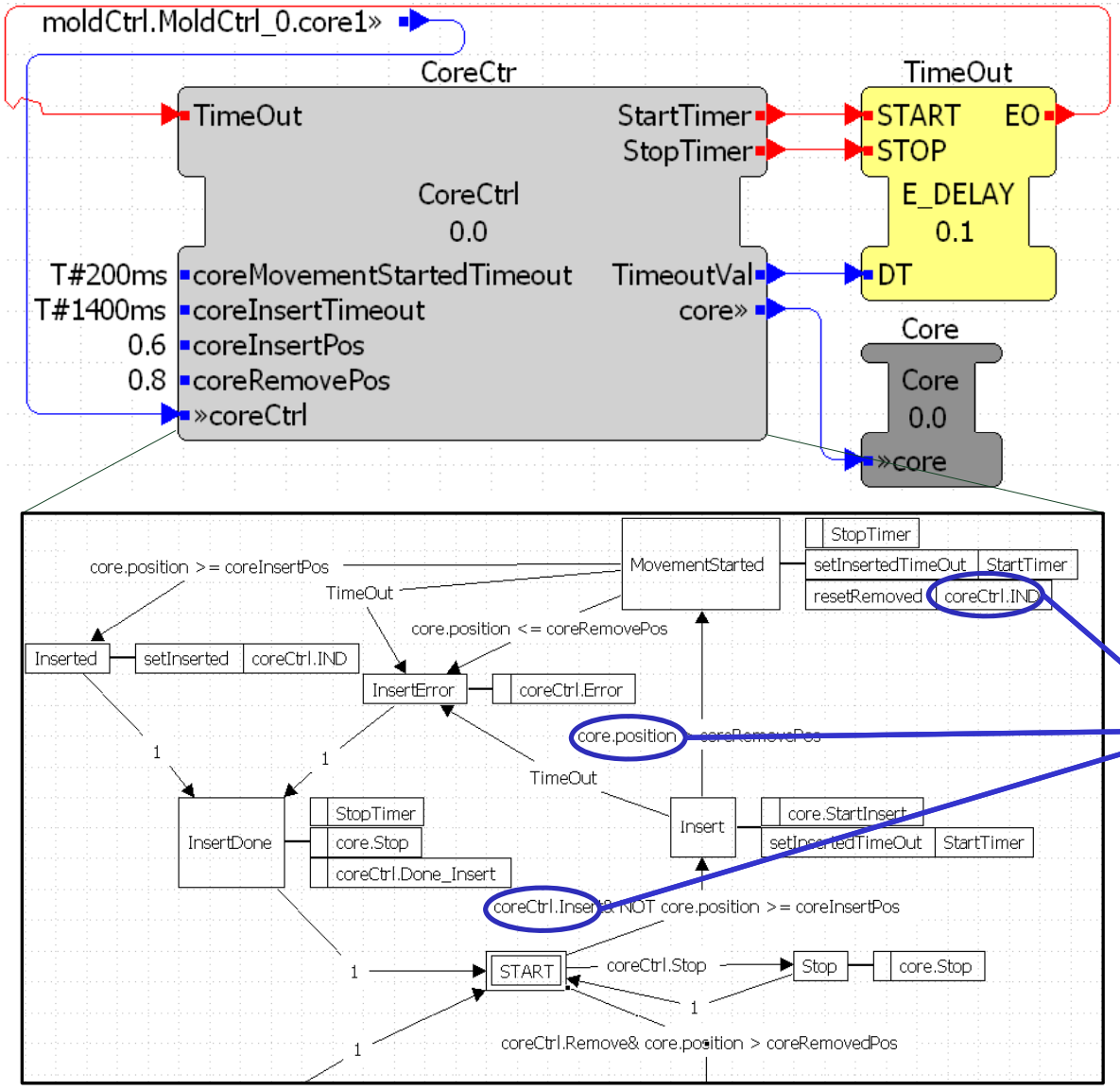


Praehofer, H., Hurnaus, D., Schatz, R., Wirth, C., Mössenböck, H.: Monaco: A DSL Approach for Programming Automation Machines. SE 2008 - Software-Engineering-Konferenz 2008, Munich, Germany, February, 2008

Overall Application Structure

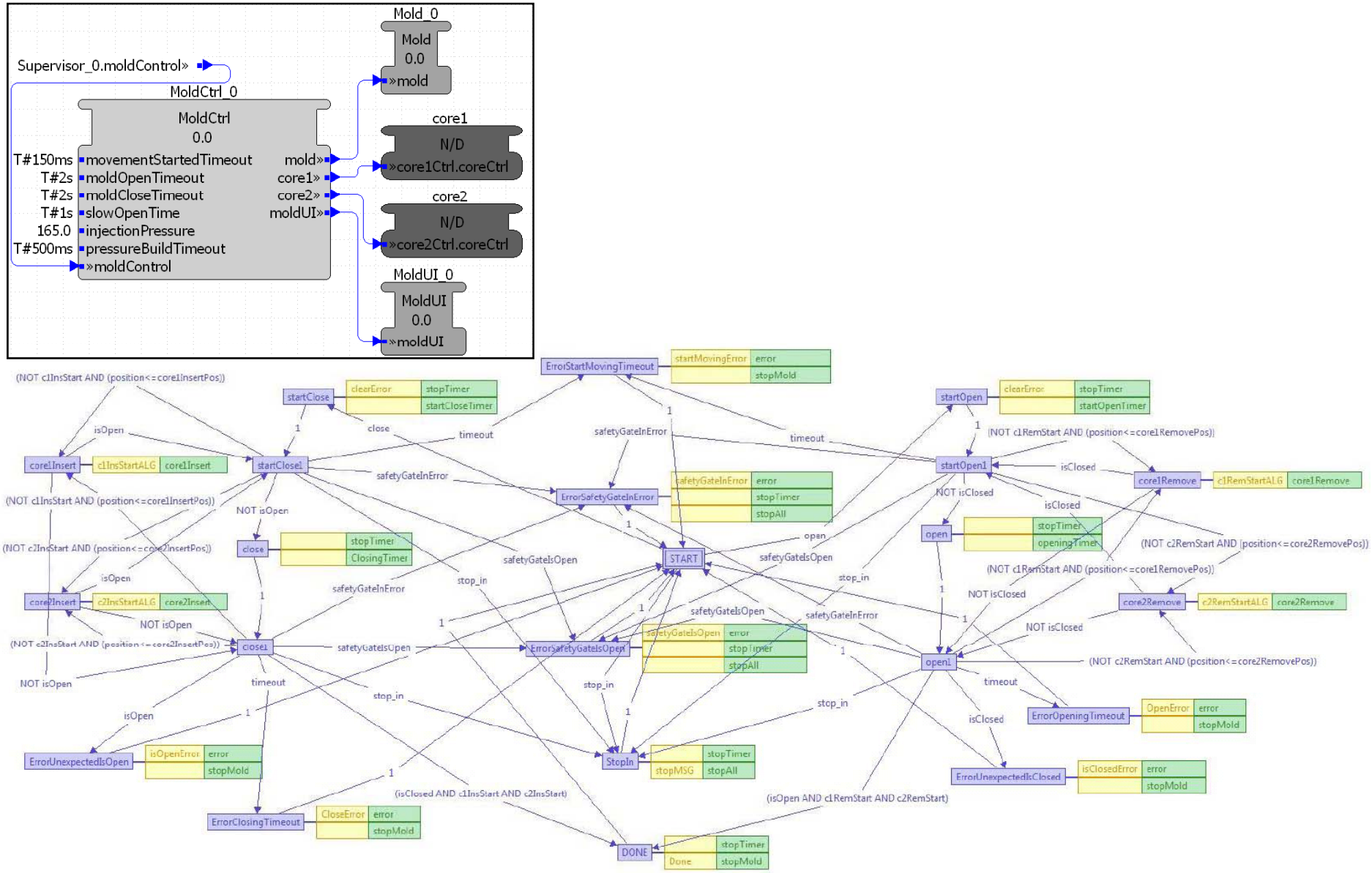


Supervisory Control of Low-Level Components



Adapter Events and Data in ECC

Supervisory Control of Several Components



Conclusion

- Hierarchical structuring and the use of Adapters greatly reduces application complexity
- Resulted in improved Adapter support in 4DIAC →FB interface designer and ECC
- Identified shortcomings of IEC 61499
  - Handling of timeout in ECCs
  - Adapter connections across composite FB boundaries
  - Error-handling complicates ECCs
    - → hierarchical state machines could improve situation
- Next Steps
  - Improve
    - User Interface
    - Error and emergency stop (e.g., safety gate) recovery mechanisms
  - Identify reoccurring supervisory control application patterns
  - Verification of components to defined adapter interface behavior

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Contact Speaker

Alois Zoitl
Vienna University of Technology,
ACIN
Gußhausstraße 27-29 / E376
1040 Wien, AUSTRIA
+43 1 5880137683
zoitl@acin.tuwien.ac.at
www.acin.tuwien.ac.at

Acknowledgements

- Herbert Prähofer
- Christian Schwingenschlögl
- Martin Fein