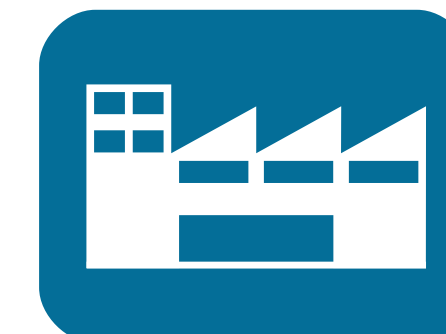
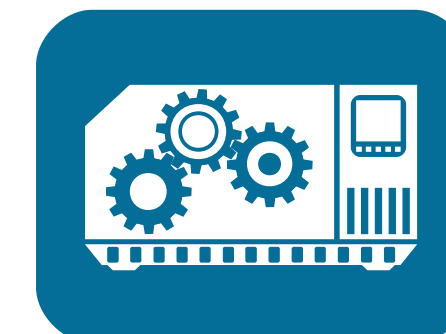


Analyzing and Refactoring the Modularization of IEC 61499 Systems

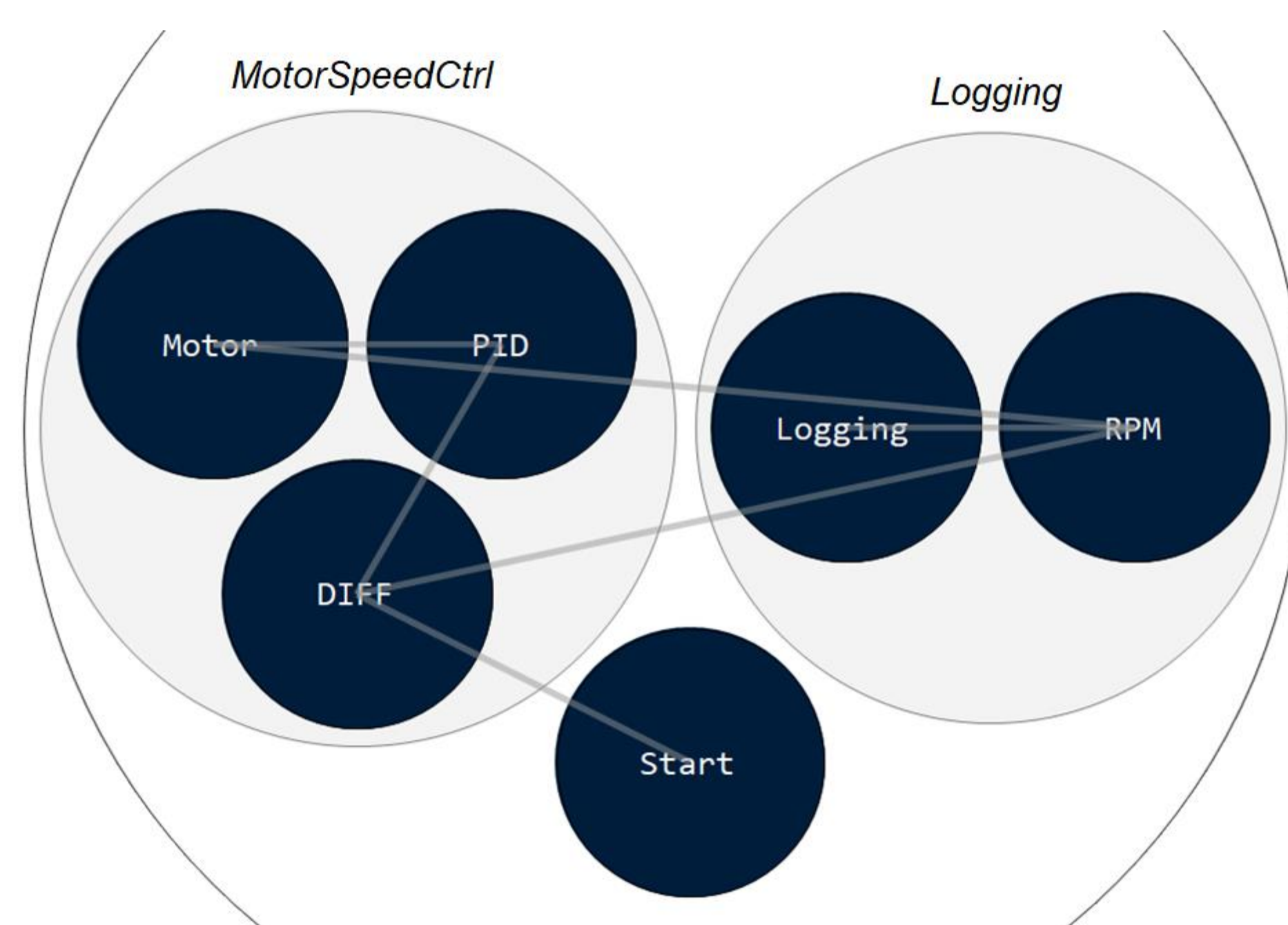
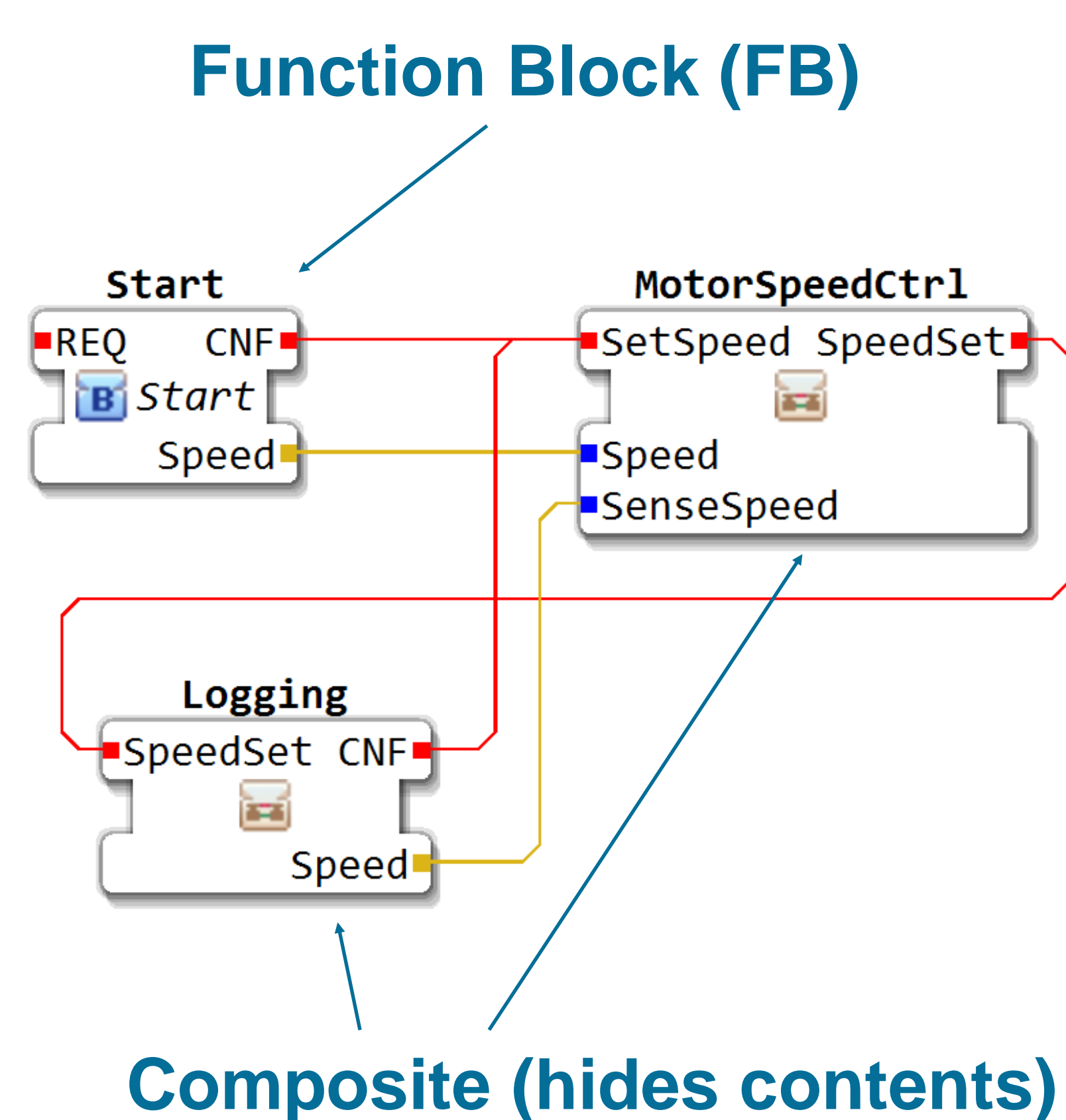
Philipp Bauer



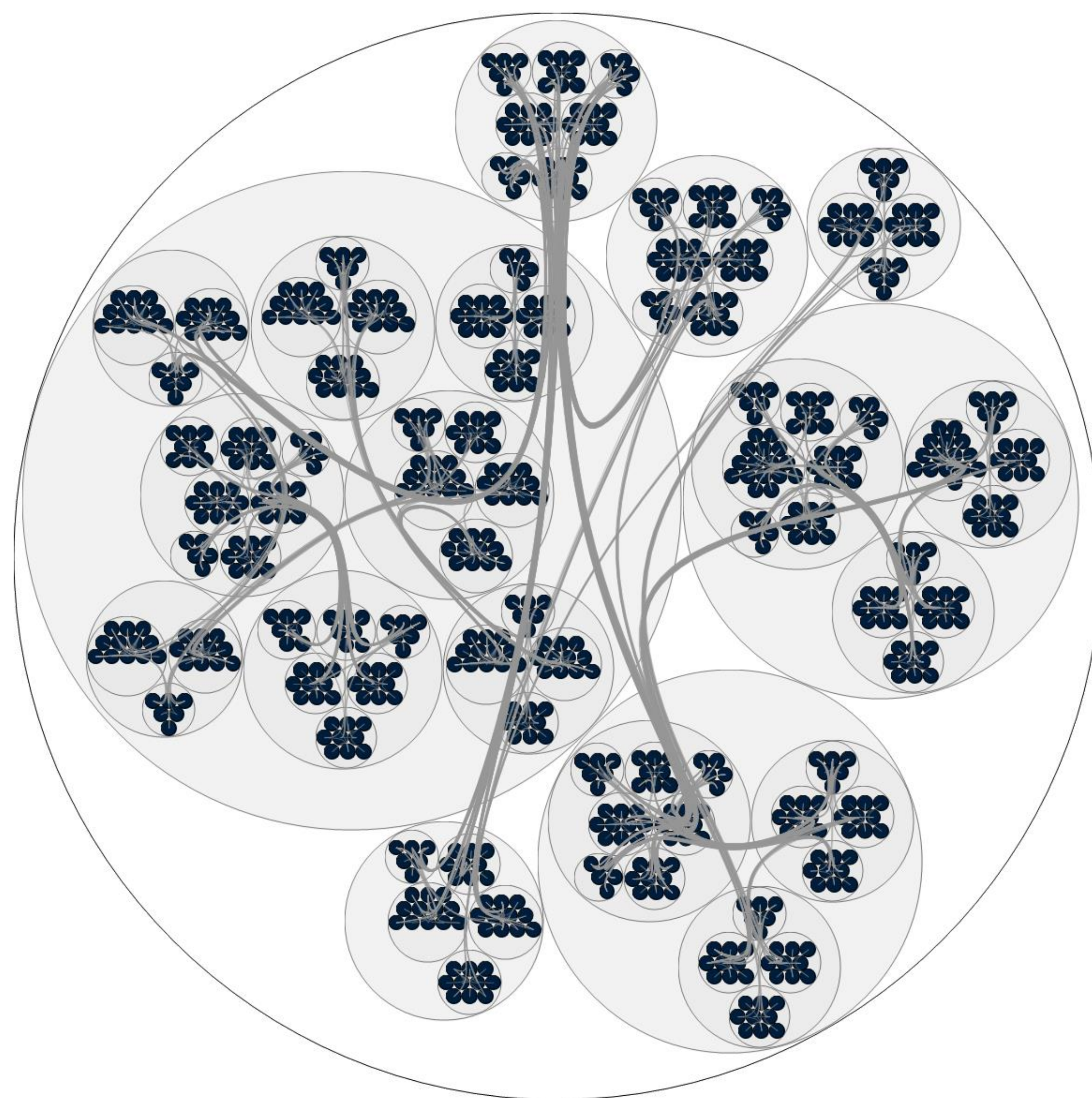
Through cooperation with industry partners, we have learned that modularization is an essential issue for the development and maintenance of control software. **Visualizing control software** and identifying, quantifying, and **reducing Feature Envy**, inappropriate coupling and cohesion of modules, through re-modularization are the key challenges of this work.

Visualization

We apply existing concepts for visualizing graphs (**circle packing**) and computer graphics techniques (**hierarchical edge bundling**) to **control software** based on the **IEC 61499** standard.



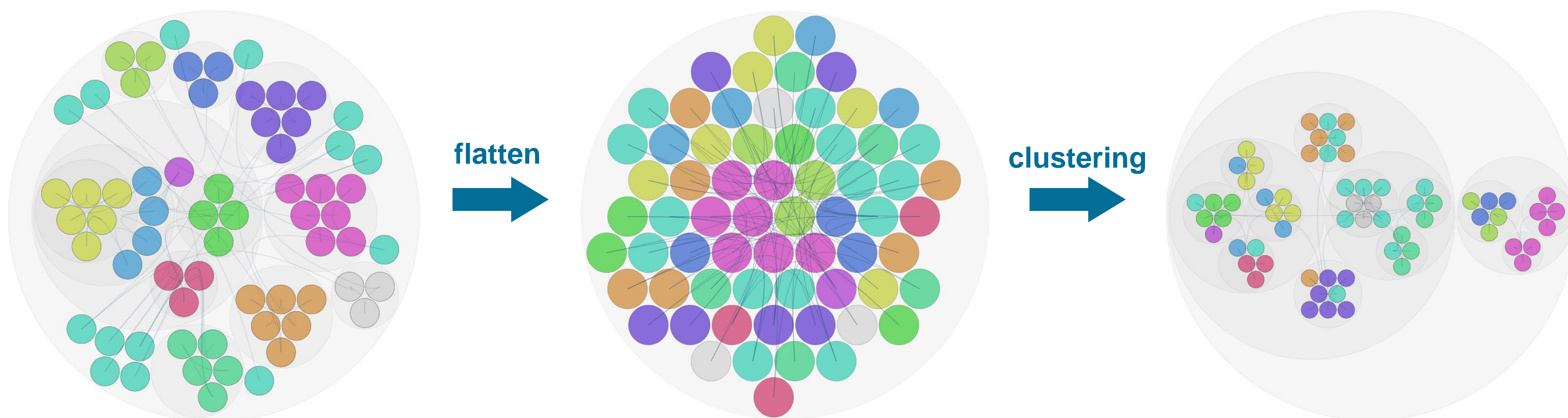
all levels of hierarchy visible;
edges between endpoints



realistic, yet still "small" example
of plant control software

Modularization

To reduce Feature Envy, we explore the use of a **semantic clustering** algorithm, based on an adapted **edge-betweenness metric**, to **refactor existing systems** according to the connections between FBs. With the help of a modularity value the best number and position of splits are evaluated and recursively applied to each subdivision until stopping criteria are met.



Conclusion & Future Work

First results of the modularization show that, that our approach **can significantly reduce Feature Envy** in the best case. Workshops with our industry partner revealed that the use of the visualization approach **helps** automation engineers to **understand** the software and **identify problems** regarding modularization and the **global connectivity** between modules more easily. Furthermore, both work packages have also been realized as an interactive tool.

