

Introduction to IEC 61499

Valeriy Vyatkin, University of Auckland

Plan

- Was ist die IEC 61499?
- Blockdiagramm-Denkweise
- Ein kurzes Einführungsbeispiel
- Ereignisgesteuertes Komponenten-Modell
- Schlüsselvorteile: Systemlevel-Design-Offenheit, Übertragbarkeit, Kompatibilität
- Tools und Plattformen
- Unterschiede zur 61131-3
 - Wiederverwendung, Flexibilität, Verteilung, Systemlevel-Design



IEC 61499 International Standard

International Electrotechnical Commission IEC TC 65B/ WG7/ MT15

Eine **komponentenbasierte, offene Referenzarchitektur** für **verteilte Industrielle Prozessmessungs- und Kontrollsysteme (IPMCS)**

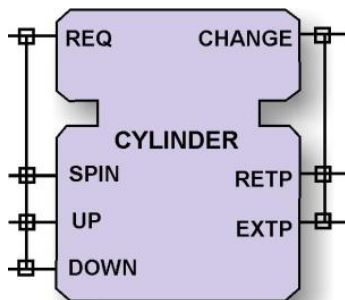
Welche die Voraussetzung für sowohl gegenwärtige als auch zukünftige Anforderungen erfüllen für intelligente Automatisierung

1996 – project started

2005 – first edition

2011 – second edition

Basiert auf und
erweitert die
Standards

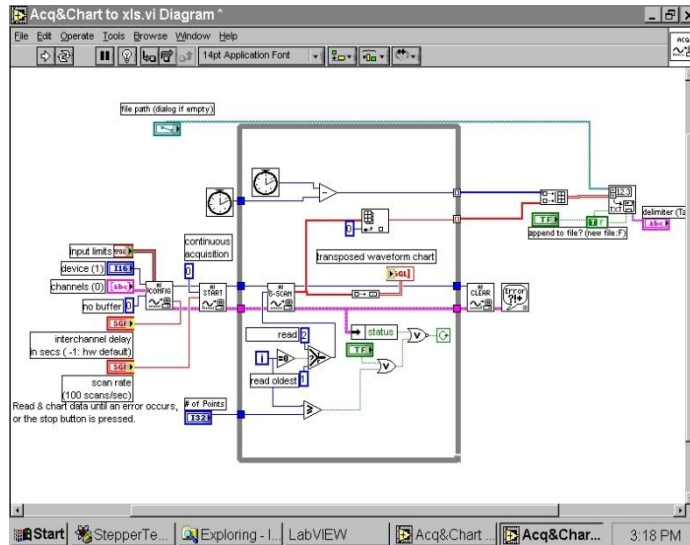


PLC Function Blocks (IEC 61131-3)

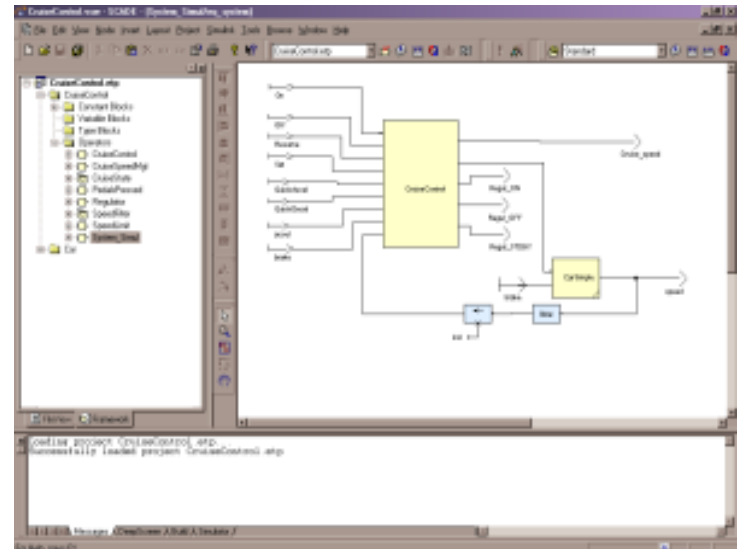
DCS Function Blocks (IEC 61804 project)

Blockdiagramm-basierte Programmierung

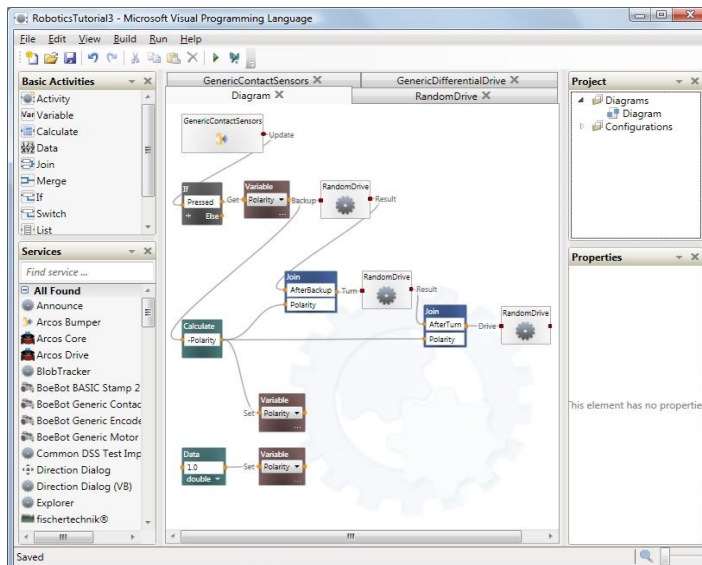
LabView



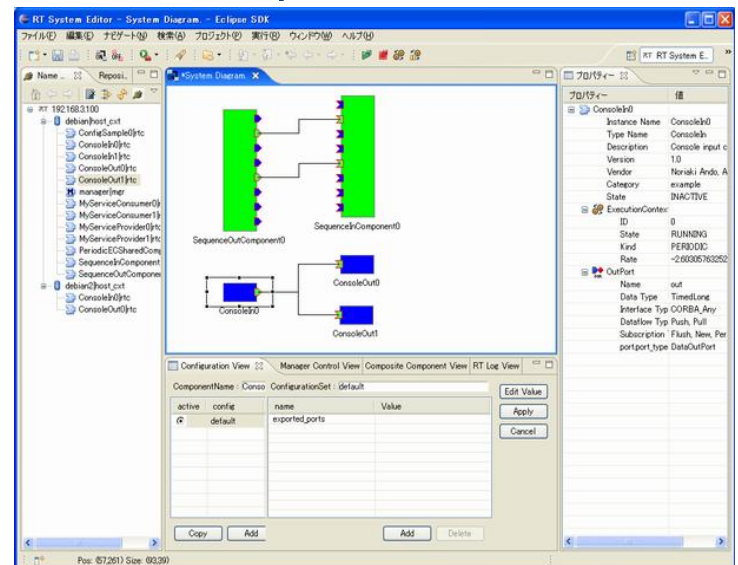
SCADE




MS VPL



Open RTM



Frühe Papiere mit IEC 61499-Ideen



Pergamon

Control Eng. Practice, Vol. 4, No. 6, pp. 855-861, 1996
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PII:S0967-0661(96)00078-0

ASYNCHRONOUS AND SYNCHRONOUS APPROACHES FOR PROGRAMMING DISTRIBUTED CONTROL SYSTEMS BASED ON STANDARDS

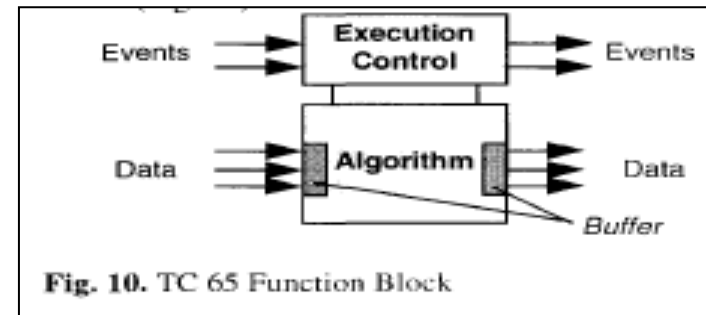
R. Schoop* and A. Strelzoff**

*AEG Schneider Automation, Steinheimer Strasse 117, 63500 Seligenstadt, Germany (schoop@modicon.de)
 **AEG Schneider Automation, One High Street, North Andover, MA 08145-2699, USA

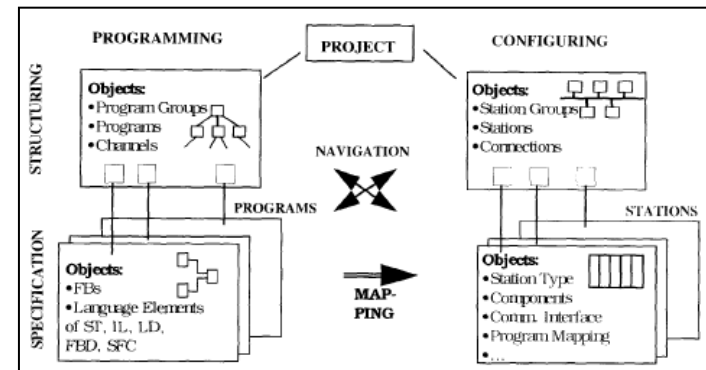
Abstract: Based on a general design model for distributed control systems, and using standardised languages of IEC 1131-3 for control, three approaches to programming are investigated. The first is based on IEC programs with extensions, the second is a decomposition of programs with SFC notations and the third approach uses function blocks corresponding to the IEC TC65 Function Block Standard. The approaches are specified and compared, and conclusions for their use and for further work are drawn. The intention of the contribution is to discuss possibilities for open programming models, rather than to present final results.

Keywords: Distributed control, distributed models, functional blocks, open control systems, programming approaches, sequential control, standards

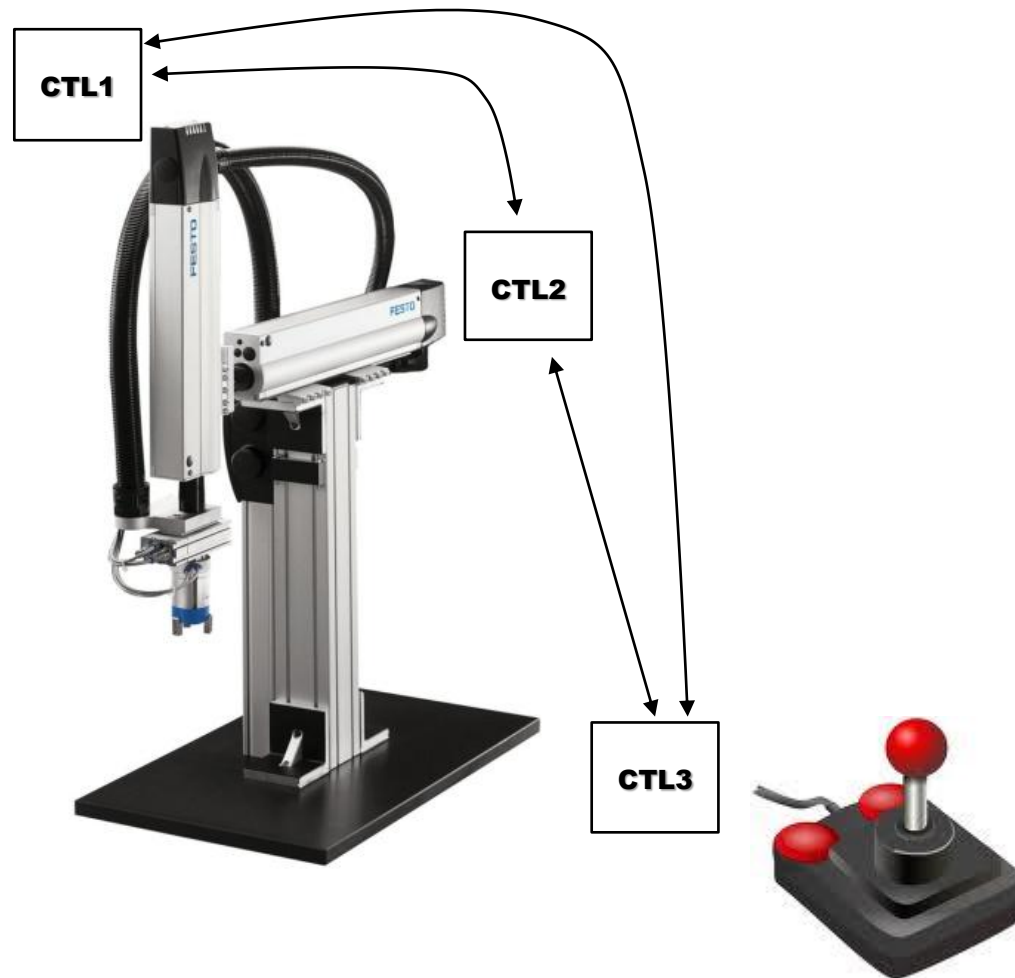
Komponentenmodell



Verteilungsmodell

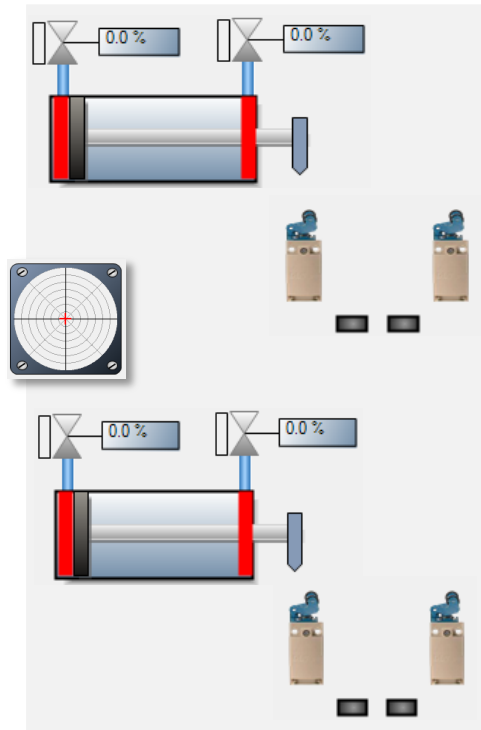
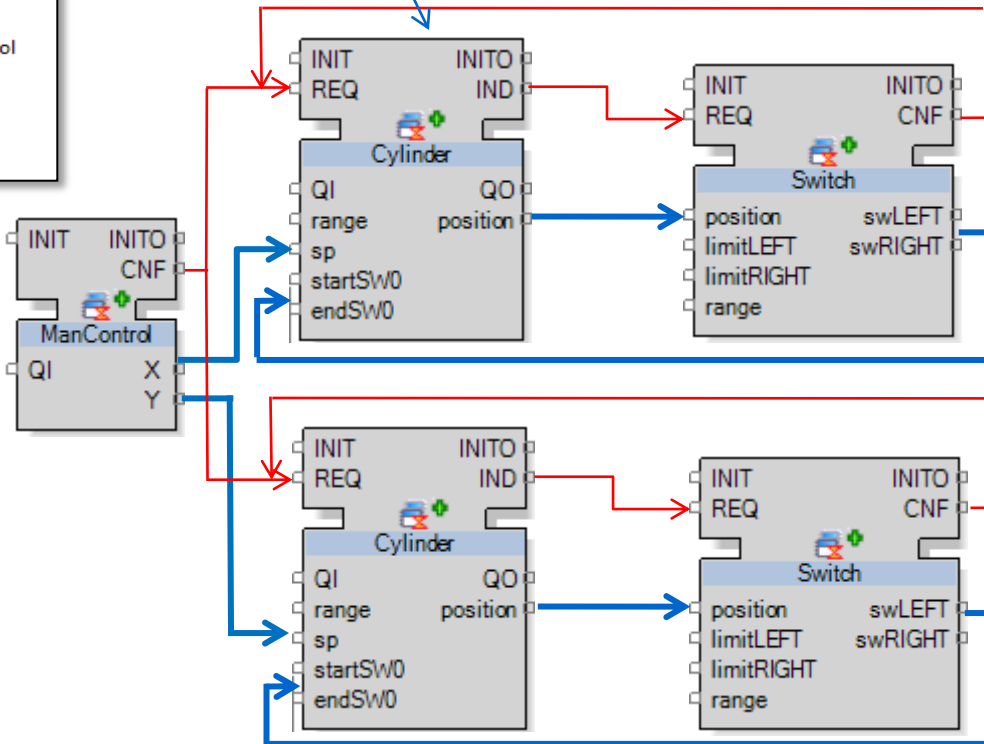
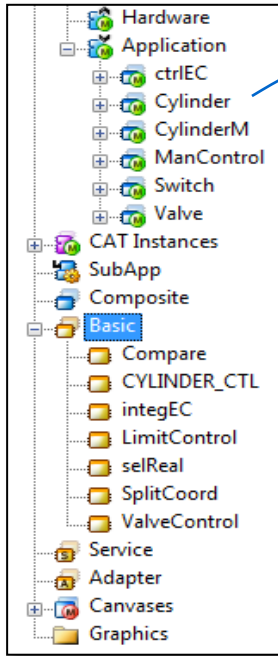


Kurze Einführung in Funktionsbausteine

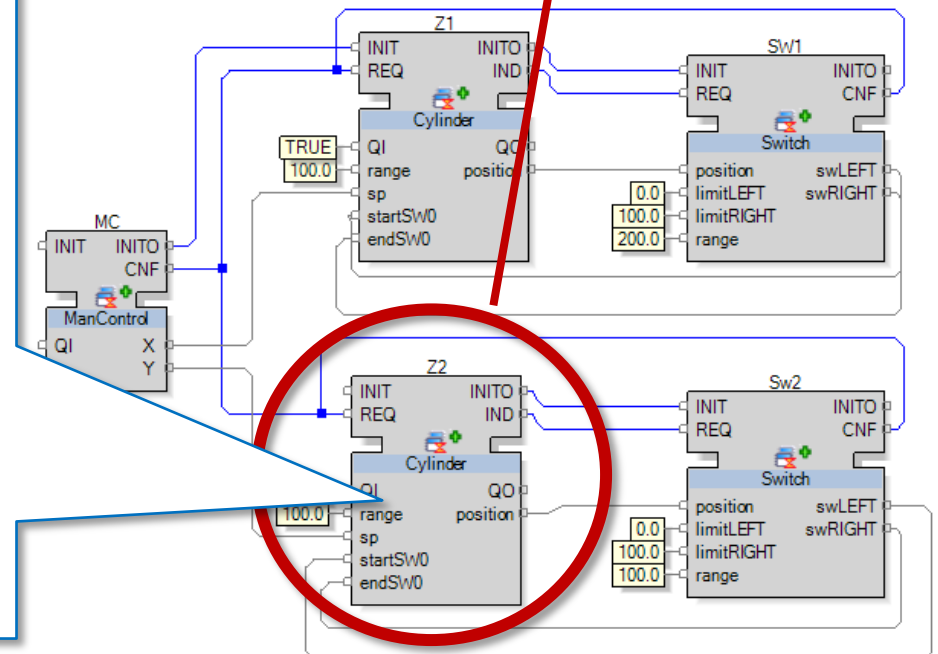
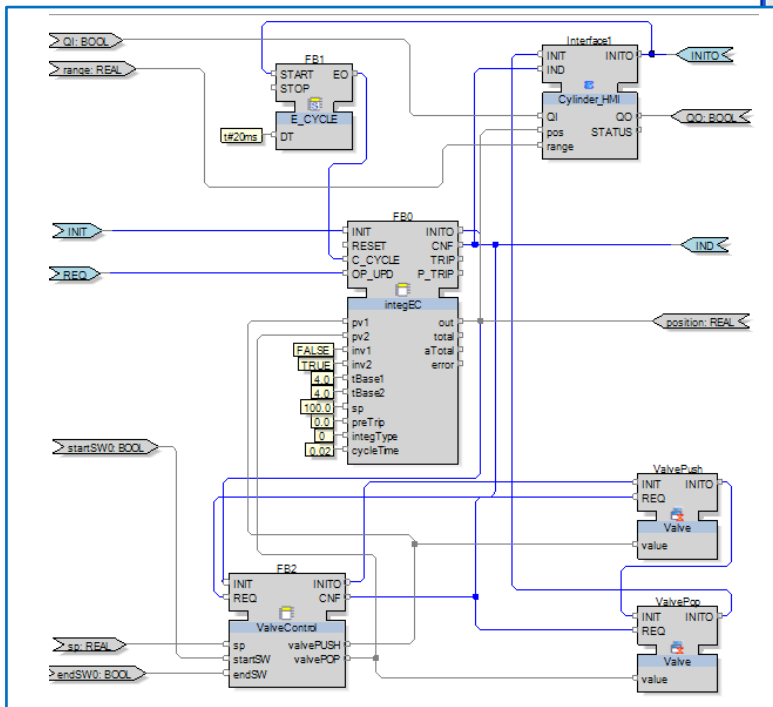
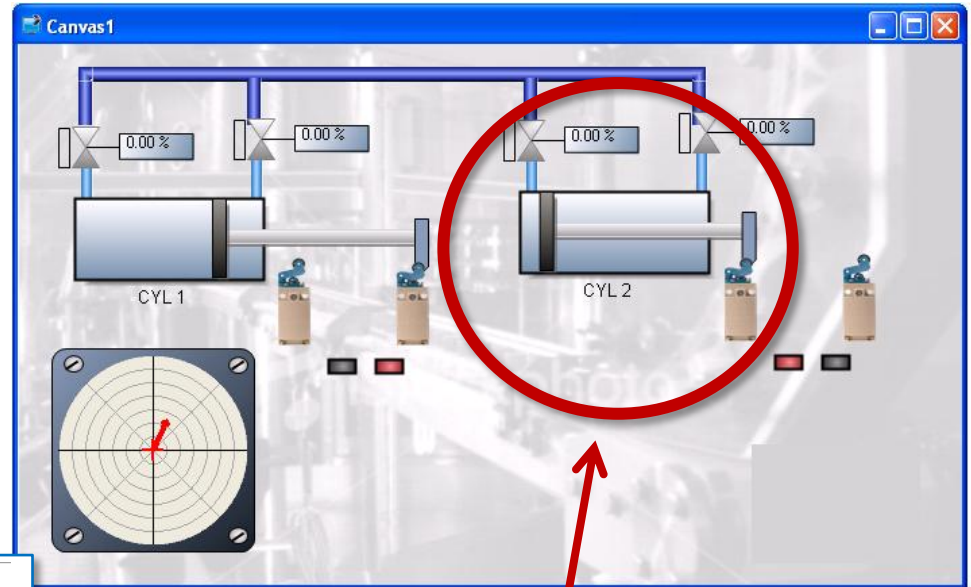


Modulare Software für Modulare Maschinen

Repository

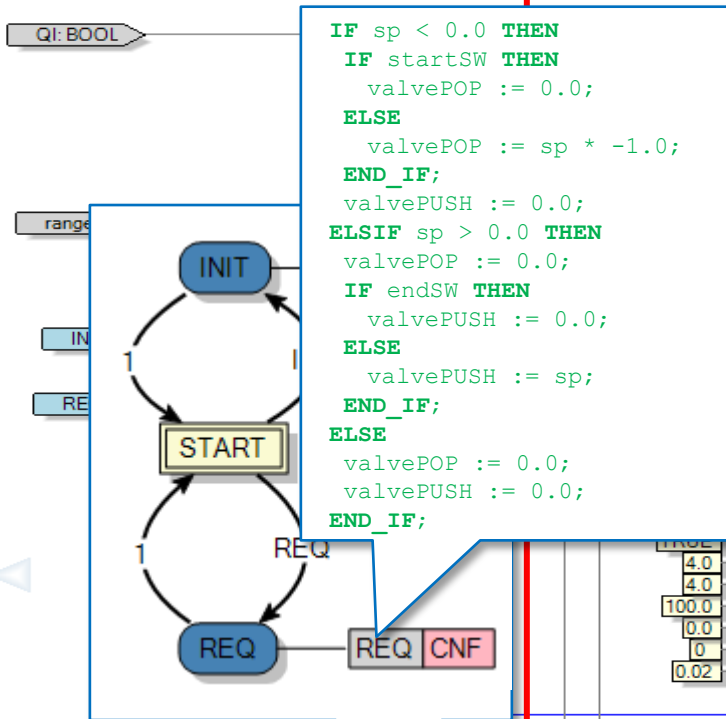


MVC Design Pattern

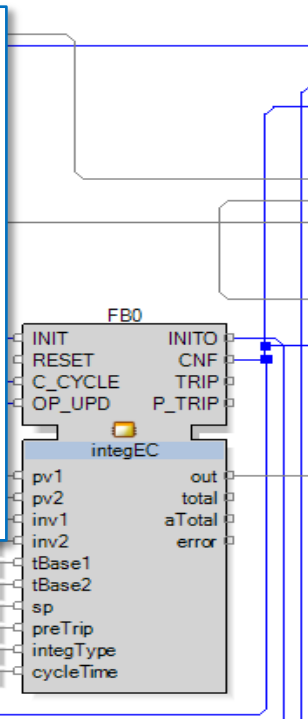


Zylinder: MVC Design

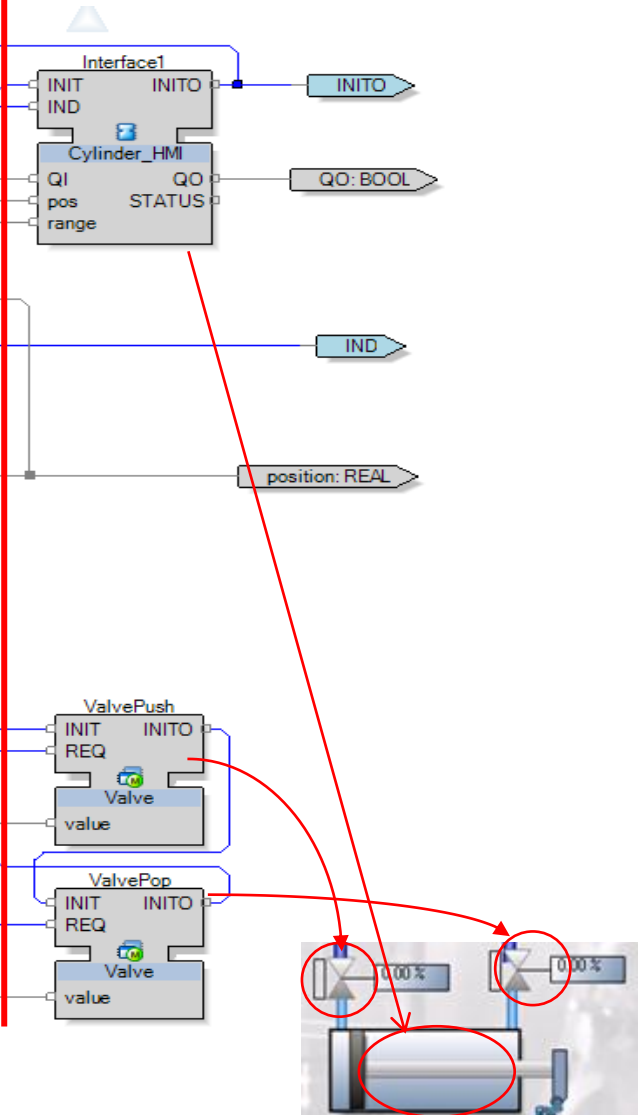
Control



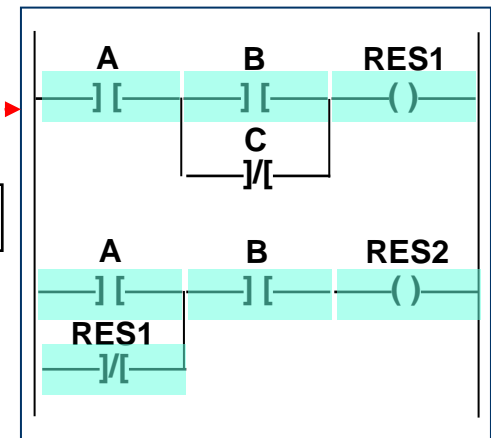
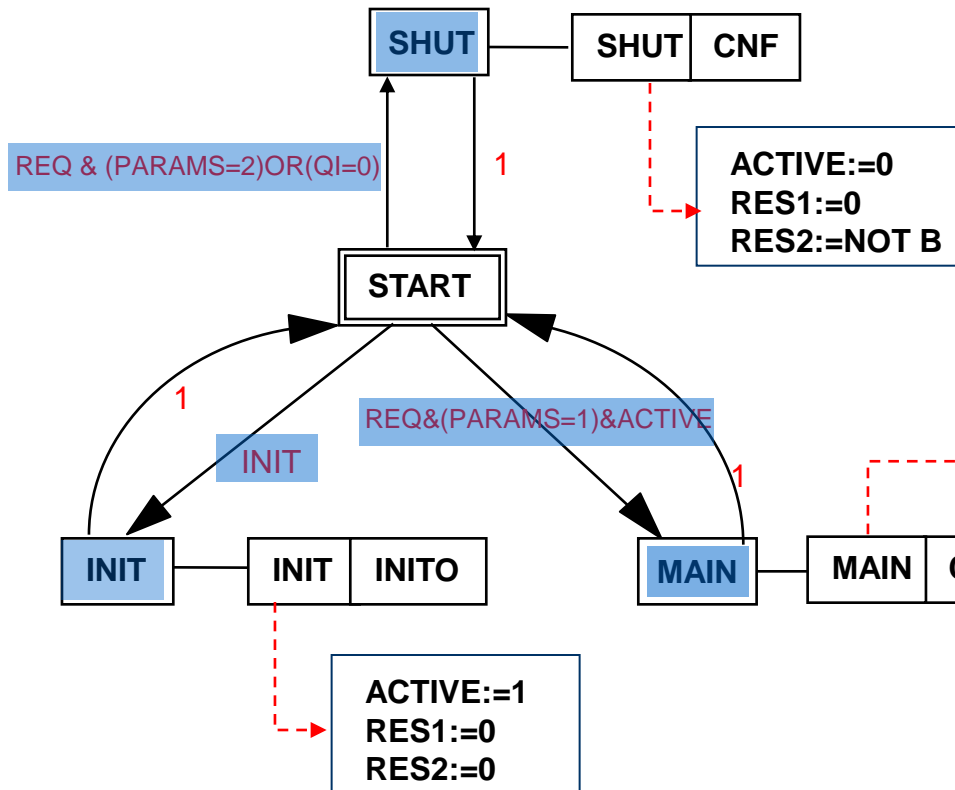
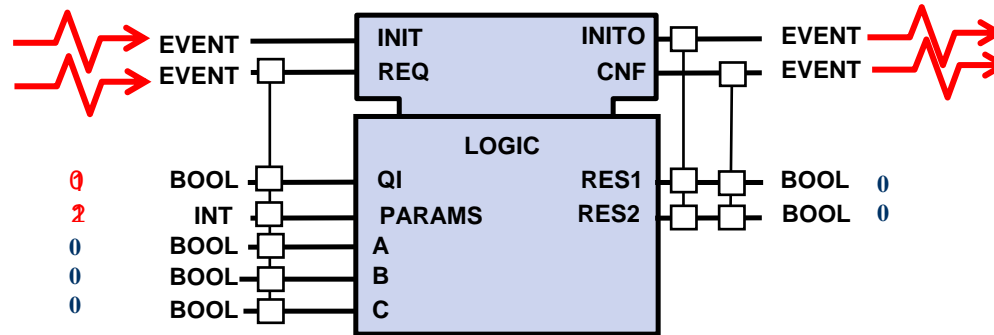
Model (Dynamics)



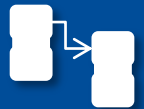
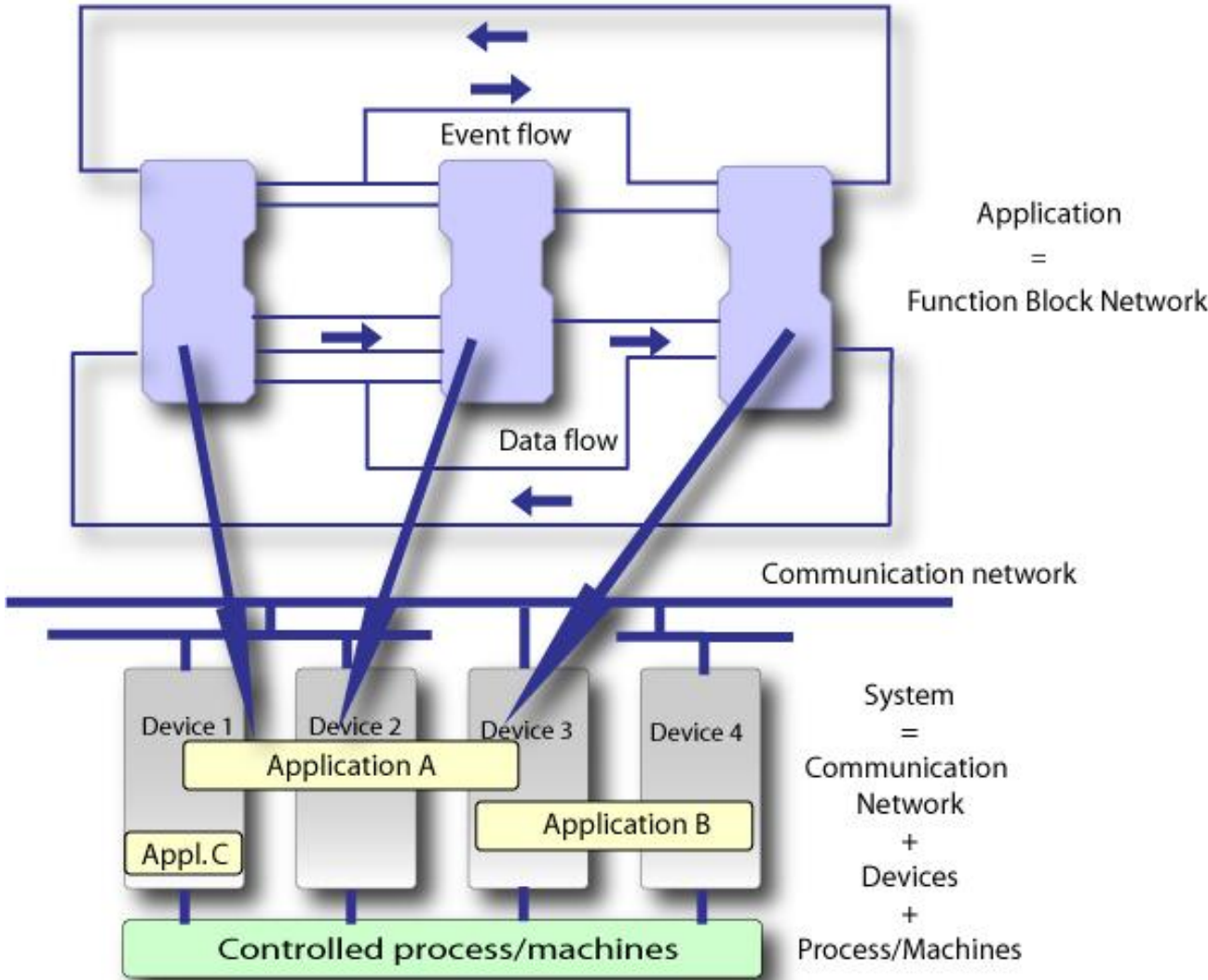
View (Structural)



Ausführungsmodell- ereignisgesteuert



System-level Model



Systemmodel beinhaltet vernetzte Geräte

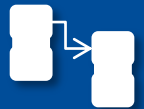
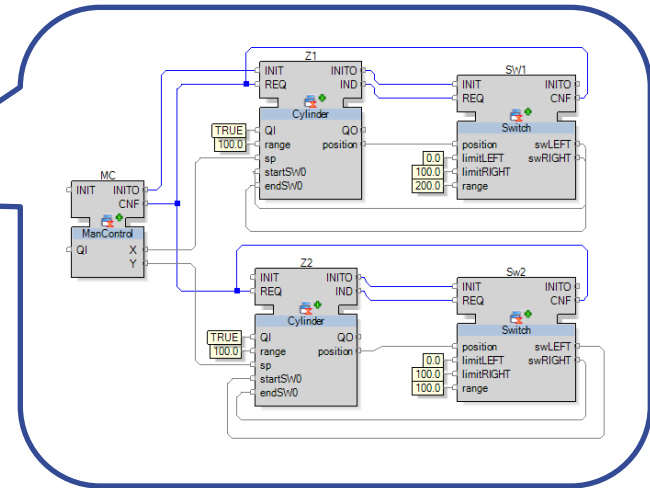
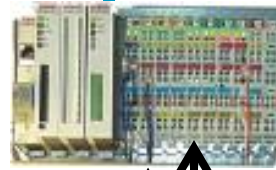
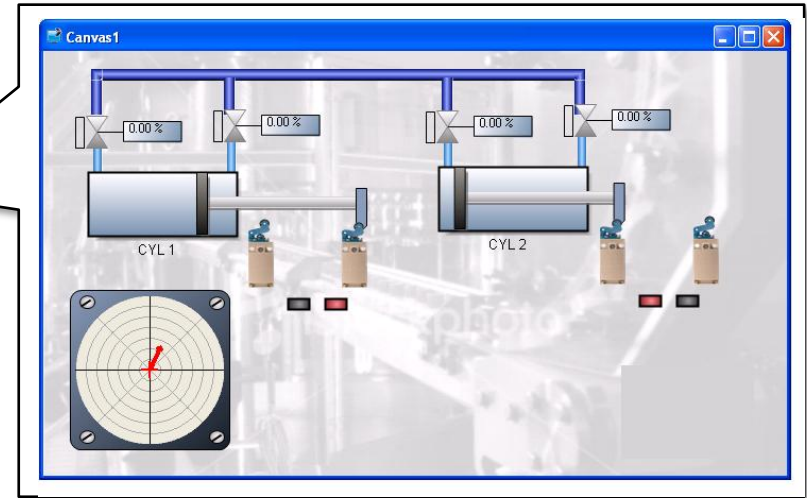
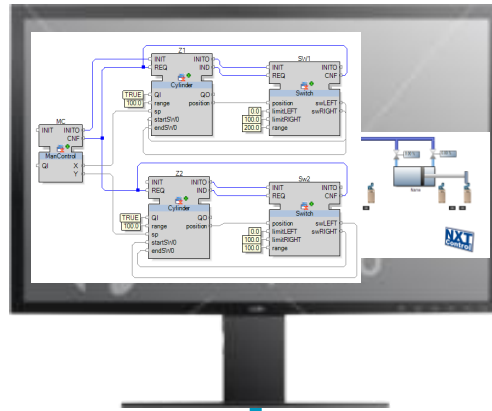
The screenshot displays the nxtStudio software interface for a project named 'ETFADemo'. The interface is divided into several panes:

- Left Pane (Solution Overview):** Shows a hierarchical tree of the project structure, including 'Solution (ETFADemo)', 'Base Library', 'nxtControl.Base', 'ETFADemo', 'System', 'Demo', 'MyCylDemo', 'System1', 'CAT', 'Hardware', 'Application', 'CAT1', 'ctrlIEC', 'IThis : ctrlIE', 'SubCATs', 'Cylinder', 'Interface1', 'HMI', 'FacePl', 'SubCATs', 'ManControl', 'Interface1', 'HMI', 'SubCATs', 'MyCylinder', 'Switch', 'Valve', 'CAT Instances', 'SubApp', 'Composite', 'Basic', 'Service', 'Adapter', 'Canvases', and 'Graphics'.
- Top Pane (System Overview):** Shows a list of components in the 'Demo' system. The table below represents this data:
- Table (System Overview):**

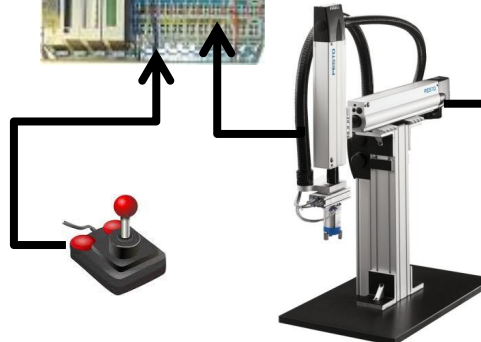
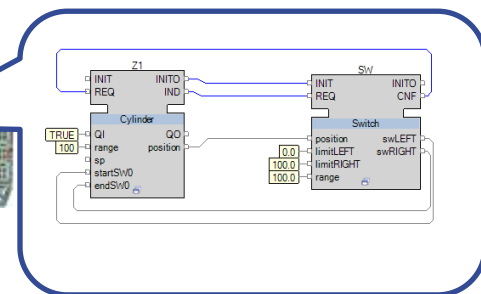
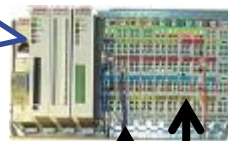
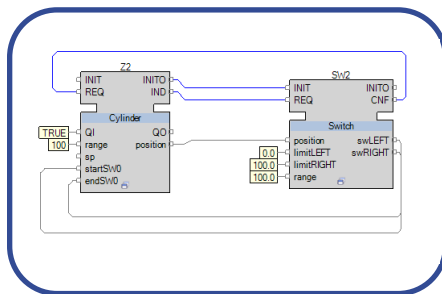
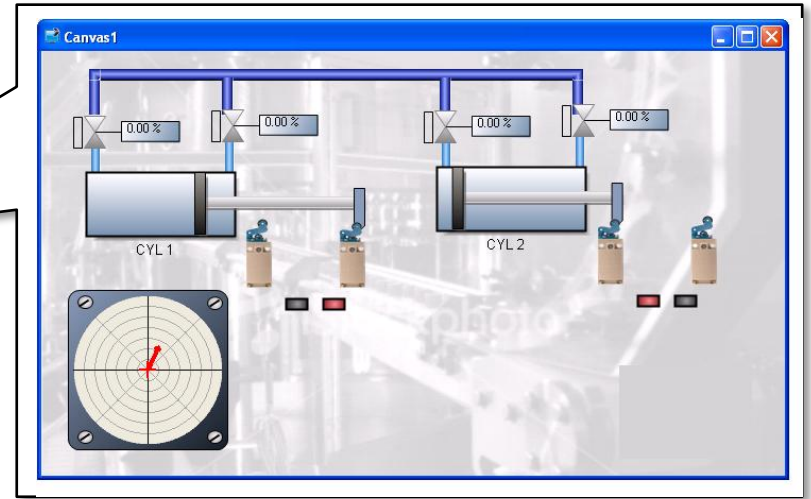
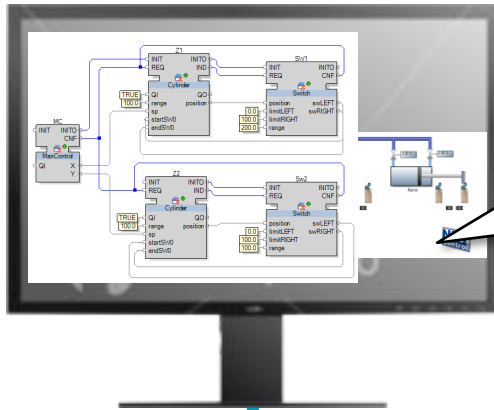
| Name | Type | Nam |
|-------------------|----------|---------|
| APP1 | | |
| Z1 | Cylinder | IEC61 |
| SW1 | Switch | IEC61 |
| Z2 | Cylinder | IEC61 |
| Sw2 | Switch | IEC61 |
| MC | ManCo... | IEC61 |
| <new application> | | |
| Demo | | |
| PLC1 | NXT_R... | nxtC... |
| MGR | NXT_R... | nxtC... |
| RES0 | EMB_RES | IEC61 |
| PLC2 | NXT_R... | nxtC... |
| MGR | NXT_R... | nxtC... |
| RES0 | EMB_RES | IEC61 |

- Right Pane (Diagram):** Shows a network diagram with two PLC units, 'PLC1' and 'PLC2', connected to a central green double-headed arrow labeled 'SEGMENT0: Ethernet'. Both PLC units have a checked checkbox next to their labels.
- Bottom Pane:** Contains 'Solution Overview', 'Tools', 'Output', and 'Documentation' tabs. The status bar at the bottom indicates 'Ready' and 'In 1 col 1 ch 1 INS ...'.

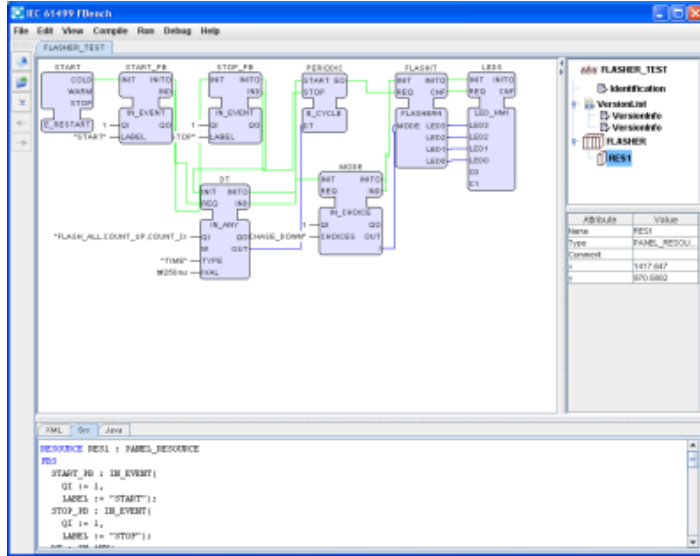
Zentralisierte Ausführung



Verteilte Ausführung



IEC 61499: Summary of Benefits



Visual System Level Language for Distributed Systems

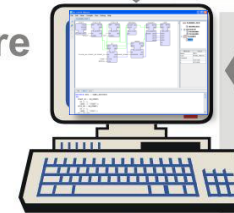


Project repository

CAN BE DEFINED IN COMPLIANCE PROFILES

DeviceNet EDs
Fieldbus DDs
IEC 61915
ISO 15745
ISO 10303
etc.

Software Tools



Import

XML

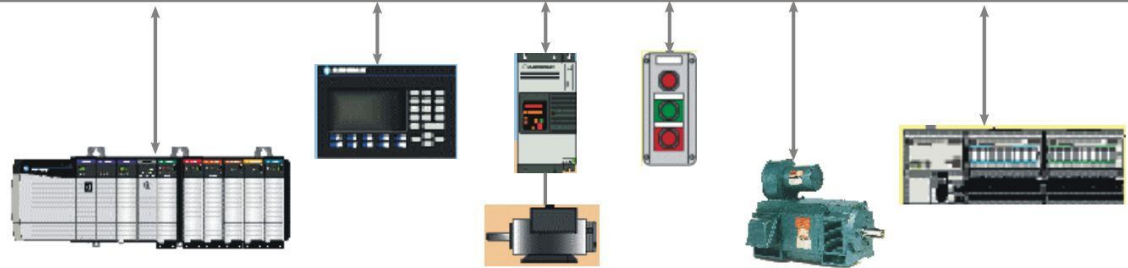
PORTABILITY

Libraries:
IEC 61499
IEC 61131-3

NORMATIVE

Standard management protocols (XML) ==> CONFIGURABILITY

Standard data transfer protocol ==> ASN.1 INTEROPERABILITY

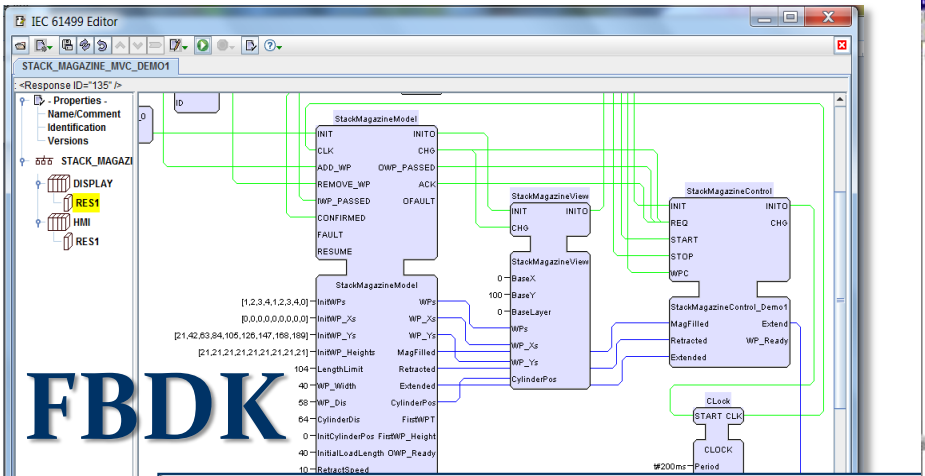


Distributed Intelligent Devices and Controllers

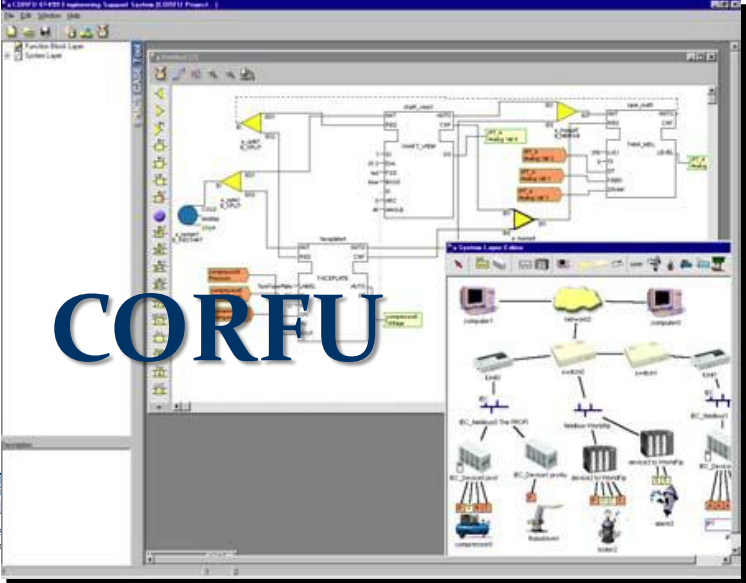
TOOLS und PLATTFORMEN



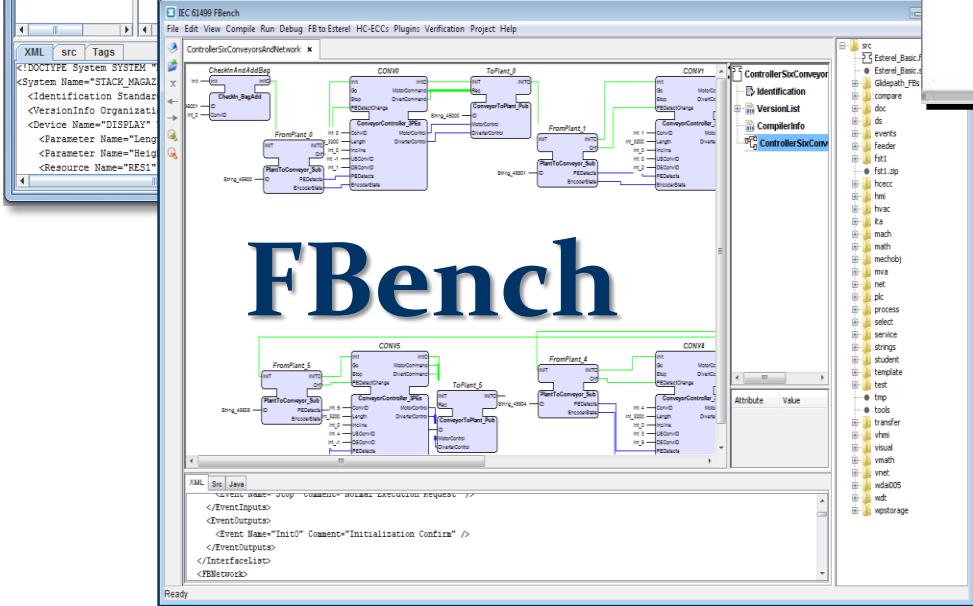
Experimental Tools



FBDK



CORFU

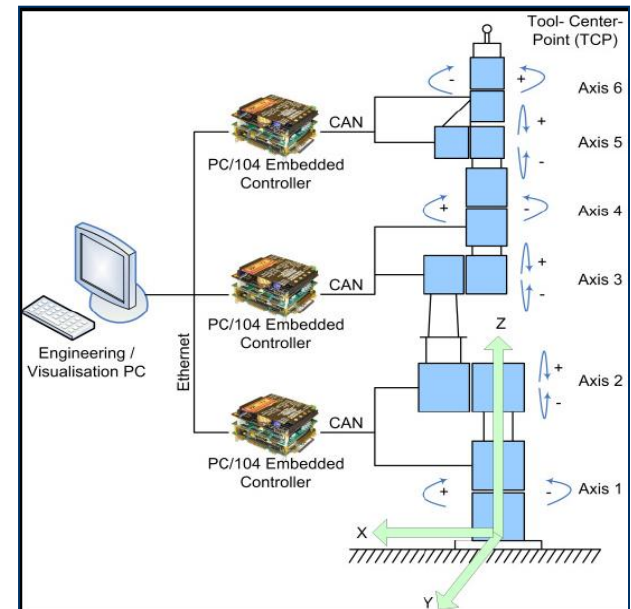
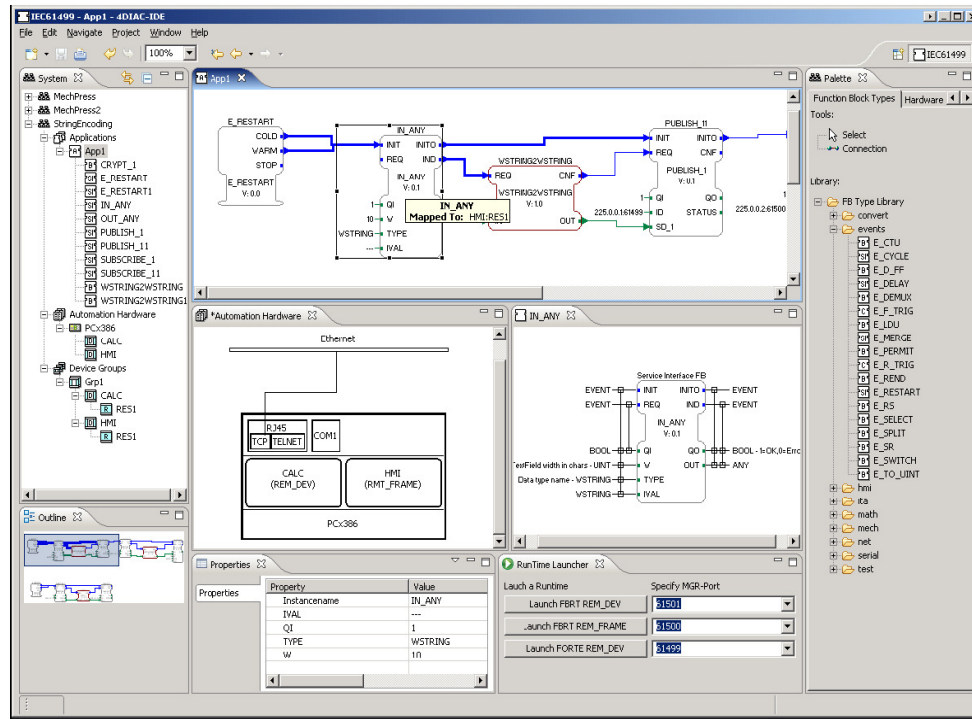


FBench



4 DIAC IDE und RTE (forte)

4 DIAC-IDE





RTUs/PLCs/PACs



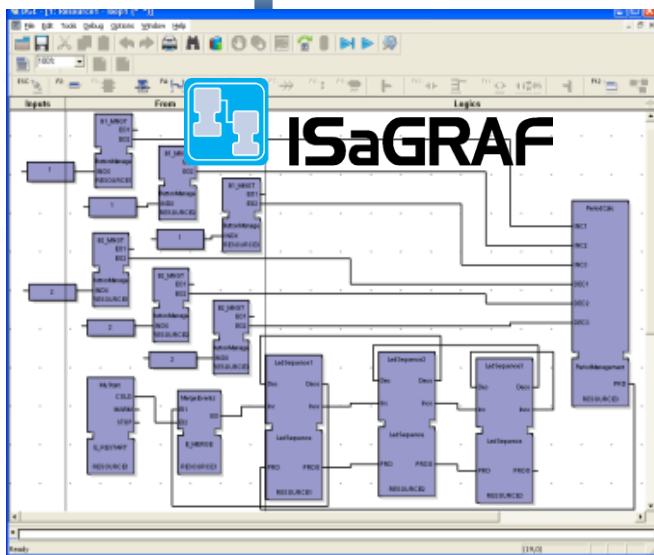
and much more...



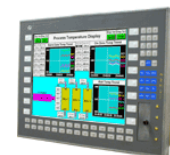
Small Controllers



Tiny Controllers



Industrial PCs



Panel PCs



PC 104



Intelligent Boards



VME Boards And Racks

ABB

AREVA

ALSTOM

SNCF

THALES

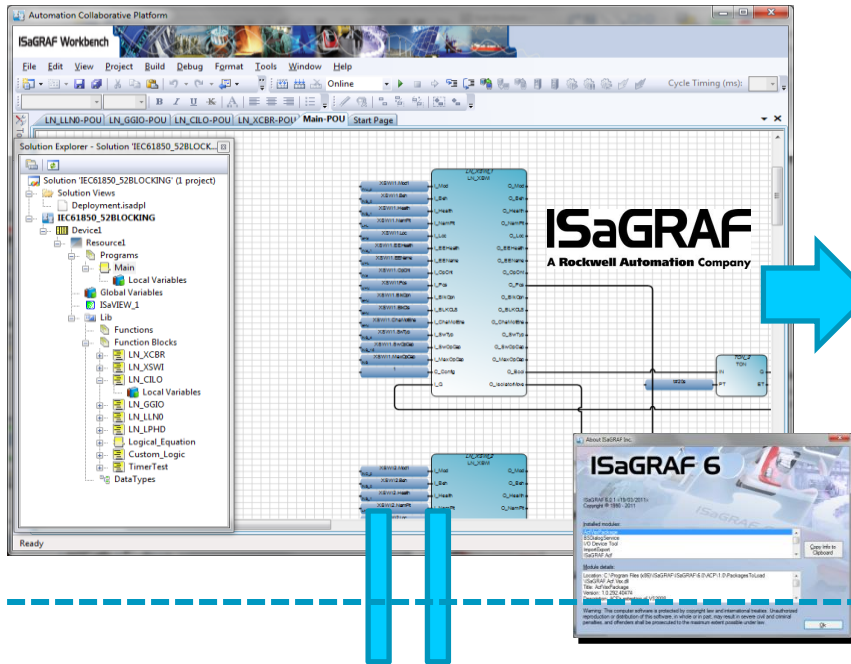


WAGO
INNOVATIVE CONNECTIONS

Schneider Electric

and much more...

ISaGRAF v.6.0

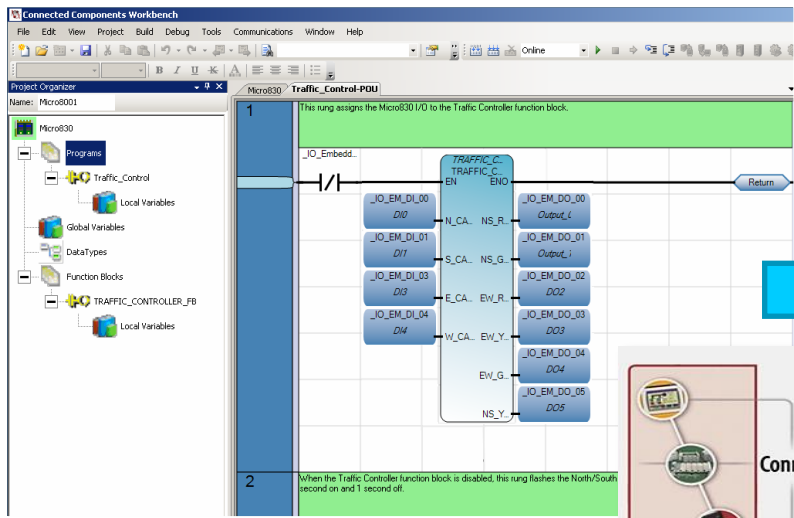


ISaGRAF v.5 supports IEC 61499 since 2005. The next generation ISaGRAF v.6 released in 2010.

And, since 2008 ISaGRAF is Rockwell Automation company.

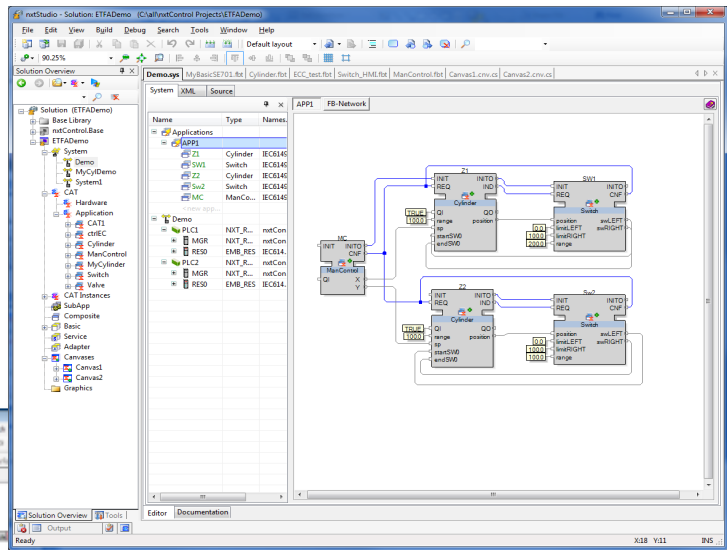
Allen-Bradley Micro800™ Family of PLCs

Featuring Allen-Bradley Connected Components Workbench™ Programming and Configuration Software

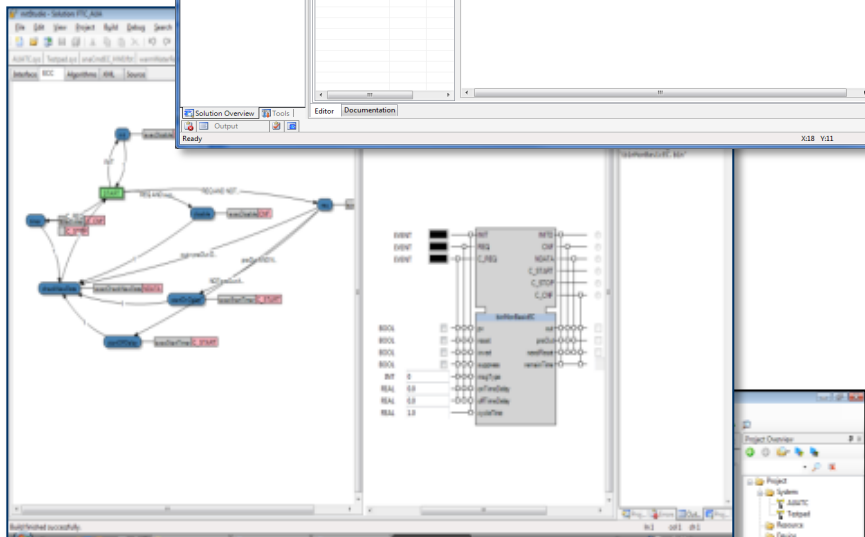




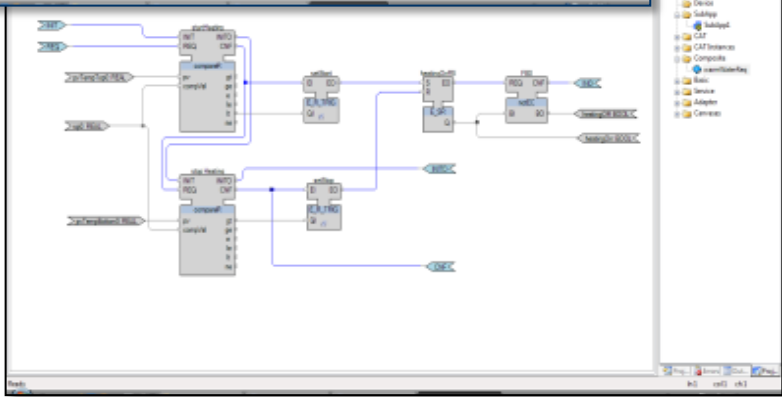
Austria



ADVANTECH



BECKHOFF



SIEMENS



WAGO INNOVATIVE CONNECTIONS

Vorteile?

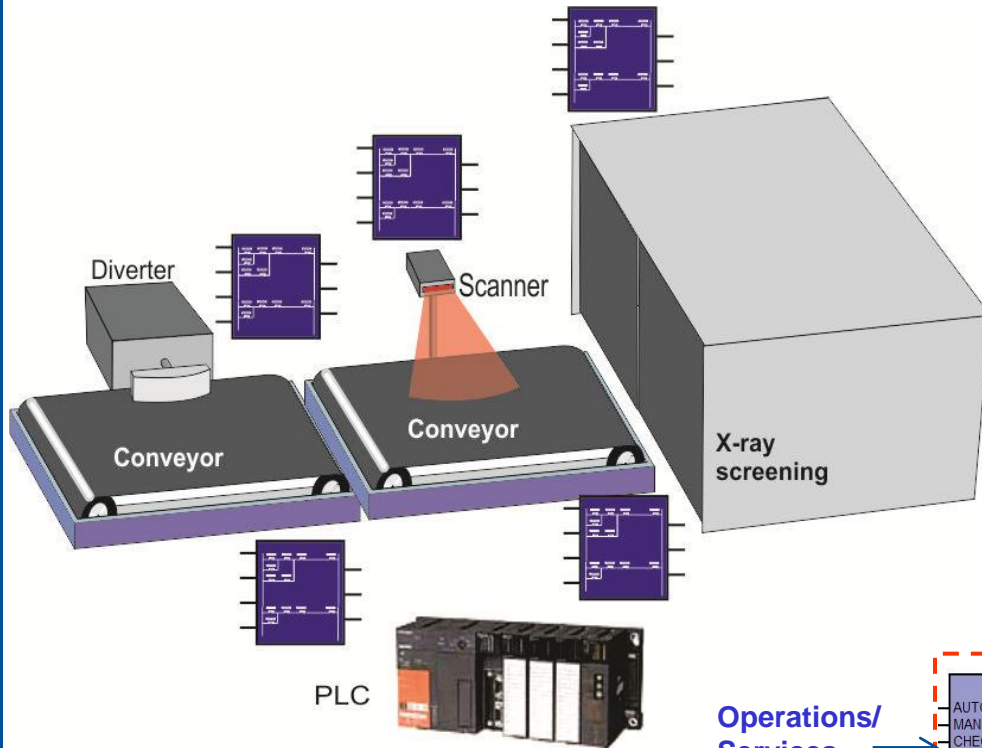
- Entwurfseffizienz
- Simulation verteilter Software auf System-Ebene
- Automatische Codeverteilung



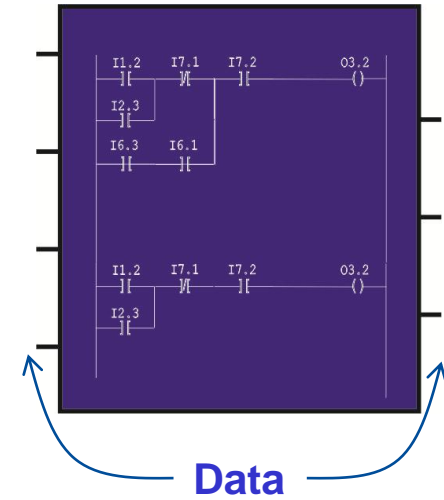
HAUPTUNTERSCHIEDE zur IEC 61131-3



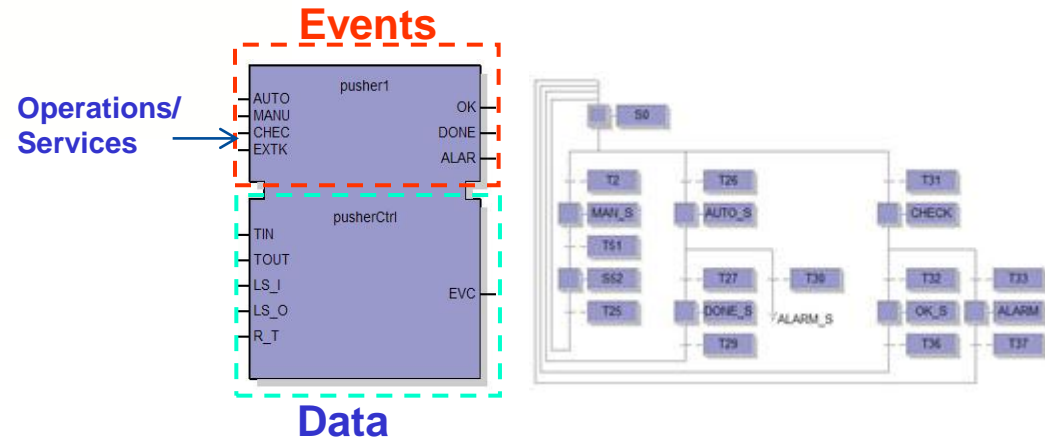
Encapsulate in Function Blocks



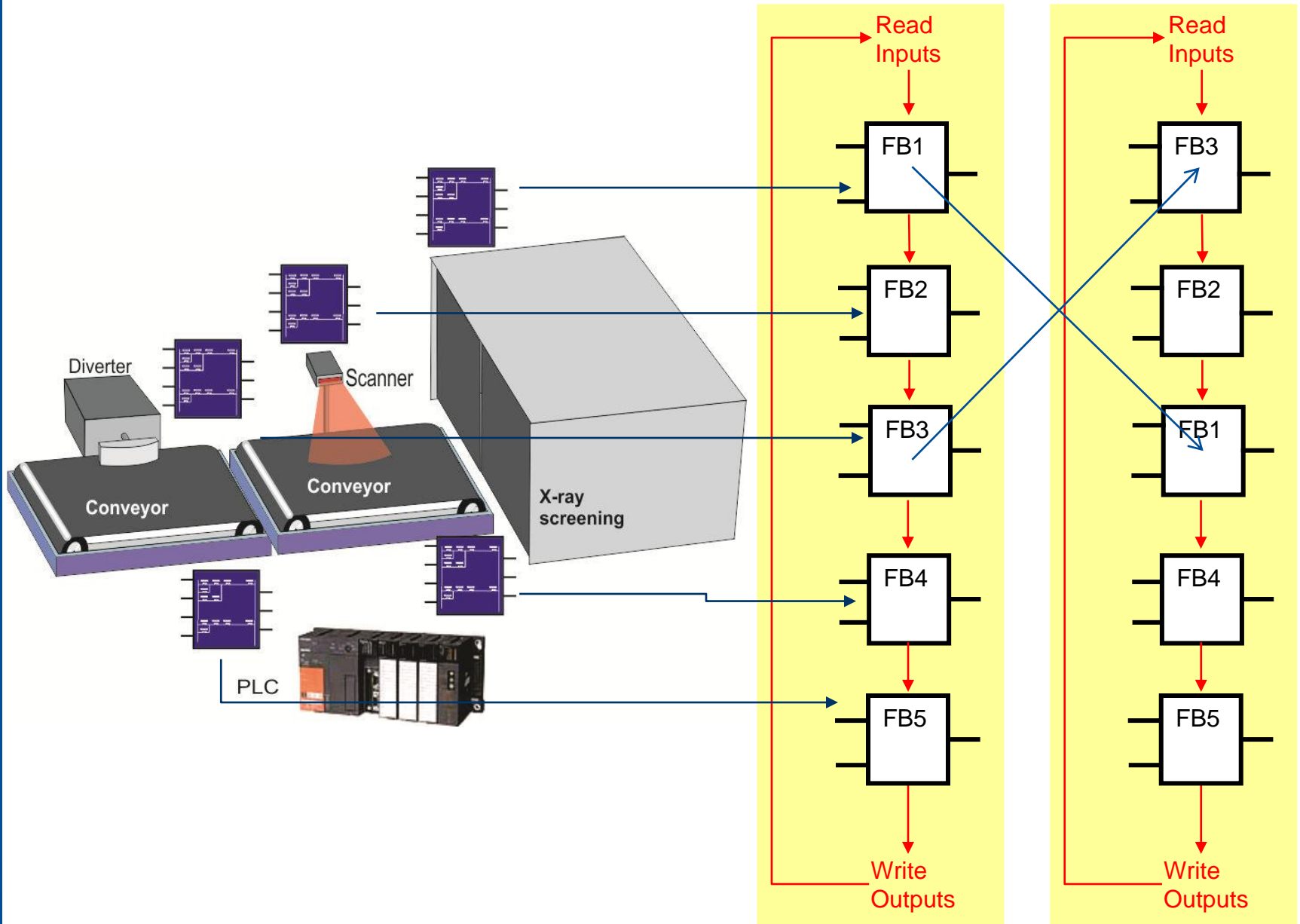
Function Block in PLC



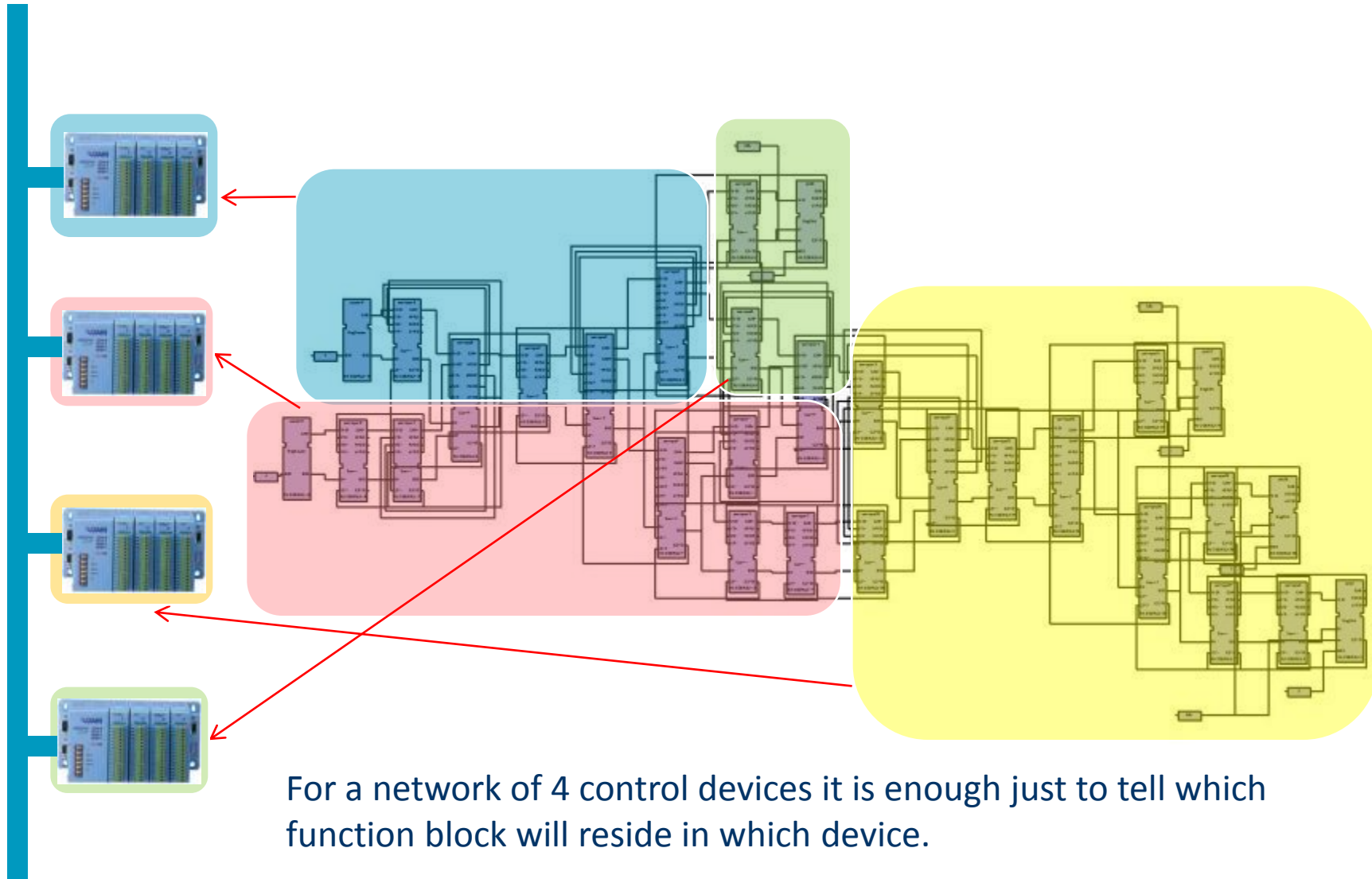
Function Block in IEC 61499



FB Re-use in the Traditional PLC Architecture



In IEC 61499 Code Distribution is Easy



For a network of 4 control devices it is enough just to tell which function block will reside in which device.

Conclusion

Function block architecture of IEC 61499 combines all essential features of a mature model-based software engineering framework with:

- System-level design of distributed systems
- Distribution on networked targets
- Open standard
- Determinism and efficiency of execution

