REM 2011

INNOVATION IN MOTION-LOGIC PROGRAMMING – A VERSATILE INTERFACE

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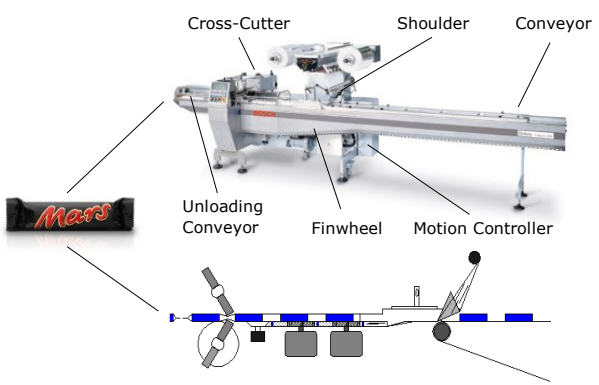
Motion-Logic Programming Interface
Presentation Structure

- Introduction & Motivation
- Design & Implementation
- Summary & Outlook

Source: Bosch Rexroth AG

Motion-Logic Programming Interface
Application Example (HFFS-Machine)



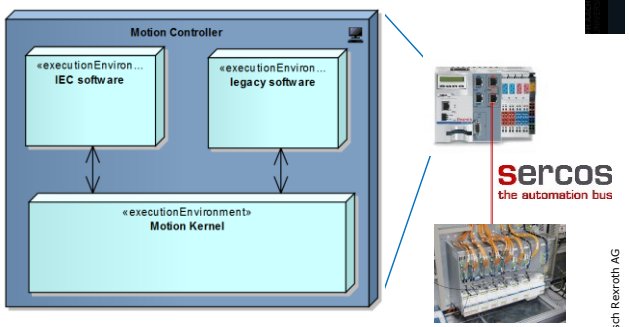
Sources: Bosch Packaging Technology, Mars Inc.

Motion-Logic Programming Interface
Motion Controller Issues

- Motion Controller (option 1)
  - **Legacy** hard- and software
    - Proprietary µC hardware
    - Real-time operating system
    - Software coded in C/C++ or similar
    - Proprietary fieldbus interfaces
  - **Disadvantages**
    - Development efforts and cost
    - Adaption of new technologies
    - Absolescence of components
- Motion Controller (option 2)
  - **Standard** hard- and software
    - Industrial PLC and software environ.
    - Software coded IEC 61131 or other PLC programming language
    - Standard fieldbus interfaces
  - **Disadvantages**
    - IEC code is automation technology
    - technology gap between automation business and computer science

Source: Bosch Rexroth AG

Motion-Logic Programming Interface
Objective



Source: Bosch Rexroth AG

Motion-Logic Programming Interface
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- Introduction & Motivation
- Realisation & Implementation
- Summary & Outlook

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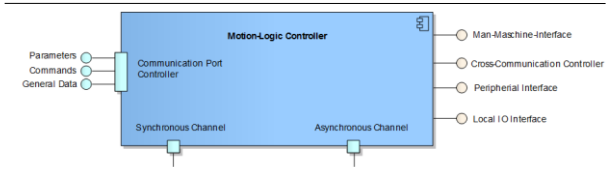
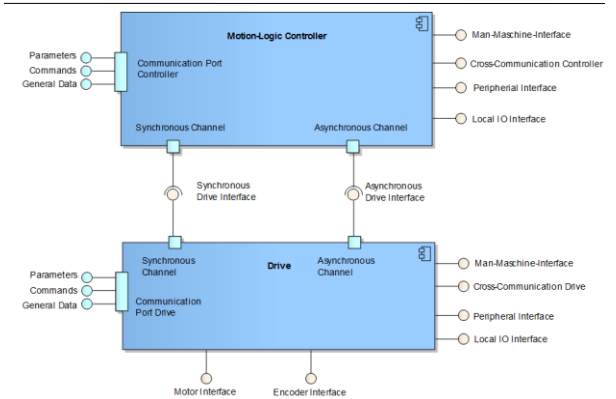
Motion-Logic Programming Interface
System Interface Requirements

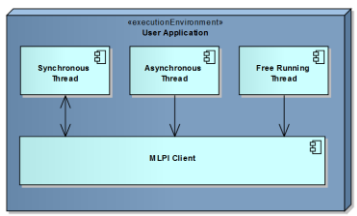


Motion-Logic Programming Interface
System Interface Requirements

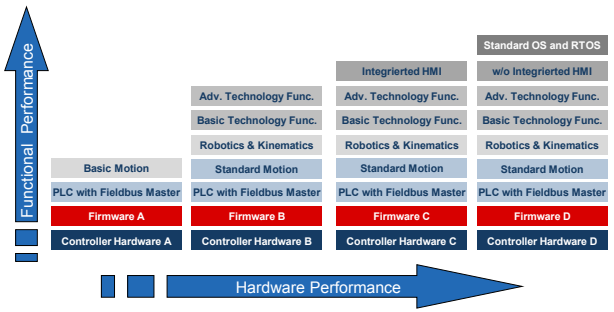


Motion-Logic Programming Interface
User Application Requirements

- Motion control application requirements
  - High precision **synchronous threads**
    - In particular for equidistant setpoint generation and communication
  - **Asynchronous threads** for non-motion tasks
    - Not necessarily in synch with the motion bus
    - Improves system performance
  - **Free running threads**
    - For low priority tasks

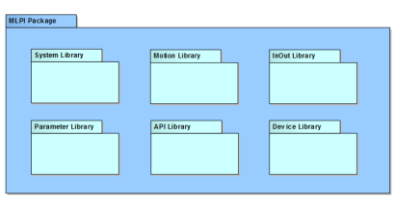


Motion-Logic Programming Interface
Performance Levels Requirements

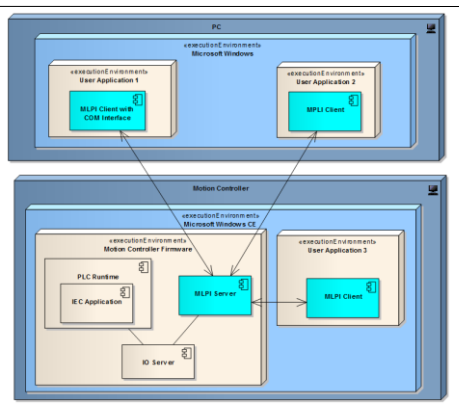


Motion-Logic Programming Interface
Derived Design Requirements for the Interface

- Design requirements:
  - Independency form the programming language
  - Well tailored layer architecture
  - Structured according to functionality
  - Object oriented design approach
  - Network support
  - High performance
  - Small footprint and multi-instance capability

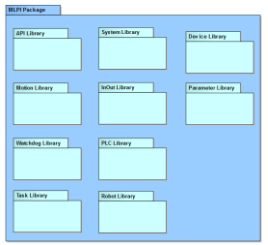


Motion-Logic Programming Interface
MLPI Architecture



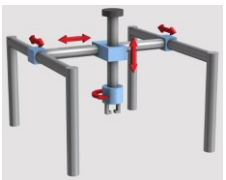
Motion-Logic Programming Interface
MLPI Structure in Libraries (1)

- Administrative functions
  - API library
    - Connect and disconnect the interface
  - System library
    - System settings and configuration
  - Device library
    - SERCOS devices and configuration
- PLC functions
  - Task library
    - Creating, destroying and configuring tasks
  - InOut library
    - Direct or symbolic access to fieldbus data and data exchange buffers
  - PLC library and Watchdog library
    - Load, start, stop and supervise PLC applications



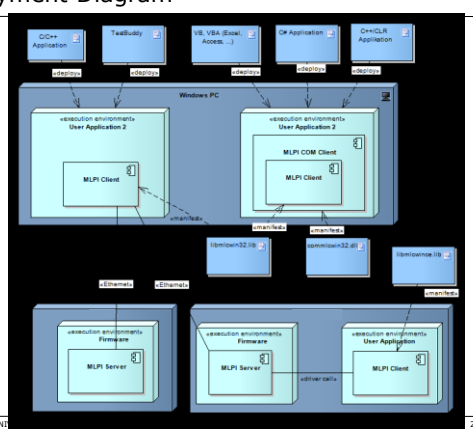
Motion-Logic Programming Interface
MLPI Structure in Libraries (2)

- Motion functions
  - Parameter library
    - Parameter access to controls and drives
    - Read, write and modify single parameters as well as list parameters and attributes
  - Motion library
    - Create and destroy real axis or virtual axis
    - Parameterization of axis properties
    - Commanding axis with discrete motion, continuous motion and synchronous motion command
  - Robot library
    - Group and ungroup axis to configure kinematics
    - load, select and execute robot control applications including



Source: Bosch Rexroth AG

Motion-Logic Programming Interface
Deployment Diagram



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Motion-Logic Programming Interface

Summary & Outlook

- Motivation for the coexistance of IEC code and C/C++ code
  - **migration purpose** of existing legacy applications
  - interfaces for **research and scientific applications** to standard automation environments
- Broad range of functionality implemented for
  - **single axis** motion
  - **synchronized axis** motion
  - **coordinated motion** for robots
- Implementation of high level **interfaces** for **rapid prototyping** and **system engineering** objected

Source: Dürr AG