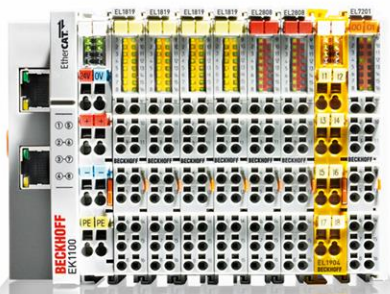
PLC_OPEN_DRIVE
TwinCAT motion layer project

BECKHOFF



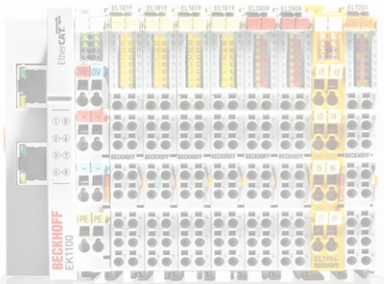
PLC_OPEN_DRIVE

BECKHOFF

Daniel Hauer

Introduction to motion layer approach

- motivation for a motion layer
- use cases
- specific construction



Motivation:

- **Centralized control:**
  - Sync communication
  - Async communication
  - Agnostic to communication technology

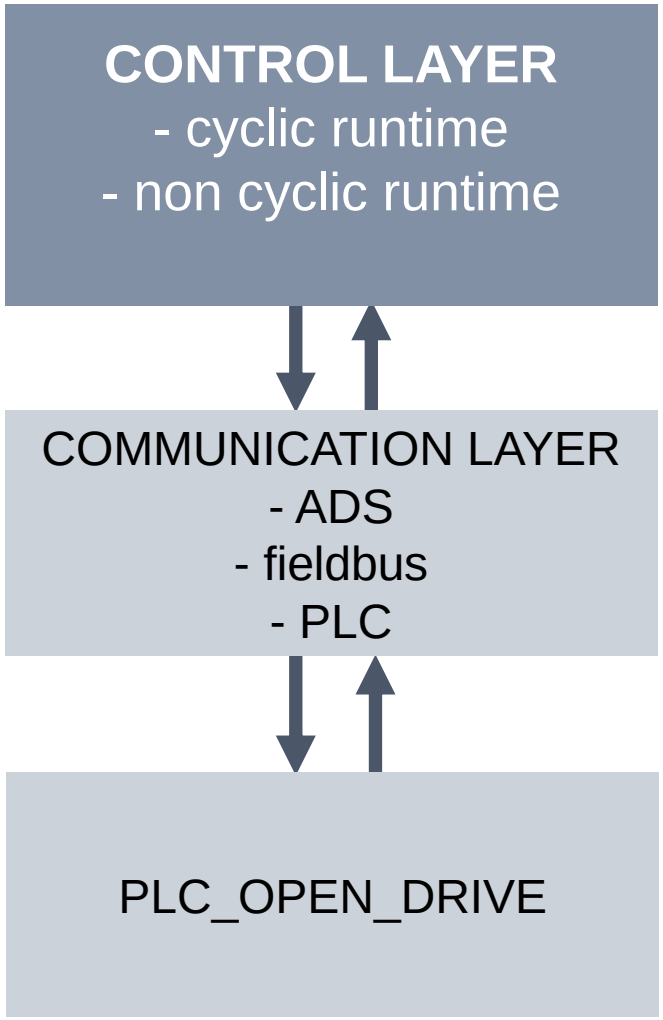
- **Decentralized execution of motion tasks**
  - Data consistency in cyclic multi task environments
  - Local machine with modular design specifications
  - Unified procedure for modular software architecture
  - Use of top layer consistent through different architectures

Motivation:

- **Use of TwinCAT supported/updated libraries**
  - Tc2_MC2
  - Tc2_MC2_Drive
  - Tc2_NC
  - Tc2_NCI
  - Tc2_PlcInterpolation
- **Open code base**
  - Migration to Tc3 MC in preparation
  - Customer/user specific changes possible
  - Access to code
  - Conversion to library possible by customer/user
- **Compiled PLC**
  - Source code is not on shipped machine

Motivation:

- Use of TwinCAT motion without detailed coding knowledge
- Transparency of communication layer
- Code base shall remain independent of control layer
- Configurable Options for specific libraries / TC functions
- Balanced load for configurable options in machine layout
- Stable cpu use for XFC applications

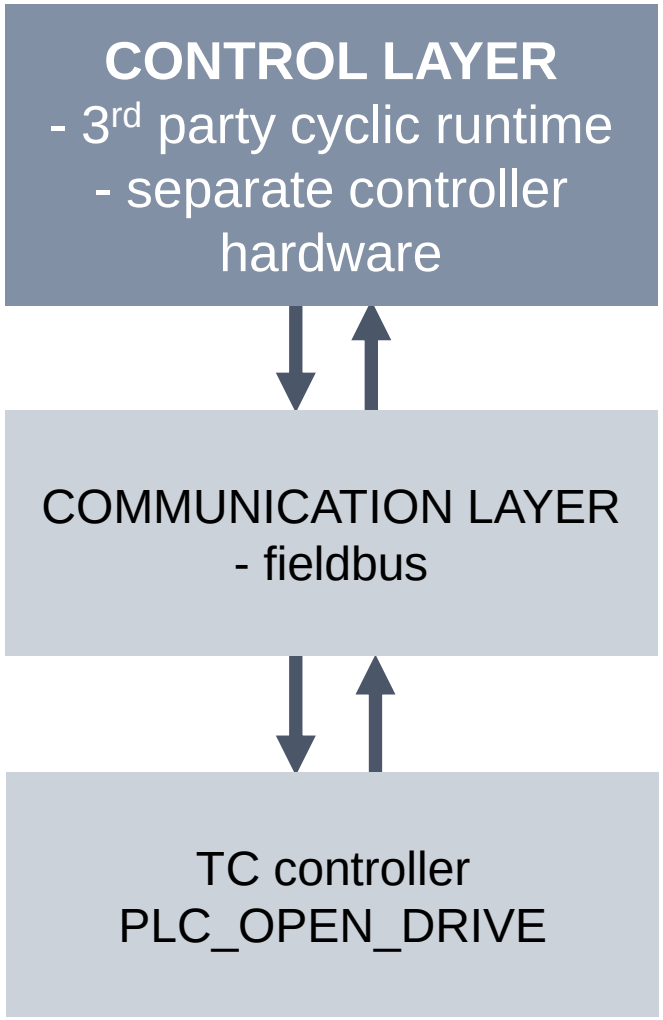


PLC_OPEN_DRIVE

BECKHOFF

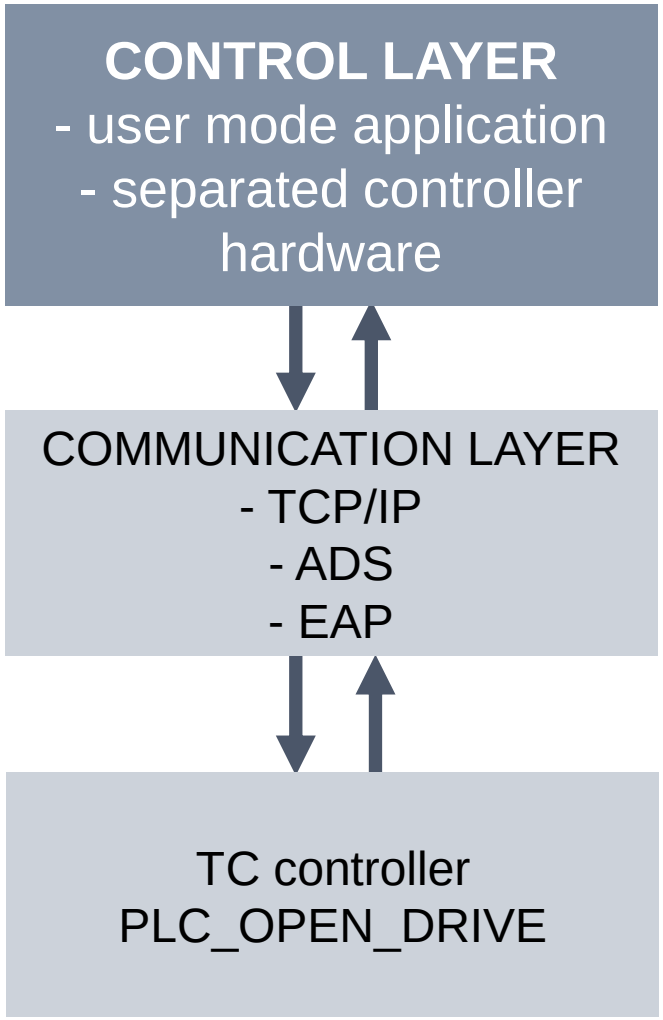
Use cases:

- Separate controller for machine logic
- Any fieldbus (EtherCAT, Profi…)
- Connected through TwinCAT mappings
- Execution of motion tasks in PLC_OPEN_DRIVE TwinCAT controller



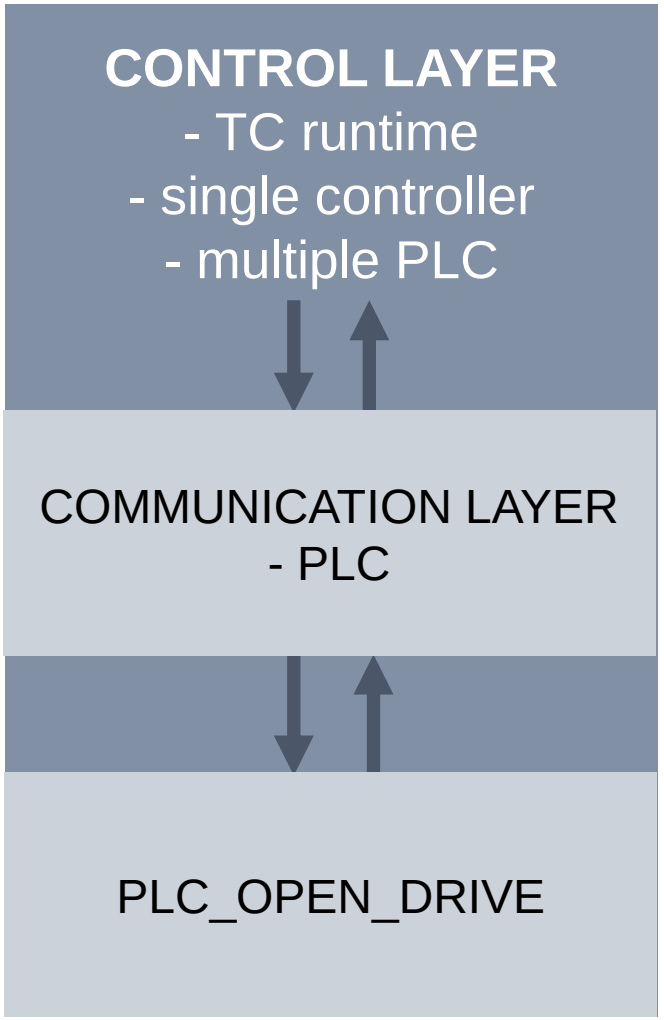
Use cases:

- Separate controller for machine logic
- Any network
- Connected through TwinCAT mappings
- Execution of motion tasks in PLC_OPEN_DRIVE TwinCAT controller



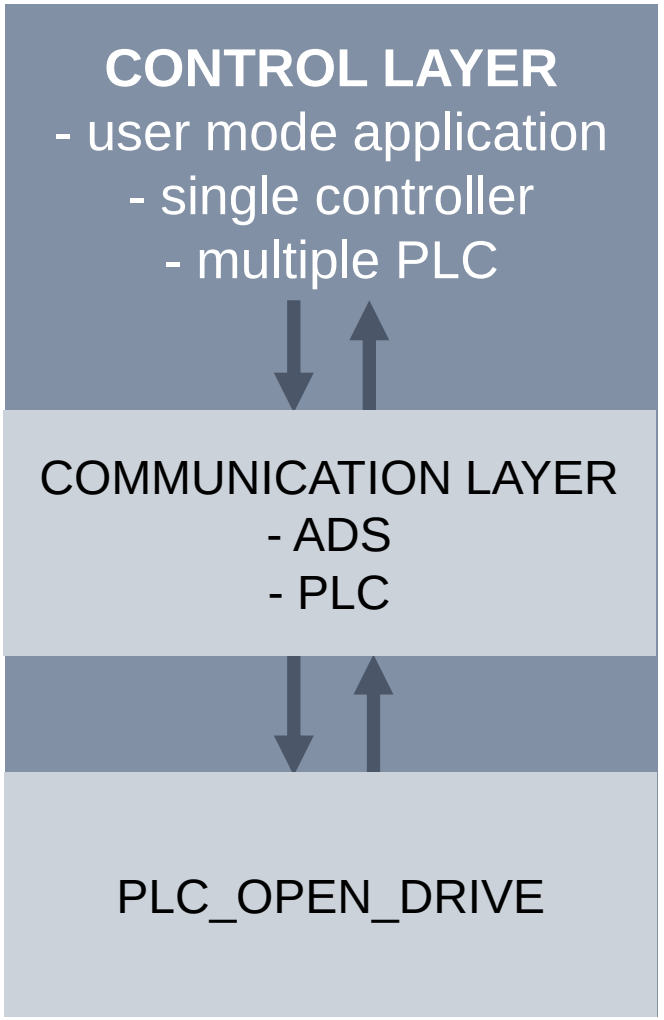
Use cases:

- One controller for machine logic
- Multiple PLC for machine logic
- Connected through TwinCAT mappings
- Execution of motion tasks



Use cases:

- One controller for machine logic
- User mode application AND/OR multiple PLC
- ADS for symbol access by user mode application
- TwinCAT mapping for connecting multiple PLCs for specific application purposes
- Execution of motion tasks



Specific construction:

- TwinCAT PLC project
- Use of specific syntactic code behaviour
- Software design
- Compiler defines / pragmas
- Logging system
- Automated and flexible unit test by testing against TwinCAT Test PLC

TwinCAT project:

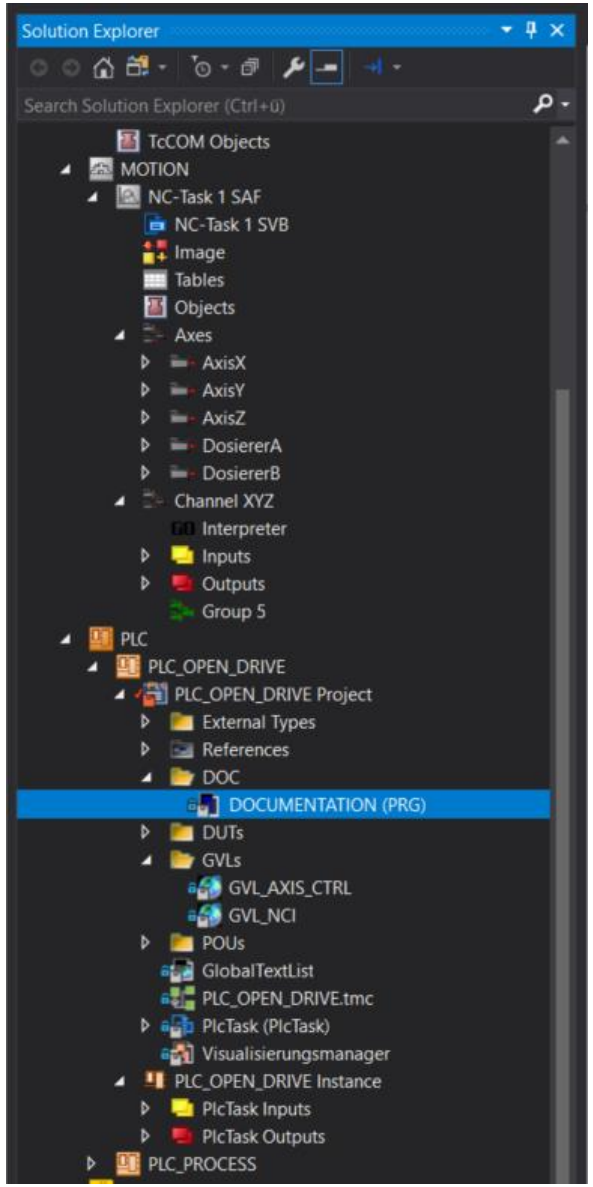
- Default TwinCAT project
  - Adjust core settings to target hardware
  - Add NC/PtP
    - Optional add NCI channel

- TwinCAT PLC
  - Add existing Item: PLC_OPEN_DRIVE
  - Add task reference

- Adjust constants in:
  - PLC_OPEN_DRIVE/GVL_AXIS_CTRL
  - PLC_OPEN_DRIVE/GVL_NCI

- Compile
  - PLC_OPEN_DRIVE Instance mapping is built

TwinCAT project:



specific syntactic code behaviour:

- C like state machines
  - State changes need not consume one PLC cycle
  - Same cycle response to command on cyclic interface
- OnChange detection for new commands
  - Cyclic check whether the command has changed
- State always carries offset about progress of command (busy, error, done)
- Instance FBs are called within states

Software Design:

- Every TwinCAT function has dedicated wrapper
  - Separate namespaces
  - Optional library binding

- Cross communication via interfaces

- Ctrl/State structures for commanding required function
  - PtP – ctrl/state
  - NCI – ctrl/state
  - CAMMING – ctrl/state

- Parameter structures carry required data for commanded function
  - PtP – (SetPos, SetVelo, SetAcc, MasterAxisIndex…)
  - NCI – (AxisGroupId, AxisIndex, MFunc, RParameter…)
  - CAMMING – (MasterAxisIndex, TableId…)

Software Design:

PLC_OPEN_DRIVE / GVL_AXIS_CTRL

```
gfbAxisController :
ARRAY[1..MAX_AXIS] OF
FB_AxisController;


gstAxisControl    :
ARRAY[1..MAX_AXIS] OF
ST_AxisController;
```

PLC_OPEN_DRIVE / GVL_NCI

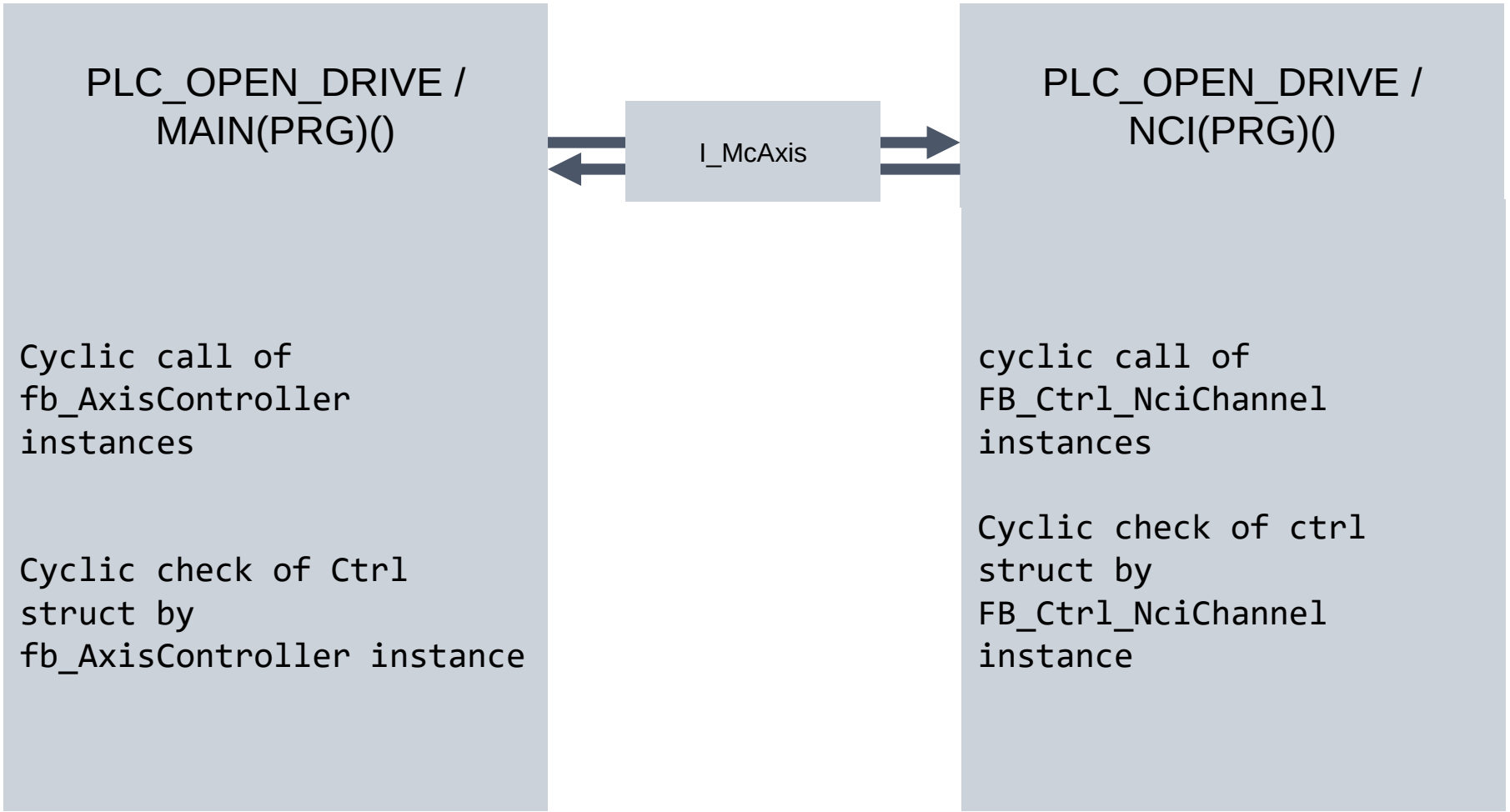
```
gfbNciCtrl            :
ARRAY[1..cMaxNciCh] OF
FB_Ctrl_NciChannel;

gstChannelCtrl        :
ARRAY[1..cMaxNciCh] OF
ST_CTRL_NCI;

gstChannelState       :
ARRAY[1..cMaxNciCh] OF
ST_STATE_NCI;
```

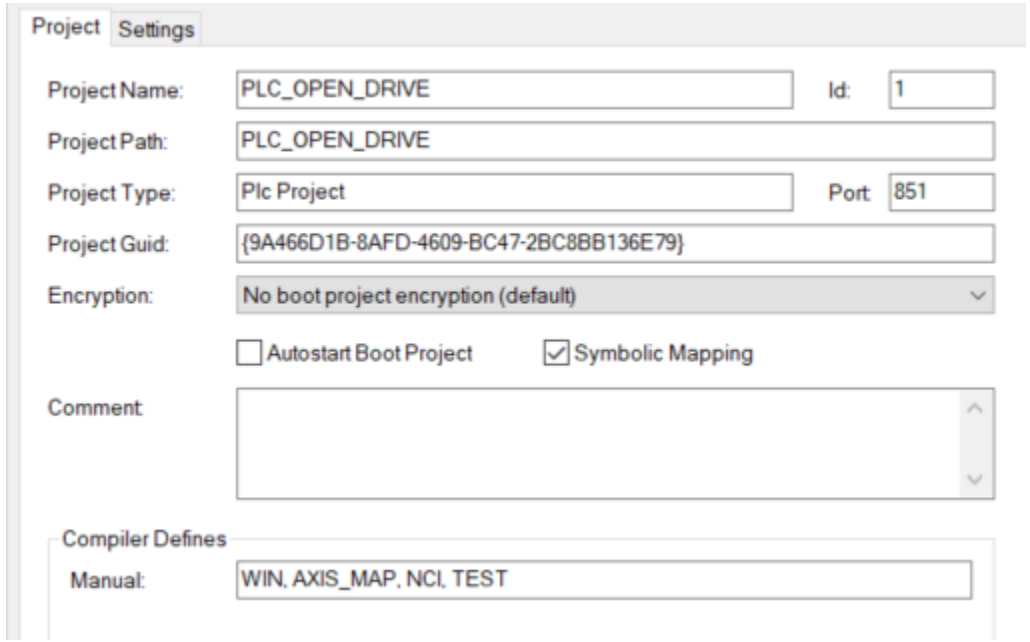
PLC_OPEN_DRIVE / GVL_CAMMING (under construction)

Software Design:



Compiler defines / pragmas:

- use of NCI and/or CAMMING
- operating specific values (Windows / TC-BSD)
- automated link to mapping



Logging System:

- Implementation from top down
  - → function based with global timestamp added automatically
- Enumeration based with 4 categories and timestamp
  - → ocurrance in strict timestamp order
- Error Id is mirrored directly from called instance
  - → Infosys error numbers can be searched in case of diagnosis
- Optional text for additional information
- Specific logging switch to get more detailed information aside error numbers
- Automated write procedure to ascii formatted file

Automated Test against TEST_PLC:

- Stand alone PLC project for testing PLC_OPEN_DRIVE
  - Useful during development
  - Xml based test definition with configured result check
- Can be extended for machine procedures as unit/module test environment
  - Test definition via enumerations
- logging for test documentation
- Automated write procedure to ascii formatted file

Git repositories:

- https://azdevops01.beckhoff.com/Nuernberg/Daniel%20Ha/_git/PLC_OPEN_DRIVE
- https://azdevops01.beckhoff.com/Nuernberg/Daniel%20Ha/_git/PLC_OPEN_DRIVE_TEST