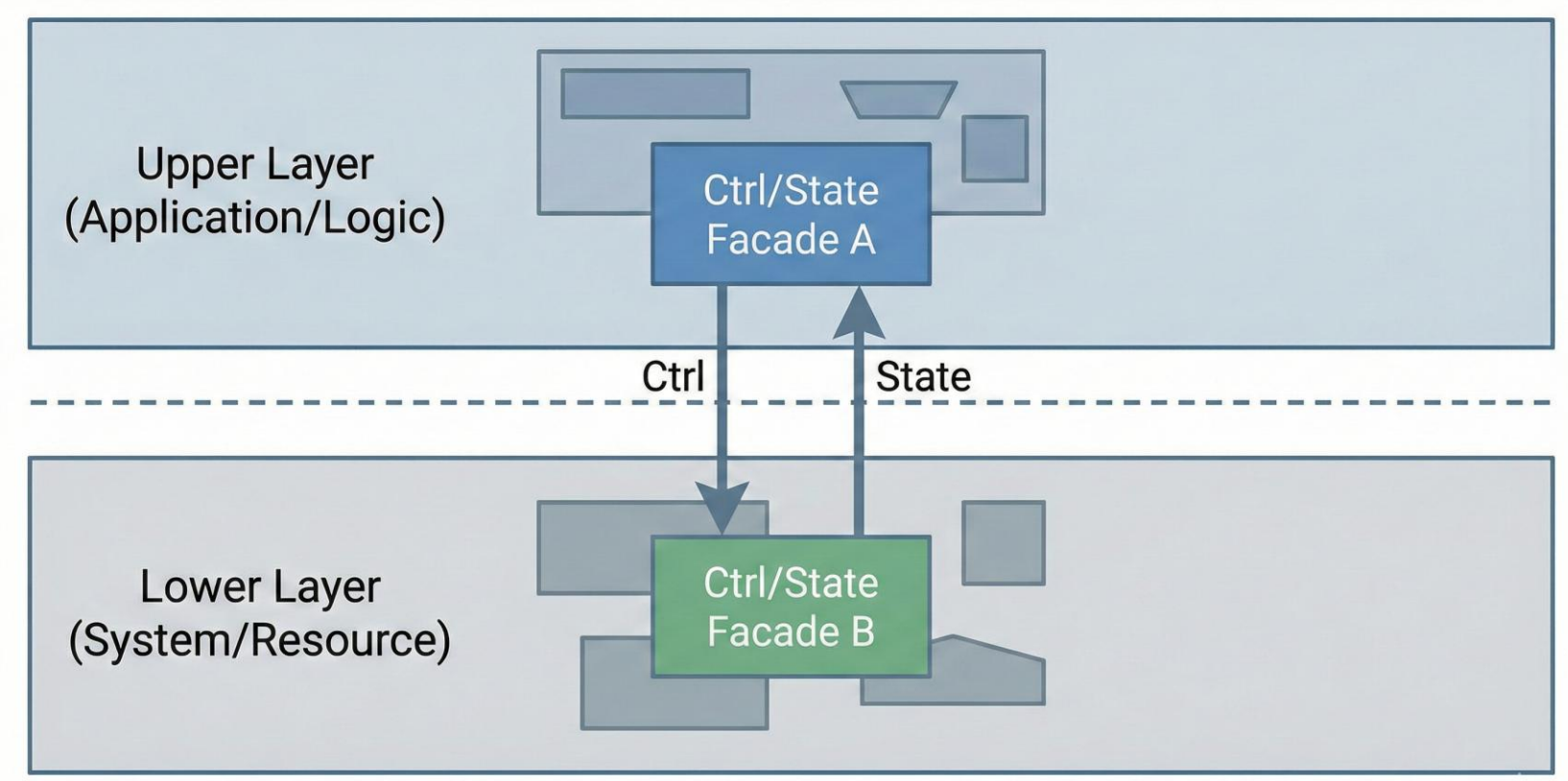
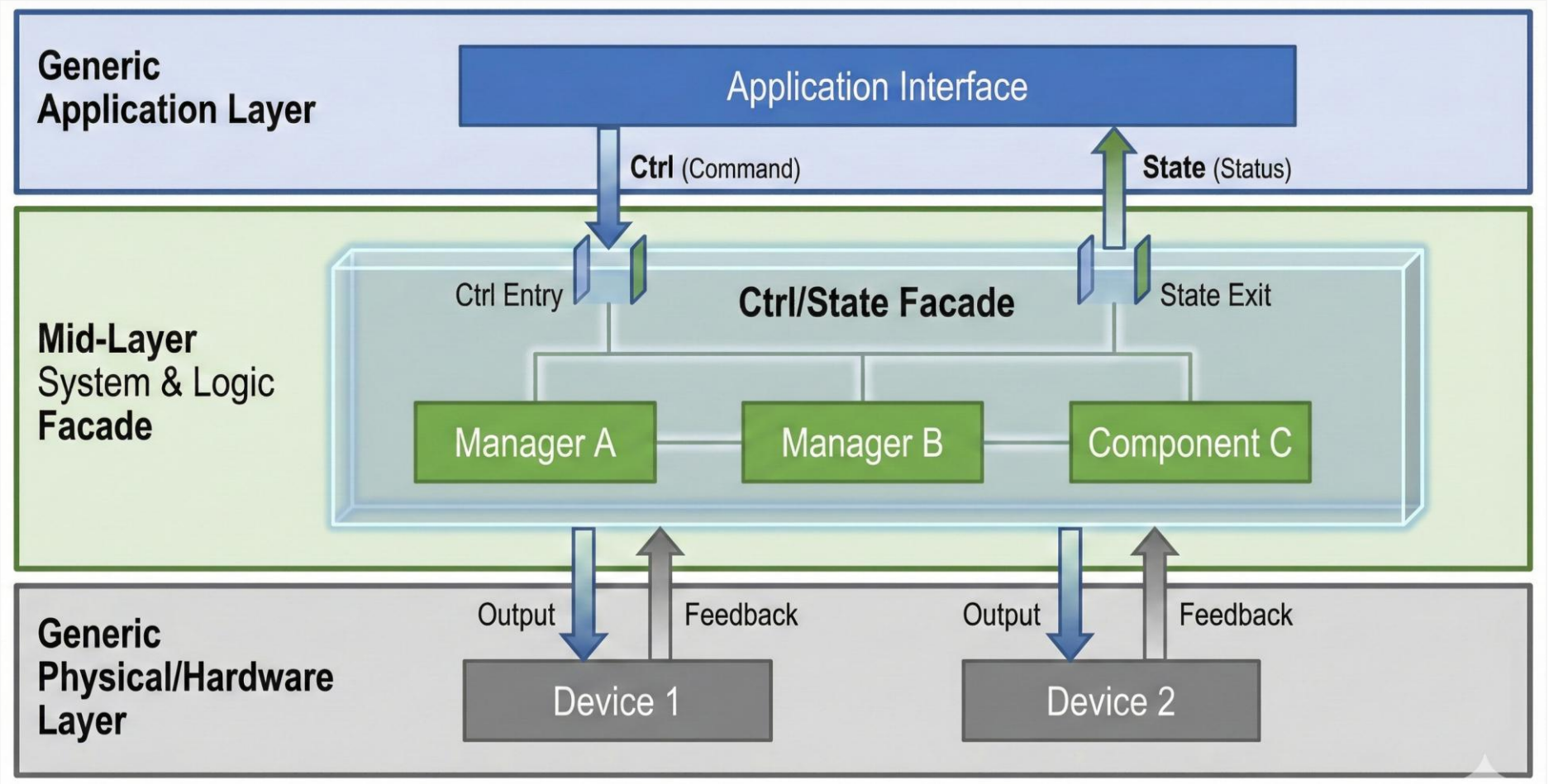

Upper Layer
(Application/Logic)
Ctrl/State
Facade A
Ctrl
State
Lower Layer
(System/Resource)
Ctrl/State
Facade B

1. Motivation
2. Design



- **Motivation**
  - Unified means of communication between entities
    - Higher level logic is preserved and shielded from lower-level changes
  - Agnostic to means of communication
    - Datafields are mappable to any cyclic or non-cyclic information transport
      - Hard real time, TCP/IP, ADS
  - Asynchronous, Atomic flow of information
    - Class instances are communicating via LinkedList implementation
  - Reducing software latency
    - Sequential case execution enables zero frame latency
    - LinkedList implementation enables atomic information transport
      - Information arrives ahead of state of the physical layer
  - Message-System with narrative syntax
    - Use of enumerations enables logs that are instantly readable for the human eye

- **Design**

  - Compliant to SOLID and ACID principles
    - Built in self similarity of approach enables fractal design choices
    - Due to strong Separation of Concerns the layered approach is suitable for distributed HRT systems

  - Encapsulated state machines with generic pattern
    - Generic pattern is applicable to existing code segments
      - Code segments may be reused.

    - Generic pattern enables secure execution
      - State isolation enables to prevent race conditions on a structural level

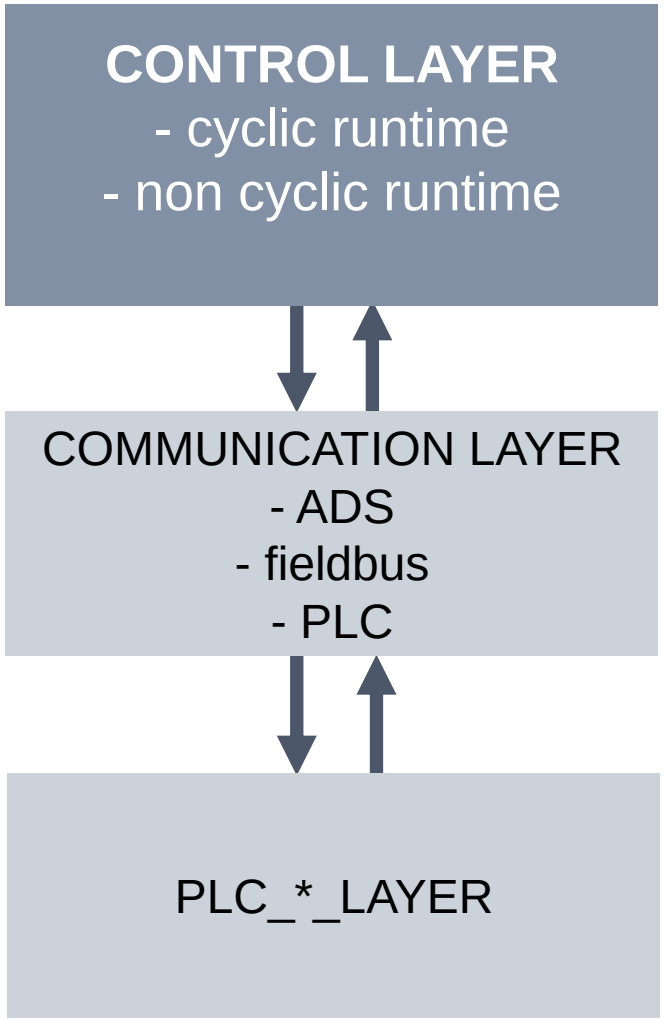
  - Use of base classes with cyclic wrappers (Ctrl/state)

  - Cross communication via Interface pointers

TC_PLC_FACADES

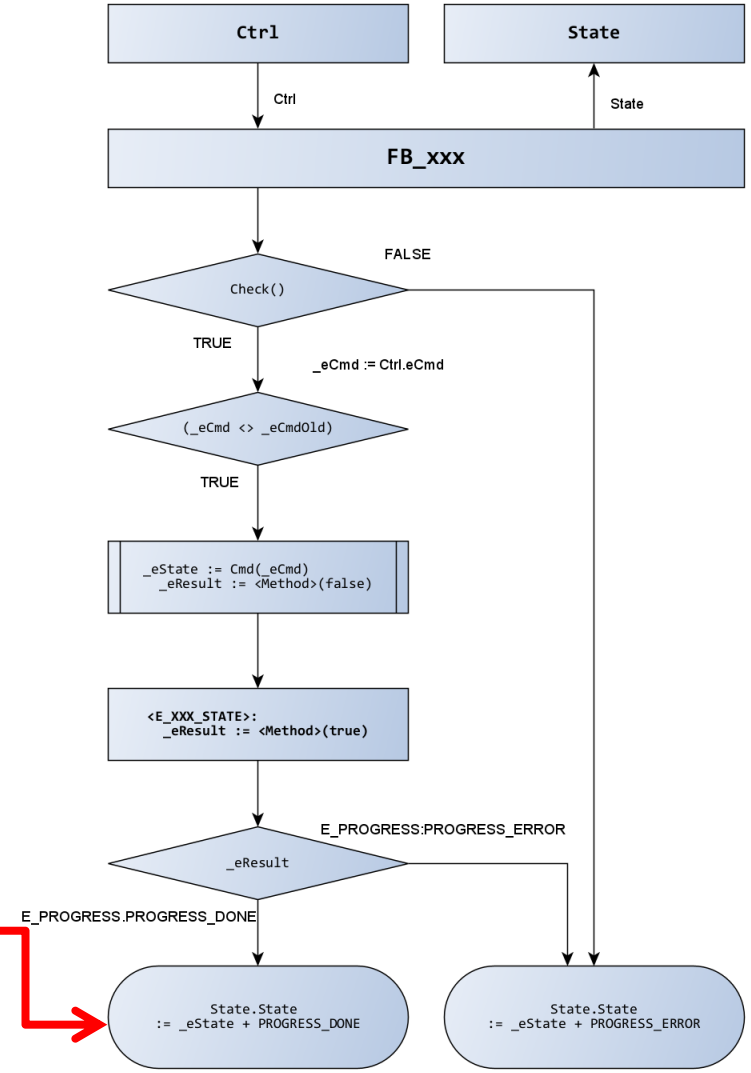
BECKHOFF

- **Design:**
- 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

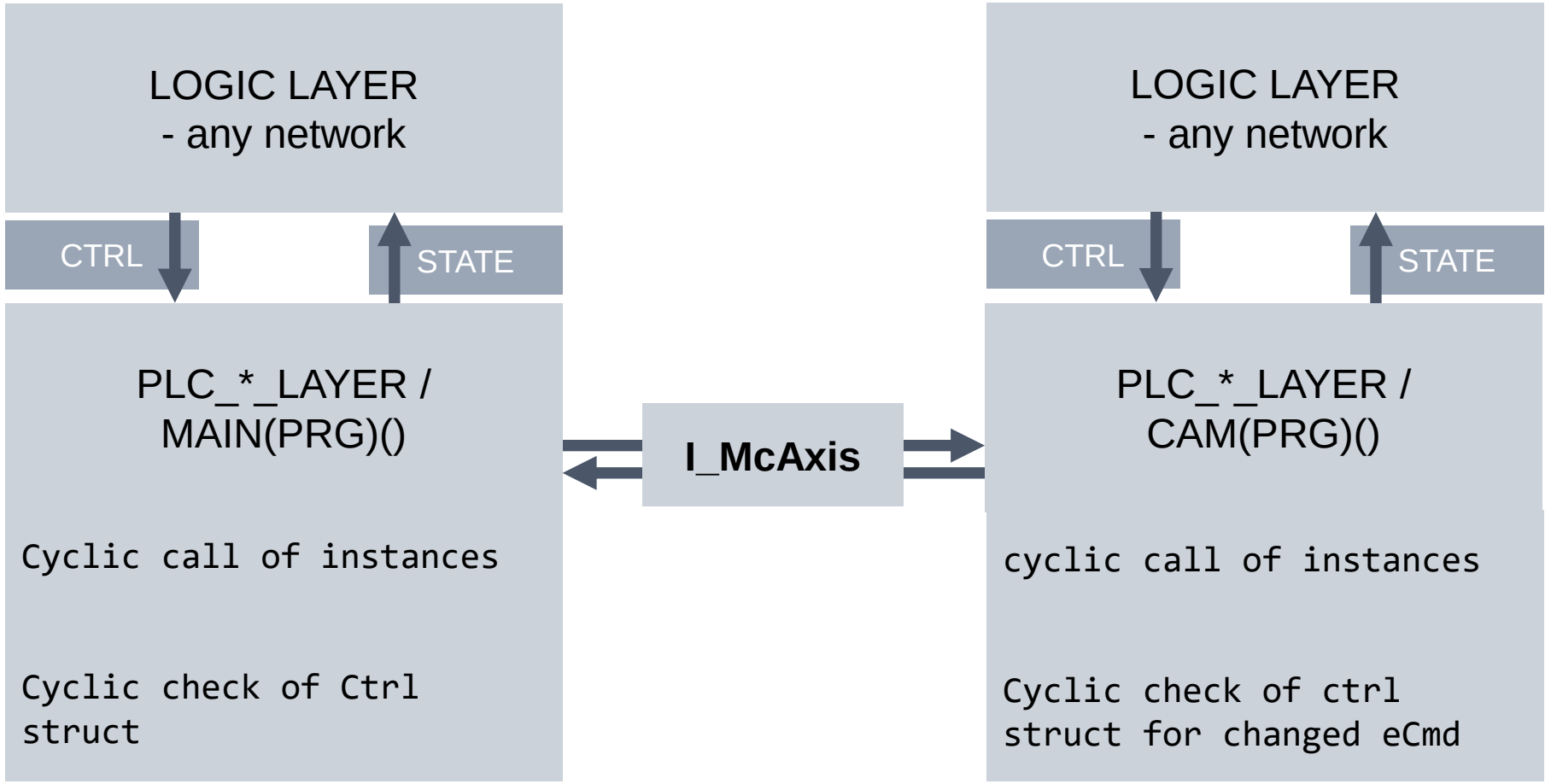


- **Design:**

- State / Ctrl structures
  - Establishes unified access
  - Commands can simply be ‘dropped’ into Ctrl datafield
    - Enables asynchronuous communication with PLC_*_LAYER (e.g. C# via ADS, C/C++ vis ADS, ADS over MQTT, …)
    - Enables cyclic communication with PLC_*_LAYER since structures can easily be mapped onto any cyclic fieldbus TwinCAT supports (EtherCAT, Profinet, CanOpen, EAP, …)
  - State is updated by PLC_*_LAYER, so you can move on doing other stuff, come back and check completion/error.
- State feedback for cyclic class wrappers
  - **Always** combined with E_PROGRESS
    - You can filter your response by a simple modulo division
      - The result may be your entry point for your reaction to State.



- **Software Design Example:** Separation of Concerns



- **SOLID DESIGN**
  - **S — Single Responsibility Principle**
    - **a class should have one, and only one, reason to change.**
  - **O — Open/Closed Principle**
    - **software entities should be open for extension but closed for modification.**
  - **L — Liskov Substitution Principle**
    - **Objects of a superclass shall be replaceable with objects of its subclasses without breaking the application.**
  - **I — Interface Segregation Principle**
    - **users should not be forced to depend upon interfaces that they do not use.**
      - **a software entity only sees the methods it actually needs to the work.**
  - **D — Dependency Inversion Principle**
    - **Depend upon abstractions, not concretions.**

- **ACID DESIGN**
  - **A — Atomicity**
    - **A transaction is an "all-or-nothing" unit of work.**
  - **C — Consistency**
    - **A transaction must bring the system from one valid state to another valid state.**
  - **I — Isolation**
    - **Concurrent transactions should not interfere with each other.**
  - **D — Durability**
    - **Once a transaction has been committed, it will remain so, even in the event of power loss, crashes, or errors.**