Drives with PROFIBUS and PROFINET move the world

PROFIBUS & PROFINET – Drive technology

Presentation agenda

- Introduction to PROFIdrive
- Core aspects of PROFIdrive
- Mapping to PROFIBUS and PROFINET
- Device development and certification test
- Benefits for manufacturers and end users

No Automation without drive technology

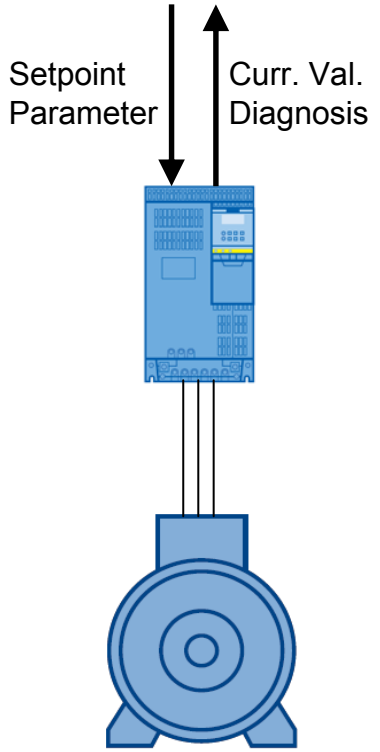
- Drive technology is a fundamental requirement for all automation tasks.
- The tasks performed and the related requirements are heavily dependent on the particular application.
- The range of applications includes …
  - … Motors with fixed and variable speed, such as pumps, fans and compressors, and drives for transport tasks
  - … Single-axis positioning for applications, such as moving, resetting, and positioning
  - … Applications with multi-axis interpolation for packaging, printing, and milling

PI supplies comprehensive and harmonized base technologies

- PROFIBUS und PROFINET
  - Approved and innovative
- PROFIdrive
  - Vendor-neutral
- PROFIsafe
  - Safe
- PROFIenergy
  - Thrifty

Interoperability – Premise for good communication

- Modern drive products are usually equipped with a digital drive interface (fieldbus interface)
- Using PROFIBUS or PROFINET all drive functions on any drive are controllable
  - On / Off, rotational direction
  - Setting of speed, position, torque
  - Parametrization of drive functions
  - Diagnosis and supervision
- Communication can be realized in a flexible way
  - The protocol to control the device can be freely selected and fits best to the product
  - Simple retrofit of existing products
- Interoperability only to products of the same manufacturer
  - No manufacture independent Interoperability



How PROFIdrive came about

- PROFIdrive is the standard profile for drive technology that relies on the PROFIBUS and PROFINET communication systems.
- It creates multiple benefits not only for the device and system manufacturers but also for integrators and end users.
  - 1991 Focus on variable speed drives exclusively on PROFIBUS.
  - 2002 New functionality of PROFIBUS
    - DPV1 acyclic services
    - DPV2 clock cycle synchronization
  - 2005 PROFINET mapping added
  - 2006 PROFIsafe integrated
  - 2007 PROFIdrive becomes international standard IEC 61800-7

Principles

- Concept of
  - Integrating standard drive and “motion control” functionality with PLC sequencing logic.
  - Distribution of Application processes across the devices
    - Motor-current control
    - Speed control
    - Position control
    - Path interpolation
    - Logic control

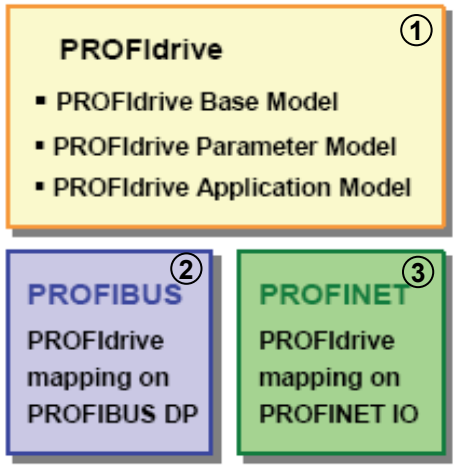
The communication system provides the link between the distributed processes, making use of dedicated services such as

- Cyclic IO
- Acyclic services
- Clock synchronization
- Profile-based Slave-to-Slave communication

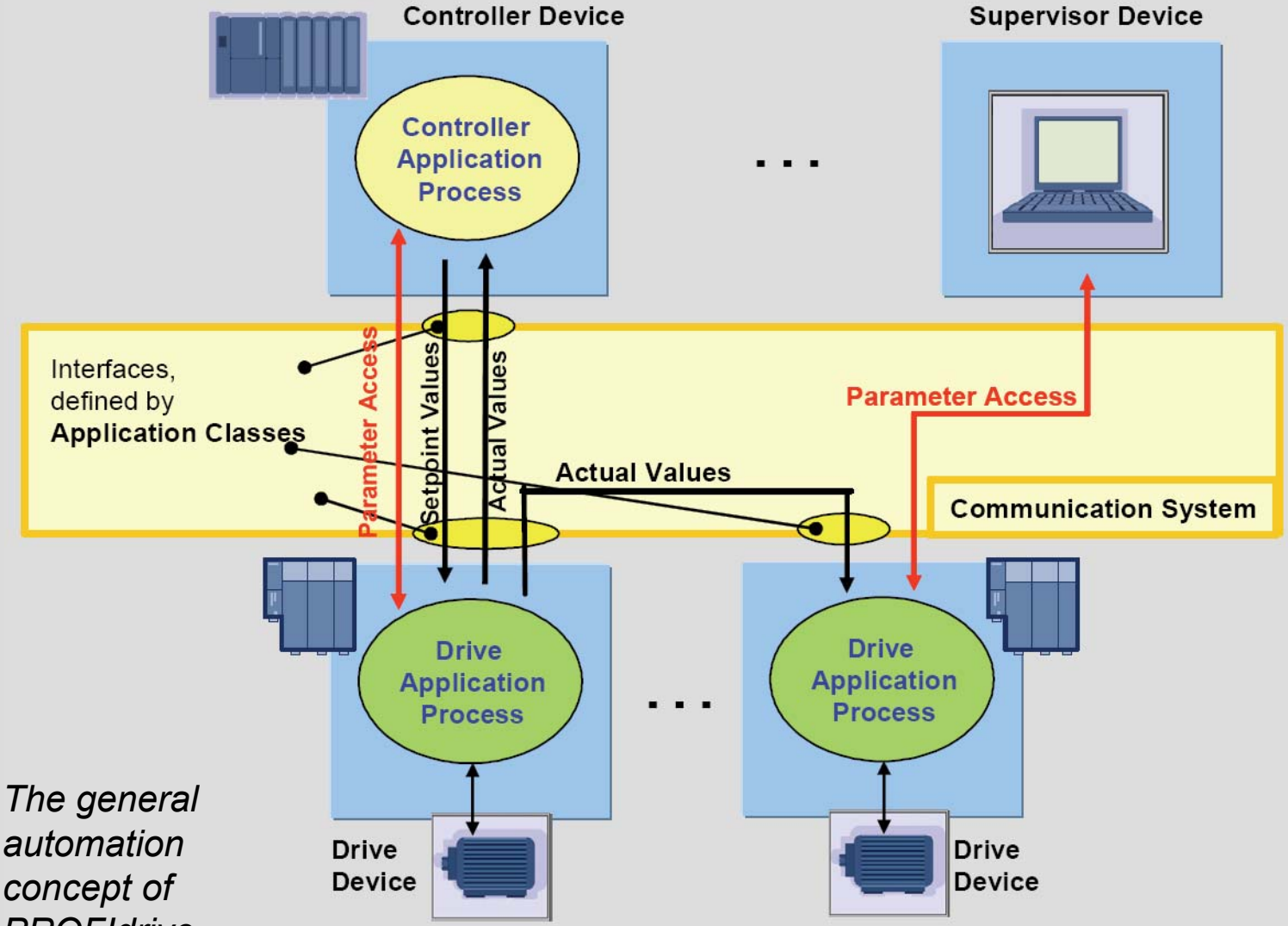
Structure of the profile

- The main part 1 of the profile describes those functions that are separate from the communication system.
  - Part 2 describes using of PROFIBUS
  - Part 3 describes using of PROFINET

- Scalable communication performance
- From a basic fieldbus to a system-wide Ethernet network
  - Same application view
  - Without any changes needing to be made to the automation system

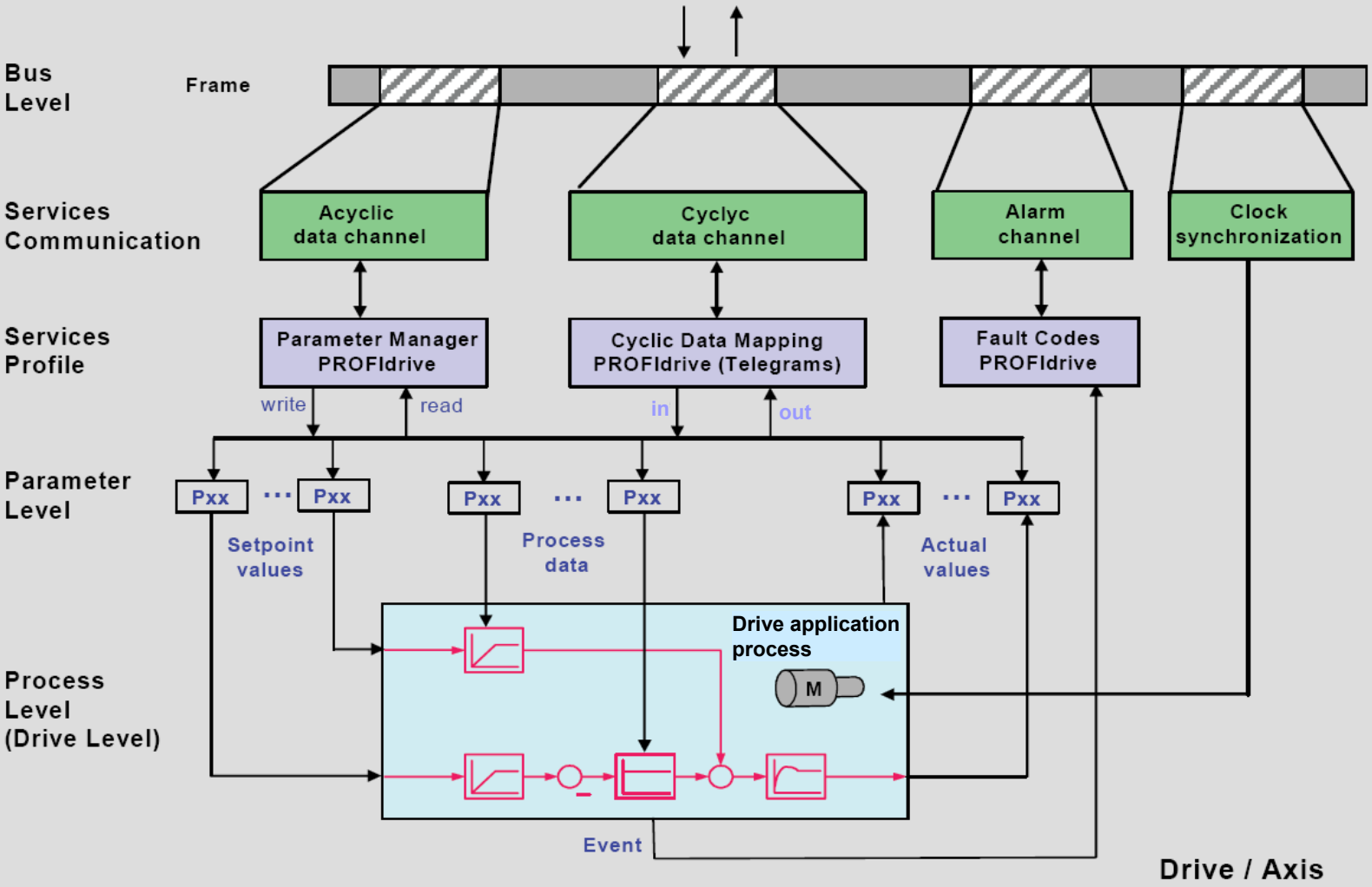


PROFIdrive base model



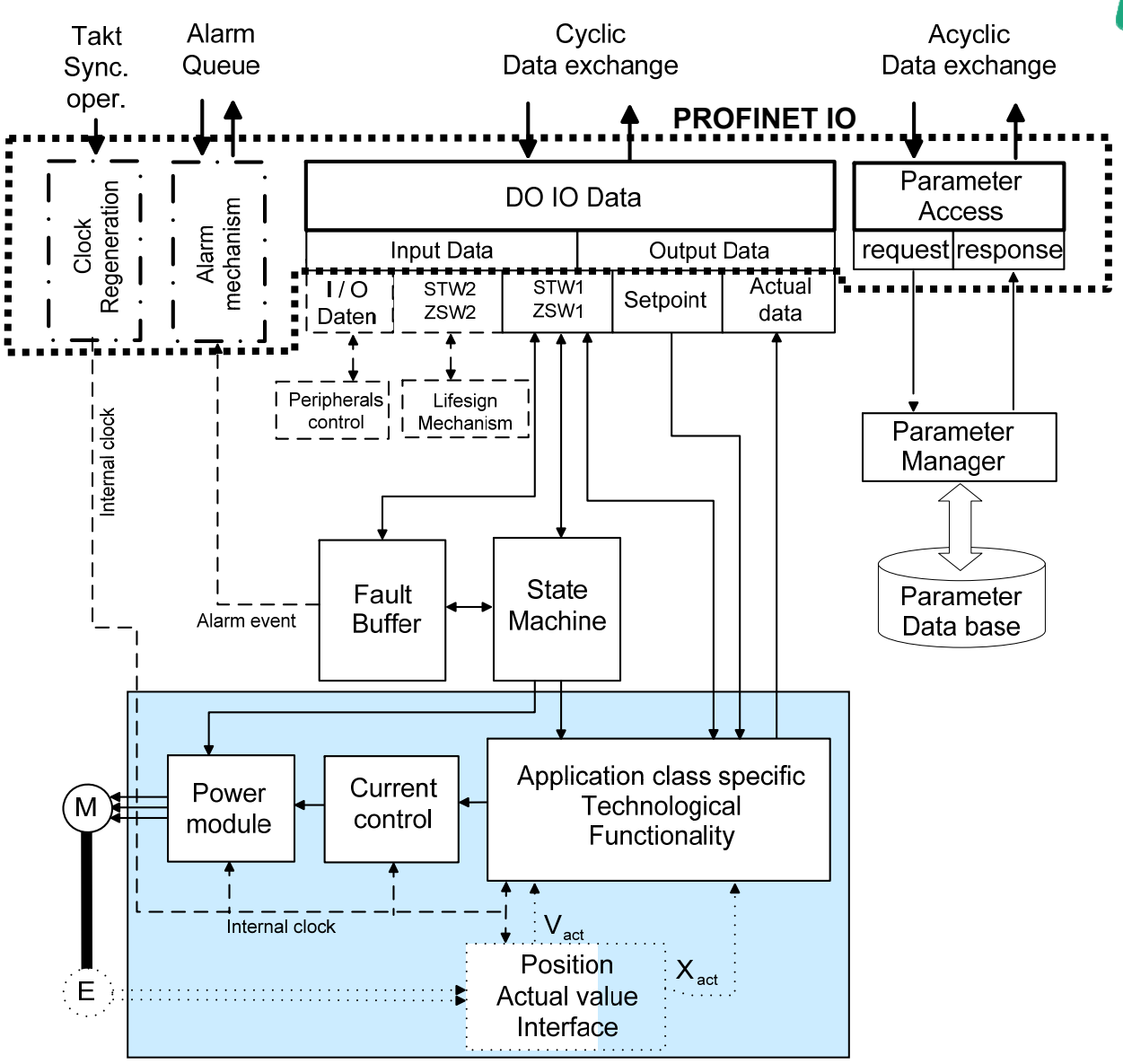
The general automation concept of PROFIdrive

Communication Services



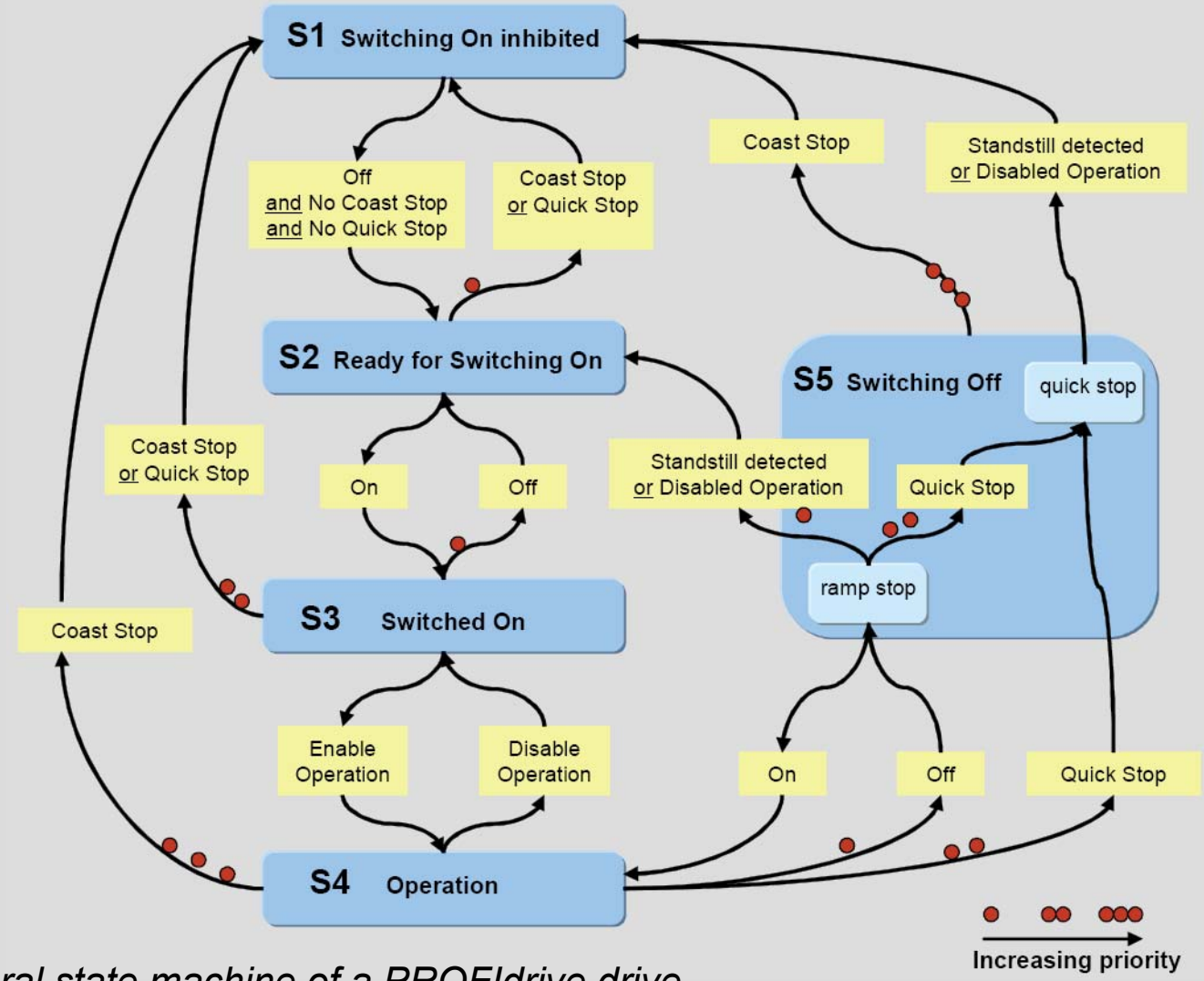
Data model and data flow in a drive

Functional overview of “Drive object”



optional

Device behavior – State machine

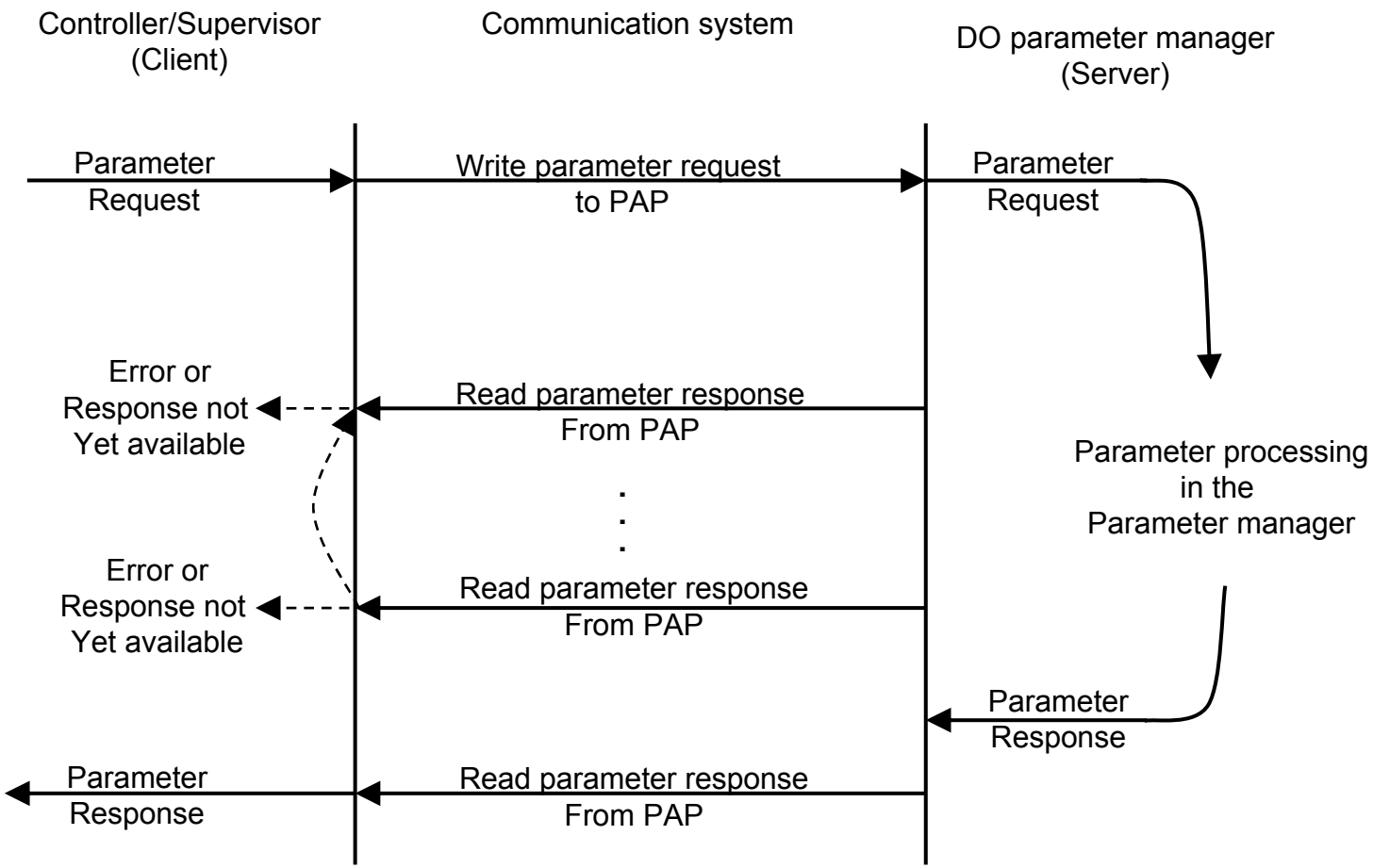


General state machine of a PROFIdrive drive

PROFIdrive Parameter Model

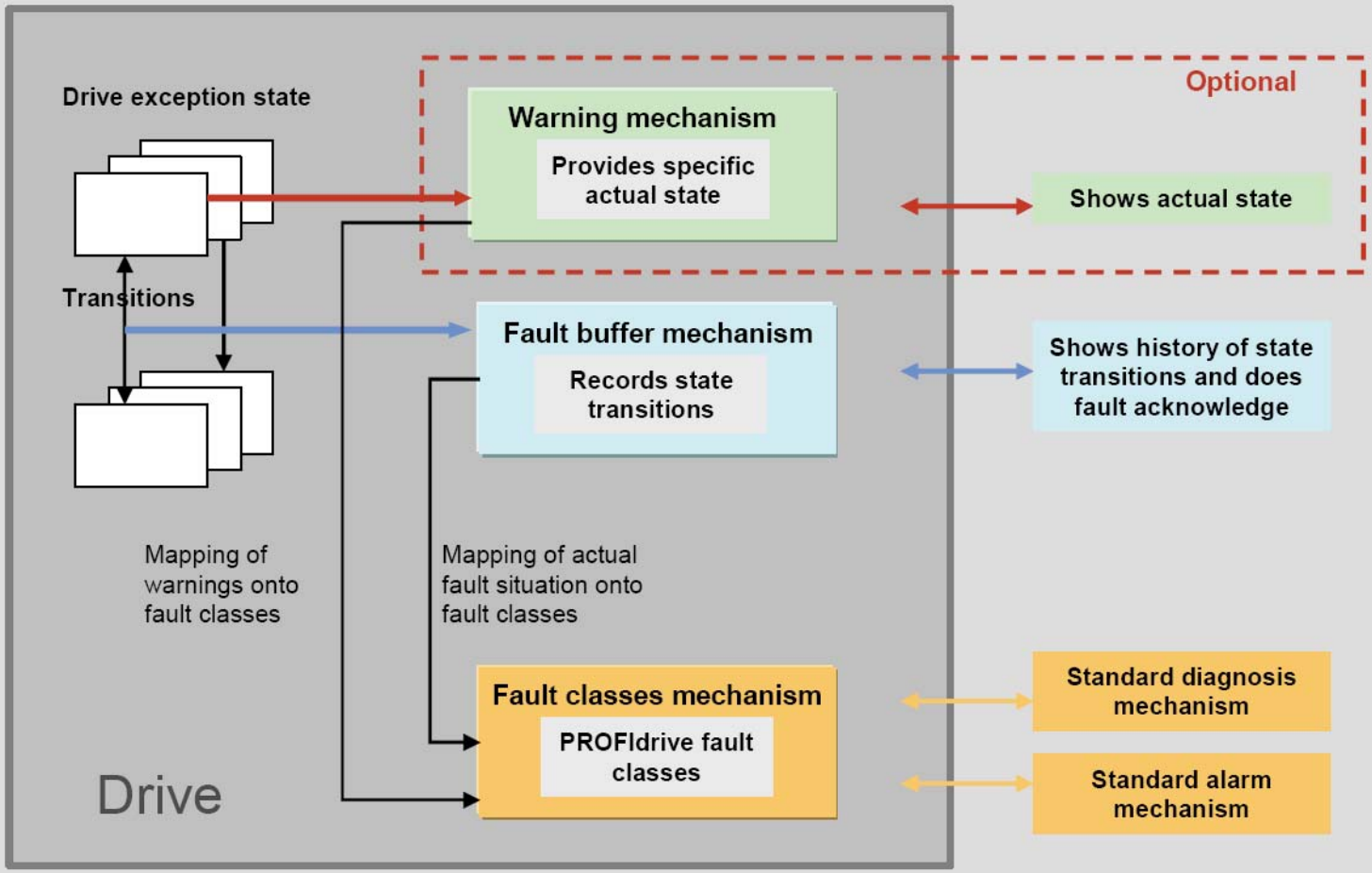
- Profile parameters
  - Same parameters for all drives
  - Drive identification
  - Fault buffer
  - Drive control
  - Device identification
  - Process data configuration
  - List of all parameters
- Manufacturer-specific parameters
  - Complex devices can add up to well over 1000
  - Provide manufacturers with maximum flexibility
  - Manufacturer specific control and monitoring
- Parameter access
  - Acyclic access
  - 256 axes per drive can be accessed
  - Up to 65.535 parameters per axis
  - Up to 65.535 array elements per parameter
  - Value, descriptions and associated text elements

PROFIdrive Base mode parameter access



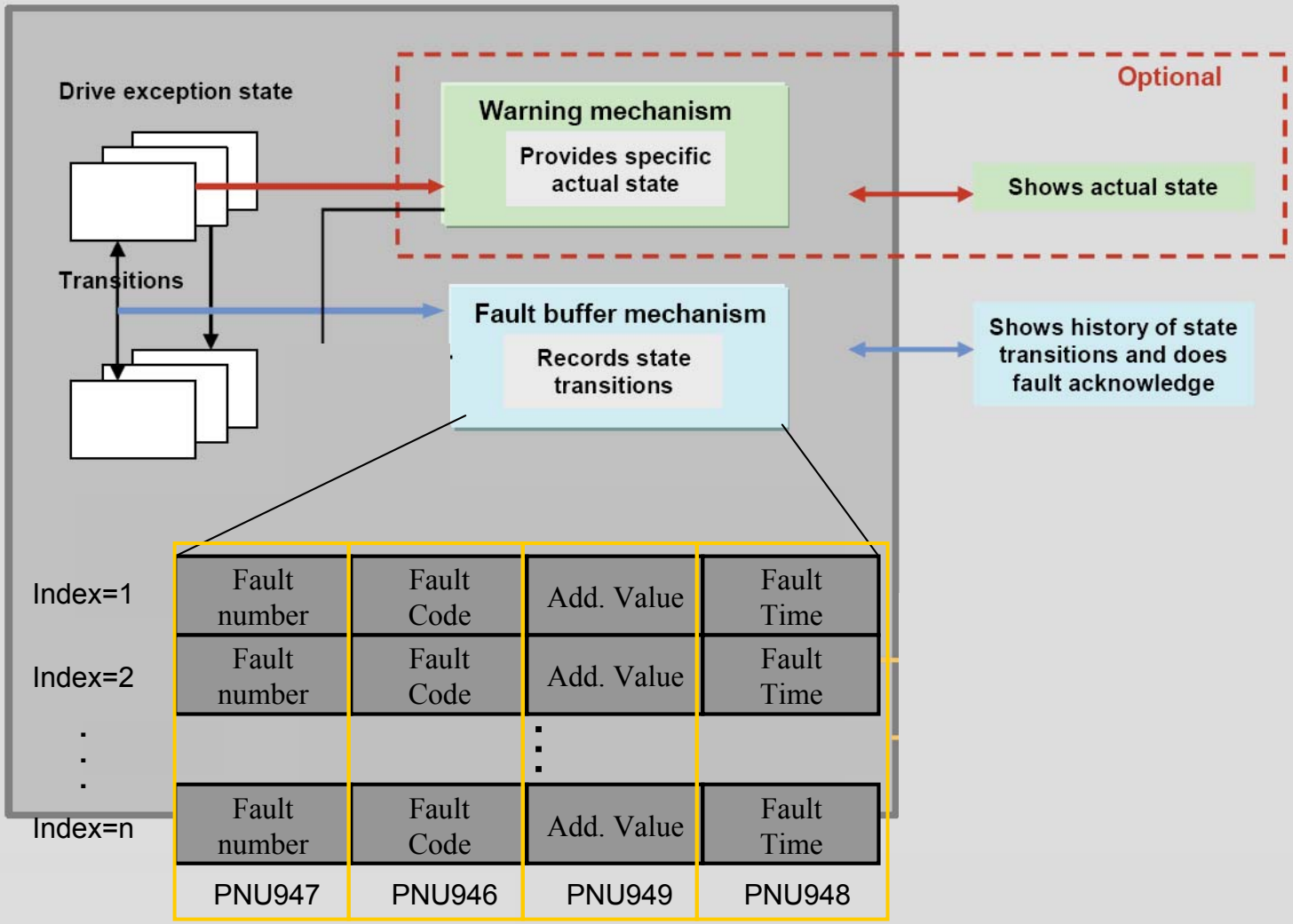
PAP: Parameter access point

Diagnosis



PROFIdrive diagnostic functions

Diagnosis



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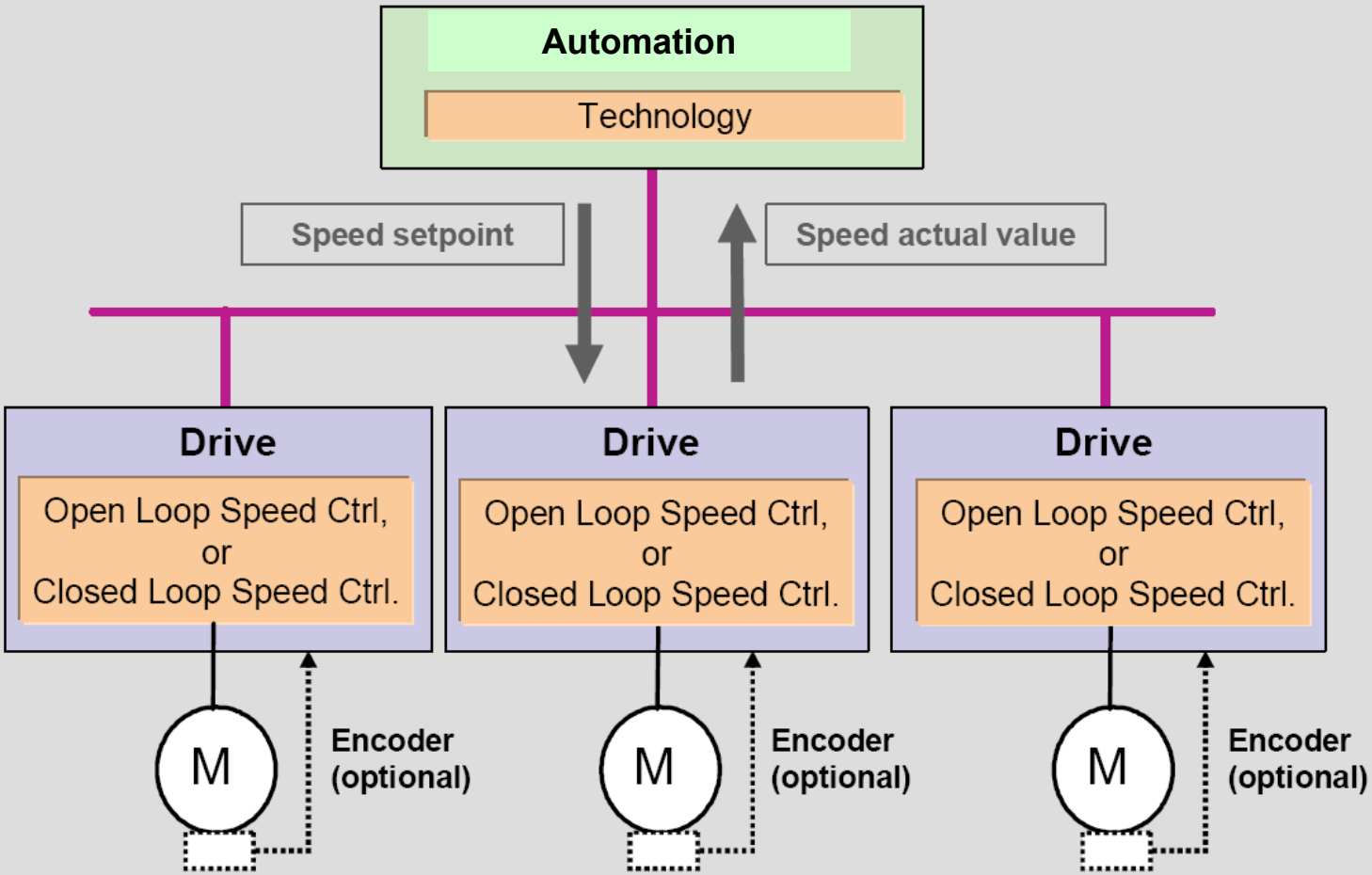
Application Classes

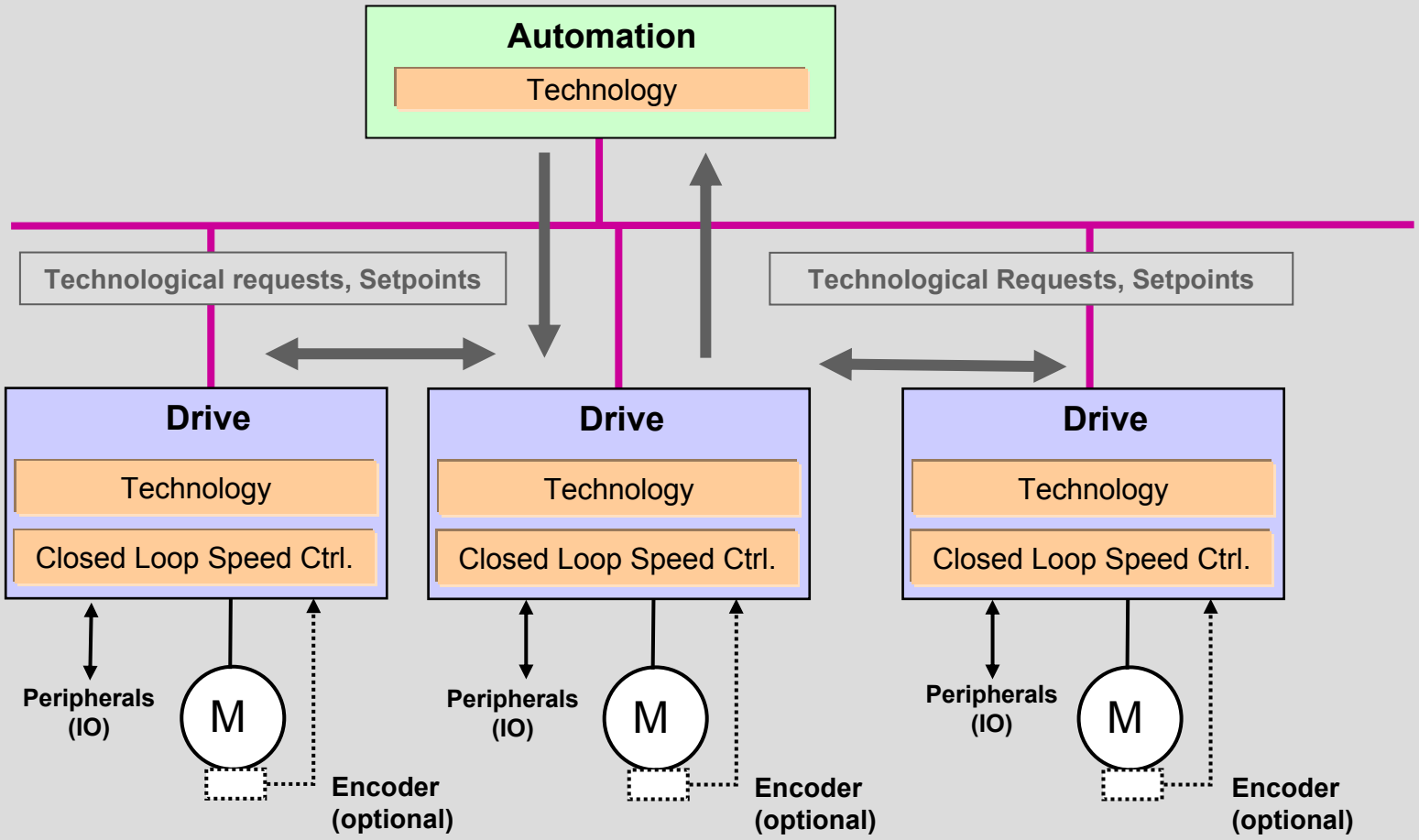
- Standard drive (Class 1)
- Standard drive with technological function (Class 2)
- Positioning drive (Class 3)
- Central motion control (Classes 4 and 5)
- Decentralized automation with synchronized processes and electronic shafts (Class 6)

Standard drive (Class 1)



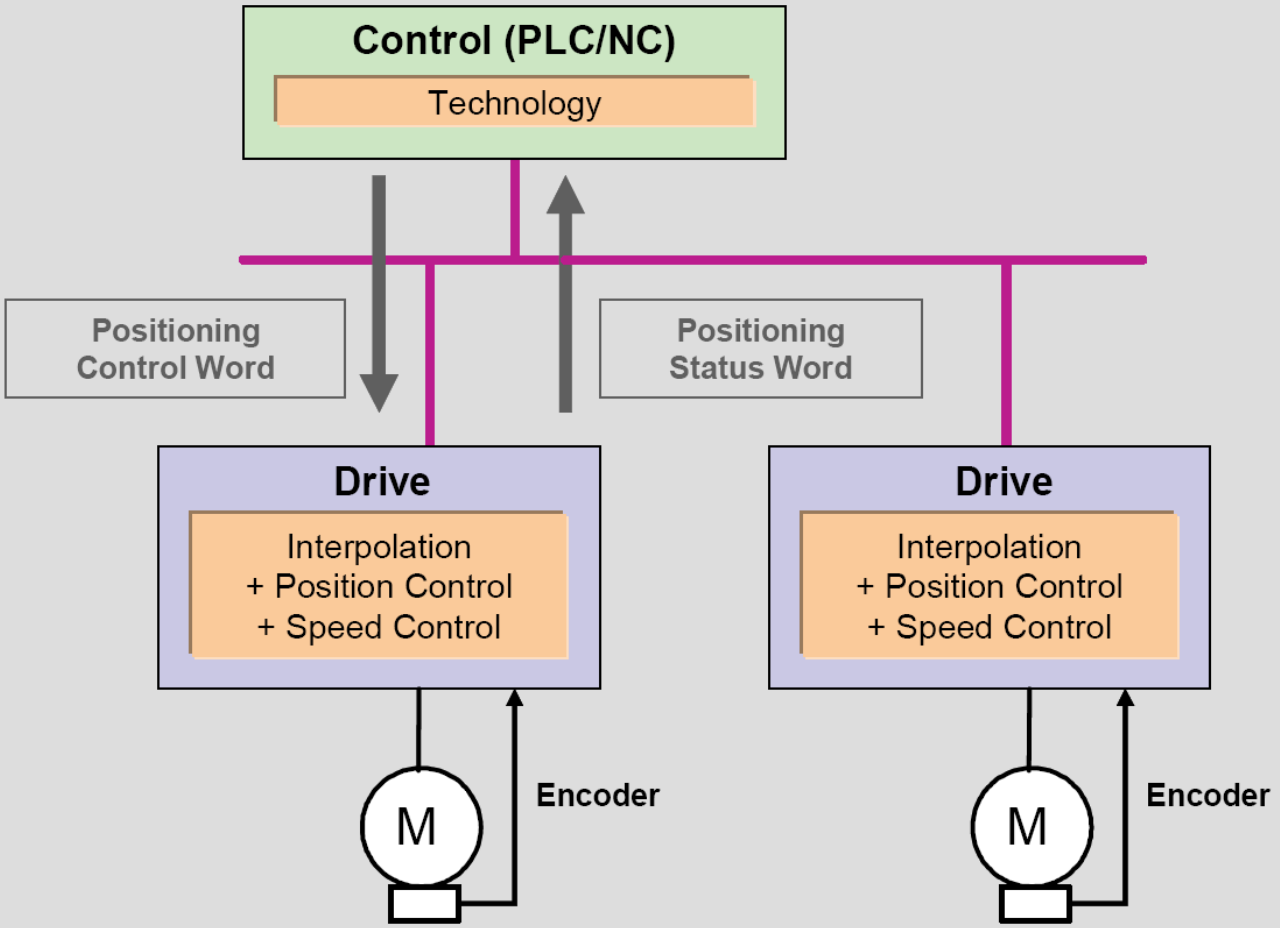
PROFIdrive application class 1

Standard drive with distributed technology (Class 2)



PROFIdrive application class 2

Positioning drive (Class 3)



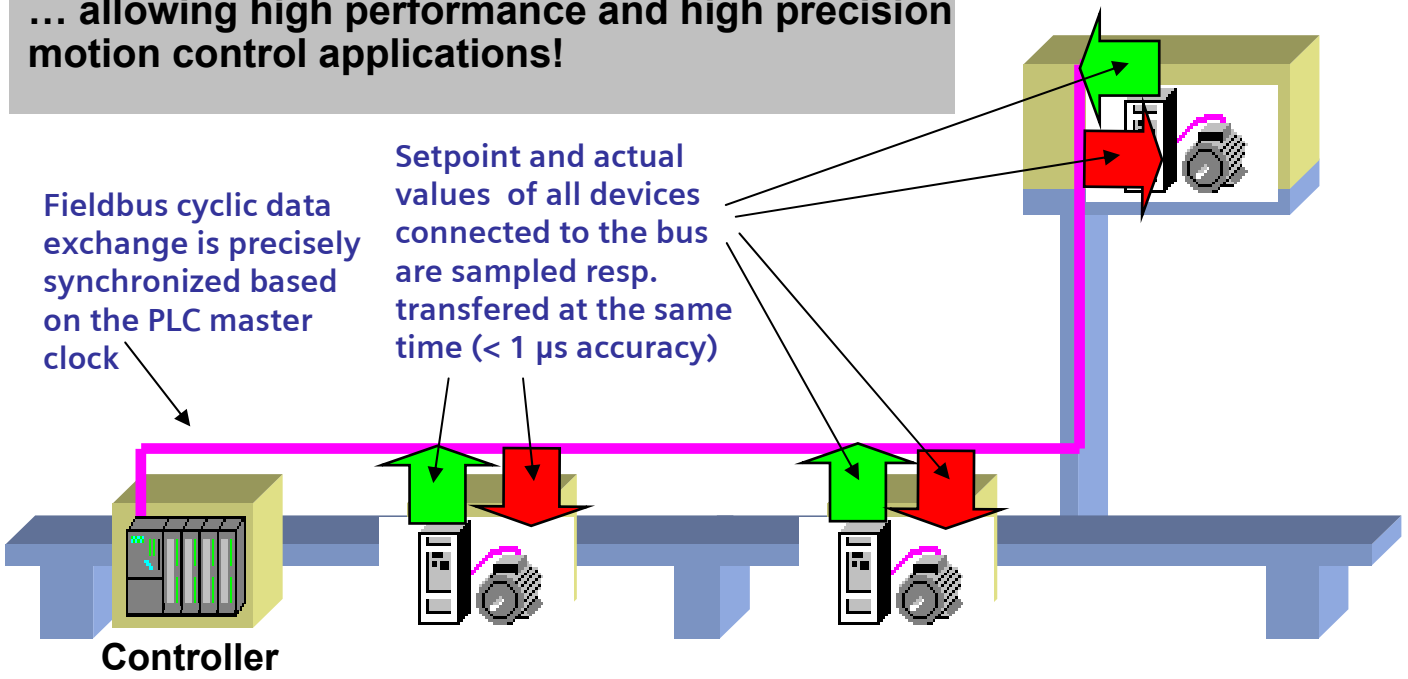
PROFIdrive application class 3

Isochronous mode for what?

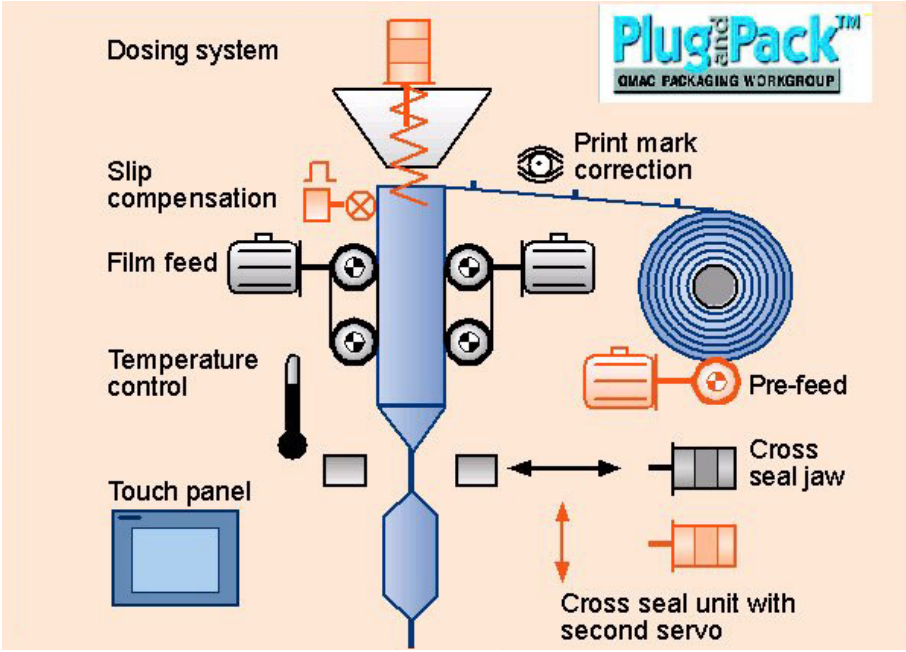
... Isochronous mode assures a bus cycle with 1 µs accuracy

All drive application processes are synchronized to the bus cycle …

… allowing high performance and high precision motion control applications!



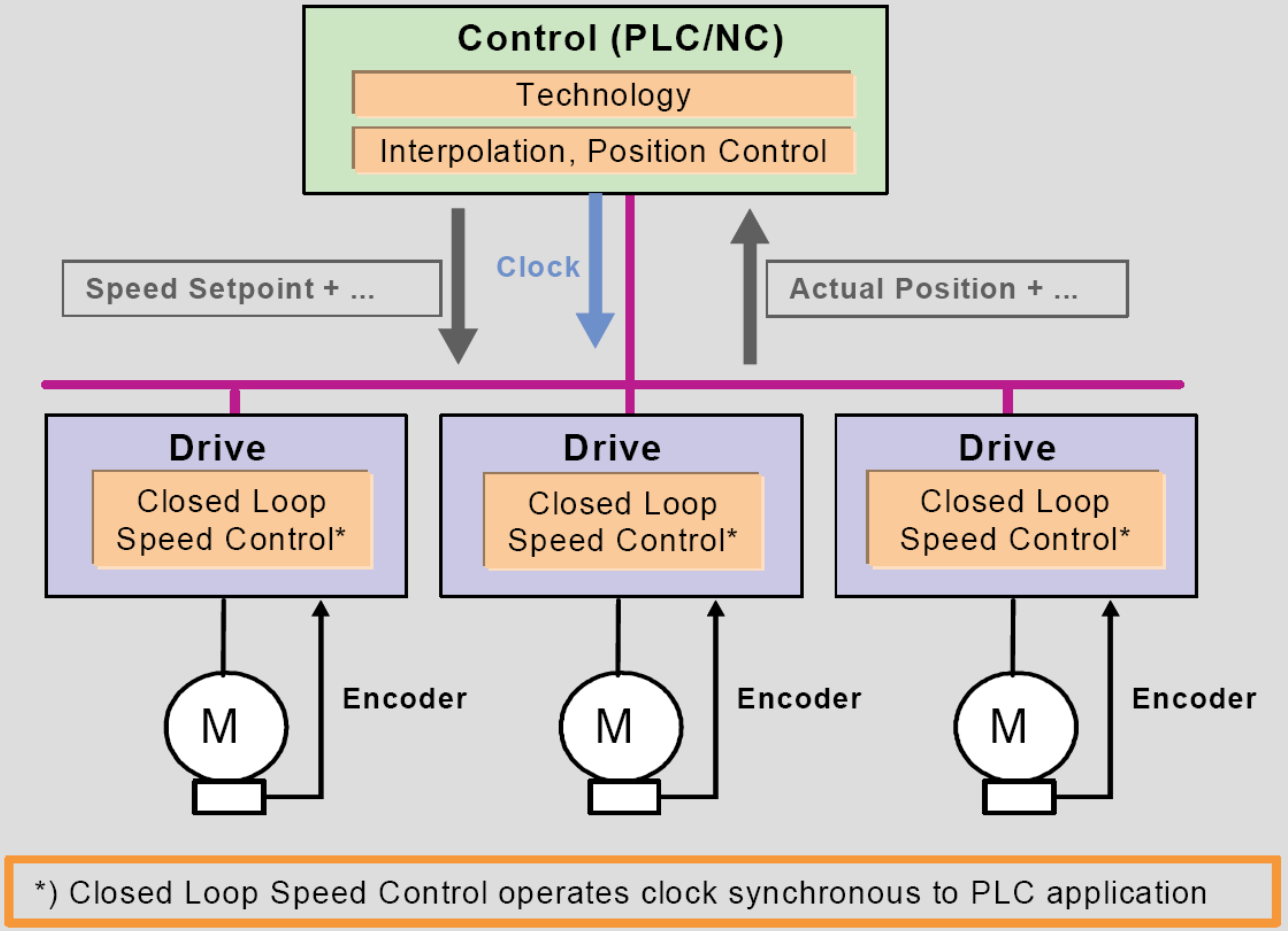
Example of a maschine using isochronous drives



Distributed automation system based on isochronous applications:

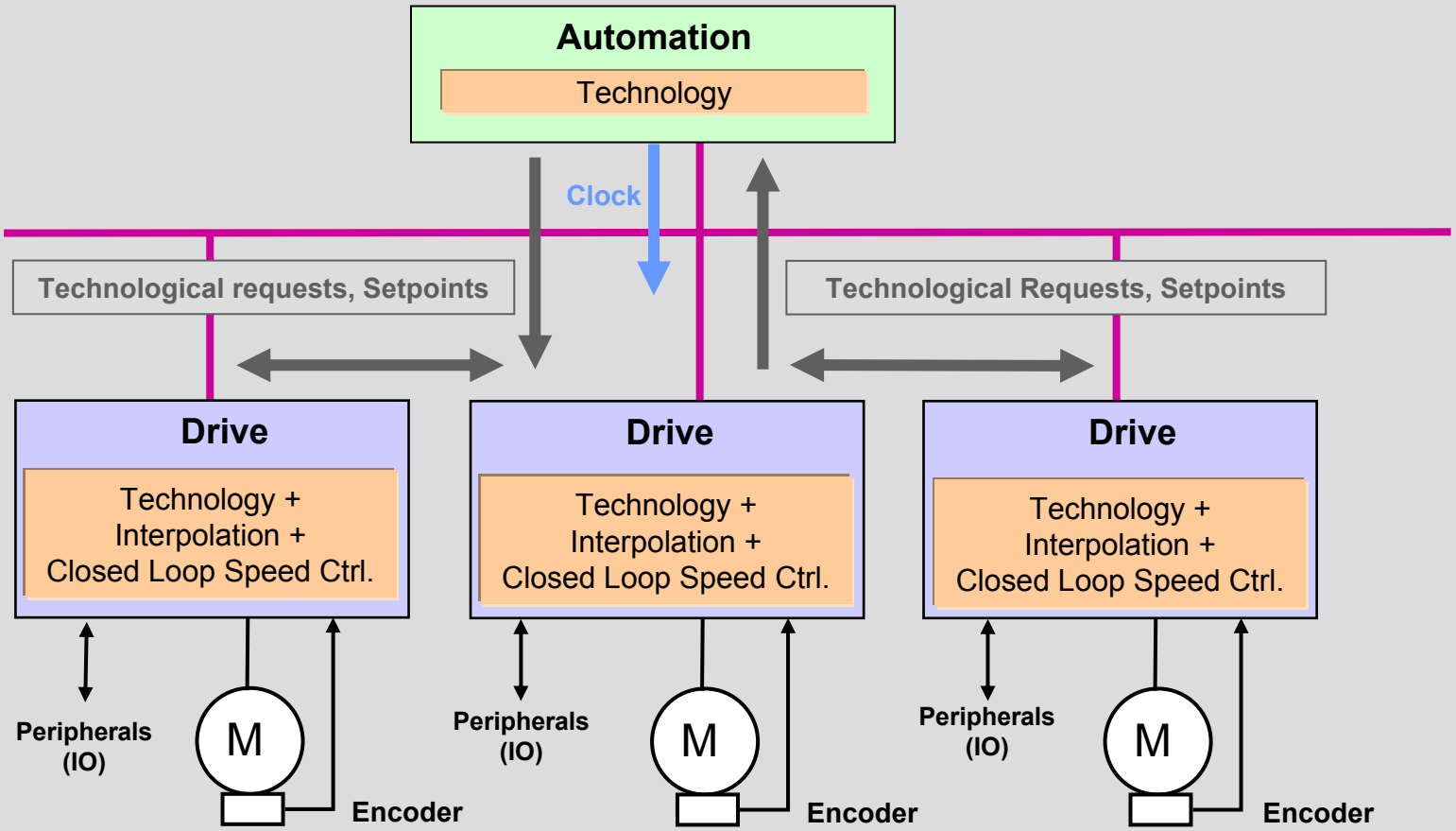
- Cam dis
- Electronic gear box
- Flying saw

Central motion control (Class 4 and 5)



PROFIdrive application class 4 and 5

Standard drive with distributed technology (Class 6)



PROFIdrive application class 6

Telegram for Standard drive (Class 1)

Standard Telegram 1:

PZD number	1	2
Setpoint	STW1	NSOLL_A

PZD number	1	2
Actual value	ZSW1	NIST_A

Standard Telegram 2:

PZD number	1	2	3	4
Setpoint	STW1	NSOLL_B		STW2

PZD number	1	2	3	4
Actual value	ZSW1	NIST_B		ZSW2

Standard telegram 3: n_{set} interface, 32 bit, with one sensor

PZD number	1	2	3	4	5
Setpoint	STW1	NSOLL_B		STW2	G1_STW

PZD number	1	2	3	4	5	6	7	8	9
Actual value	ZSW1	NIST_B		ZSW2	G1_ZSW	G1_XIST1		G1_XIST2	

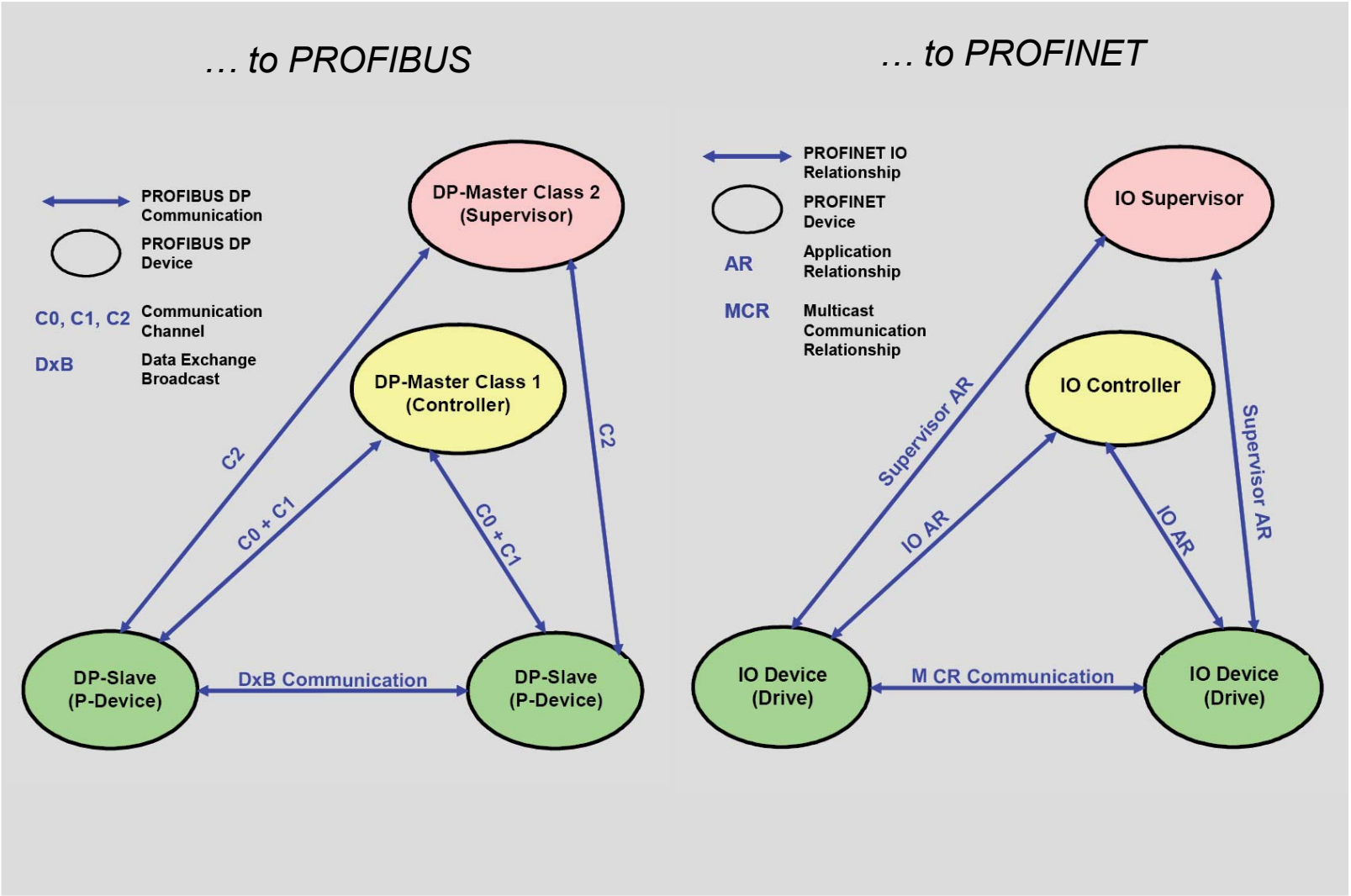
Standard telegram 4: n_{set} interface, 32 bit, with two sensors

PZD number	1	2	3	4	5	6
Setpoint	STW1	NSOLL_B		STW2	G1_STW	G2_STW

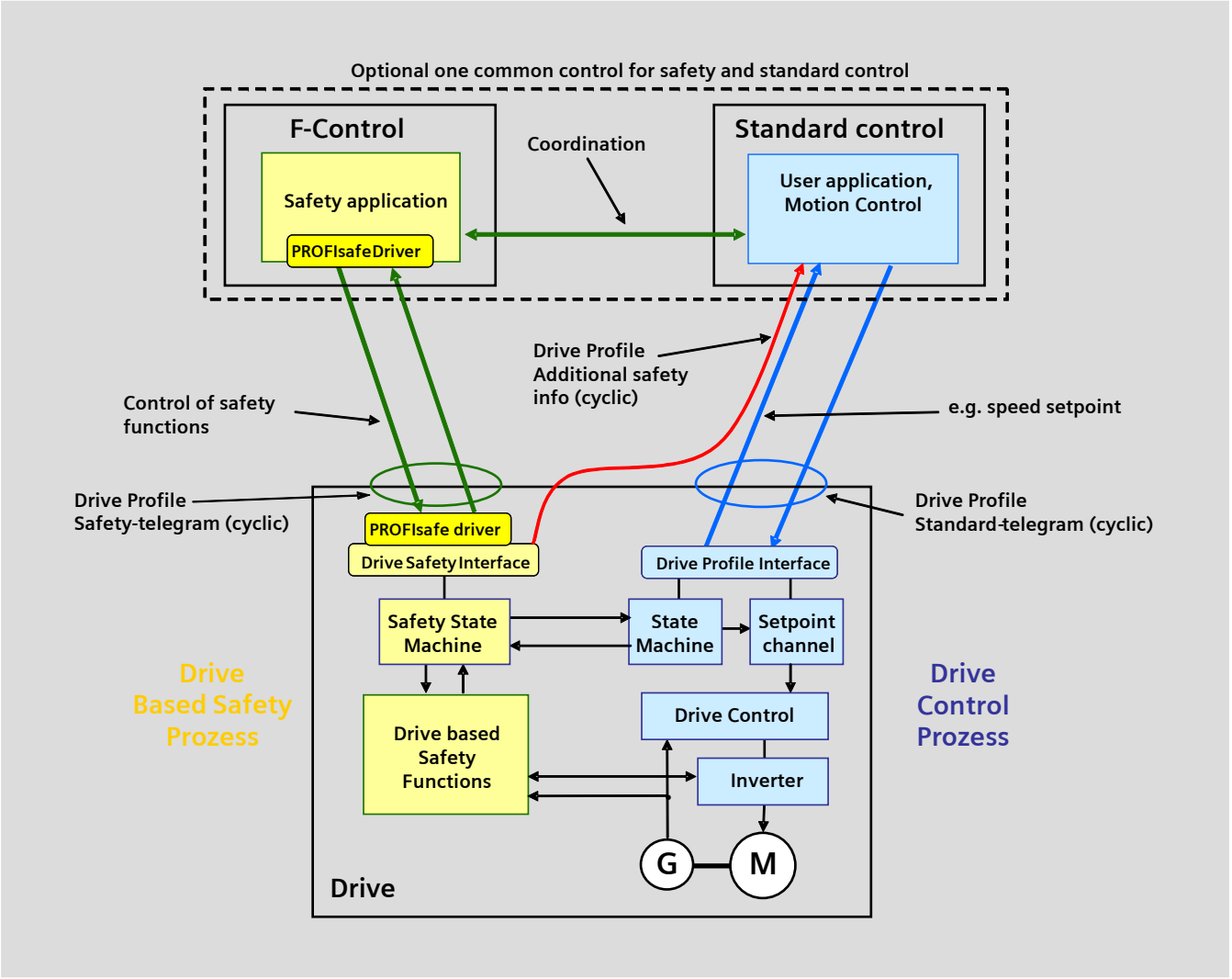
PZD number	1	2	3	4	5	6	7	8	9
Actual value	ZSW1	NIST_B		ZSW2	G1_ZSW	G1_XIST1		G1_XIST2	

10	11	12	13	14
G2_ZSW	G2_XIST1		G2_XIST2	

Mapping to communication systems



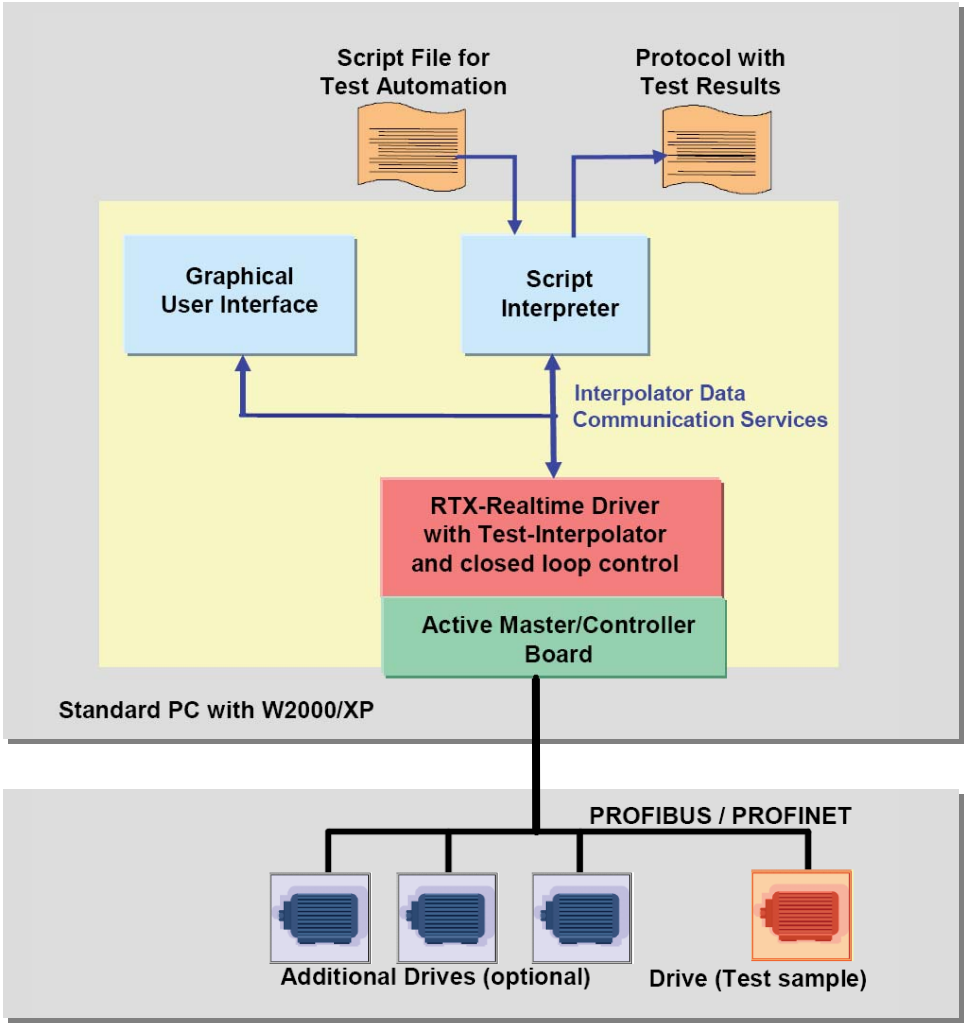
Integration of PROFIsafe



Conformity and certification

PROFIdrive Conformity test

- The products (test samples) undergo automated testing based on script descriptions
- Test steps are recorded automatically in the product test log
- Quality system and accreditation procedures ensure a consistent level of test quality



Benefits...

...for device and system manufacturers

- Cost-effective thanks to only one communication technology for drives, control, I/O, and B&B
- Highly flexible thanks to integrated technology for the entire drive spectrum
- Functional security thanks to independent certification
- International acceptance thanks to IEC standardization and recommendation by end-user organizations such as OMAC
- Fit for the future on the basis of PROFIBUS and PROFINET

...integrators and end users

- Cost-effective thanks to a single bus technology, reduced training requirement and high impact
- Reduction in costs thanks to lower installation overheads and system-wide application programs
- Flexibility in terms of the adaptation of drive equipment
- User-friendly thanks to the interoperability and interchangeability of devices built by different manufacturers
- Investment security thanks to IEC standardization
- Fit for the future thanks to the position of PROFIBUS and PROFINET as market leaders