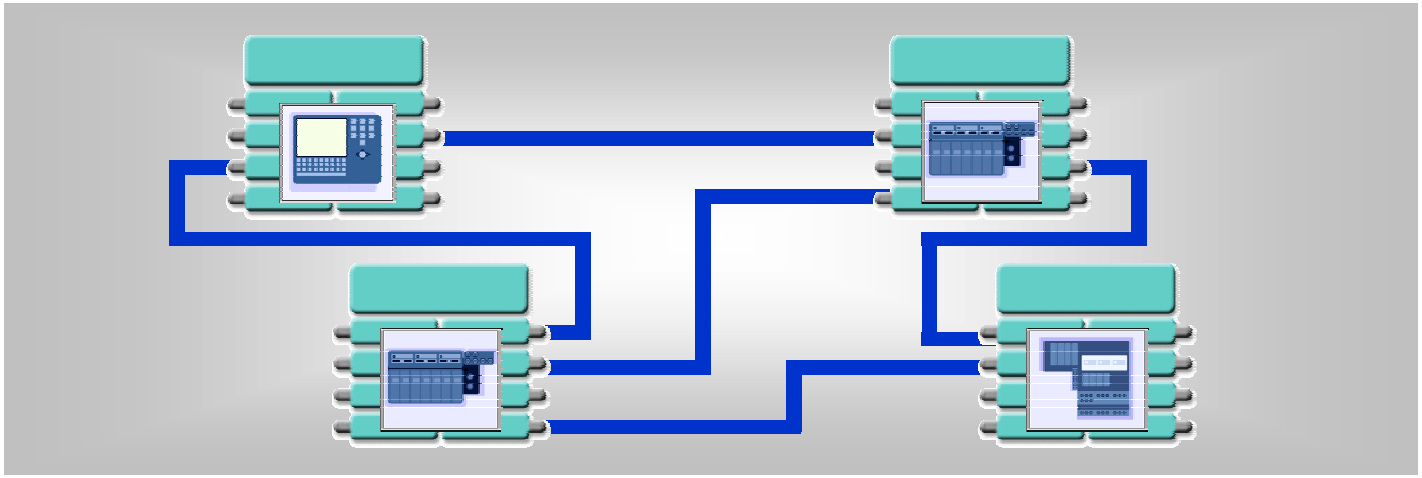
# PROFINET CBA

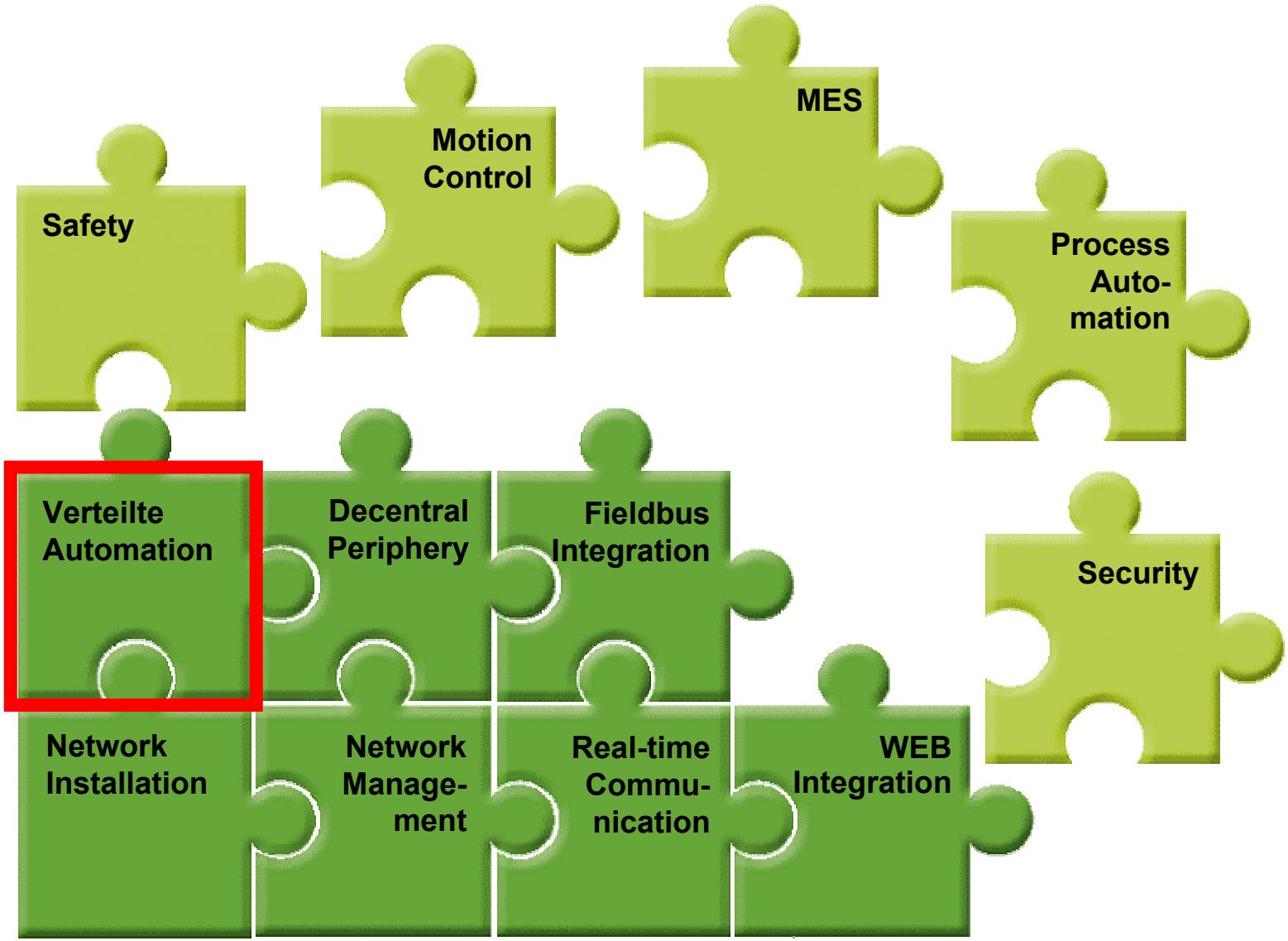


# Distributed Automation

# PROFINET as Modular Technology

**PROFINET CBA – Distributed Automation**

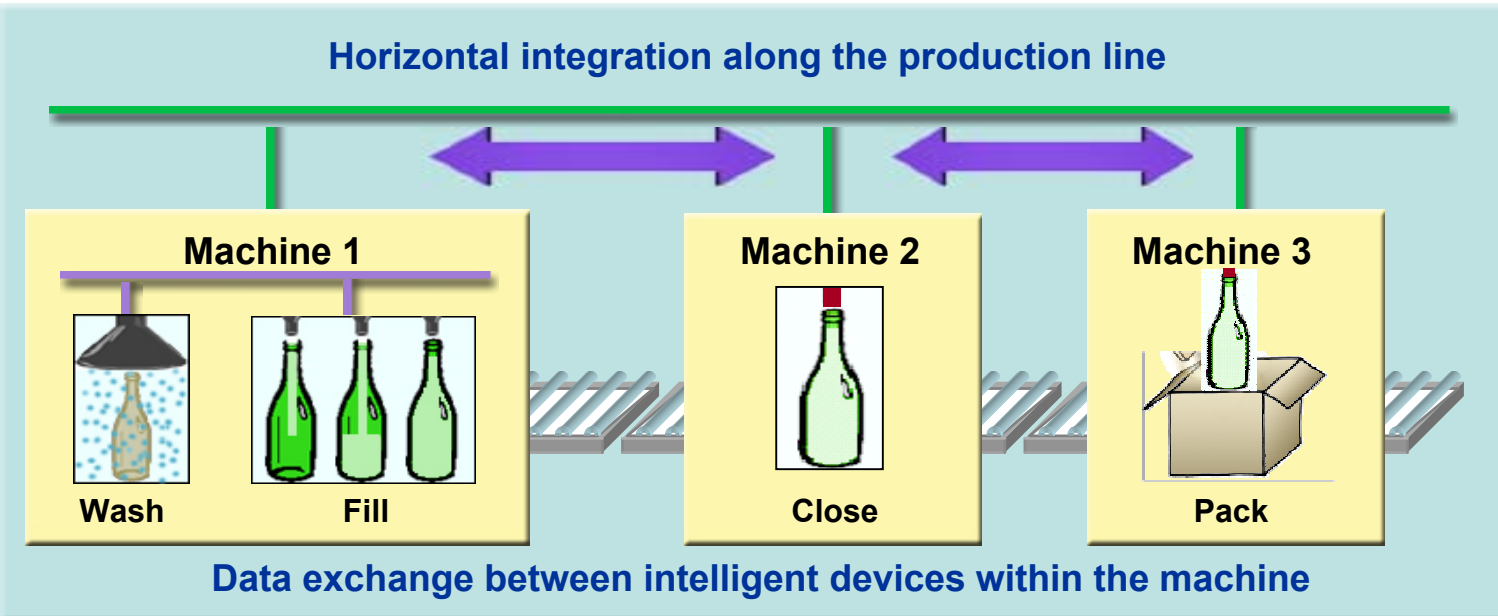
- Functional Scope
- Component Technology
- PCD
- Engineering
- Runtime
- Diagnostics
- Fieldbus Applications
- Software



# Modular Plant and Machine Construction

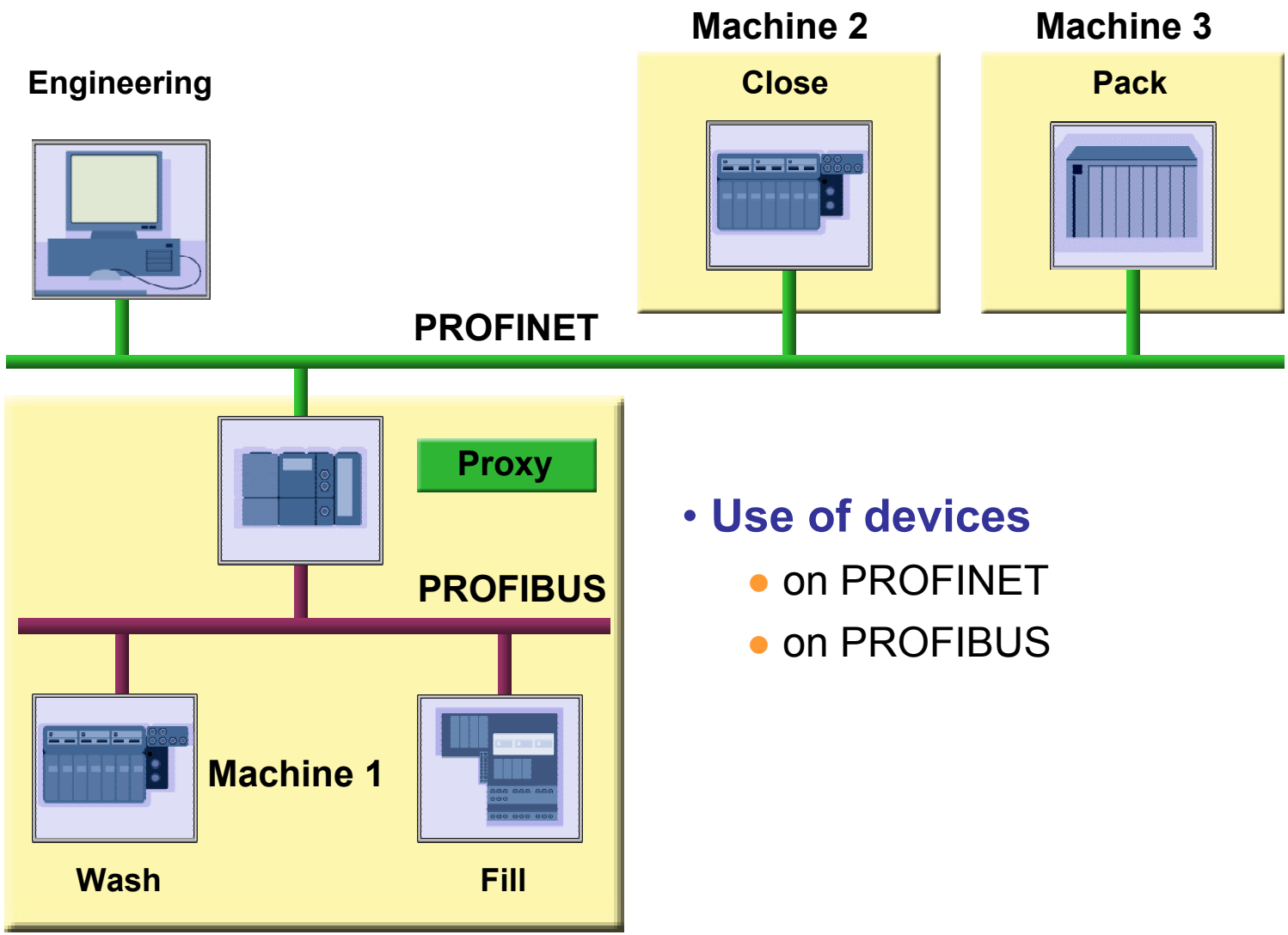


- **Example from the food & beverage industry:**
  - Wash bottles
  - Fill bottles
  - Close bottles
  - Pack bottles



# The Automation Structure



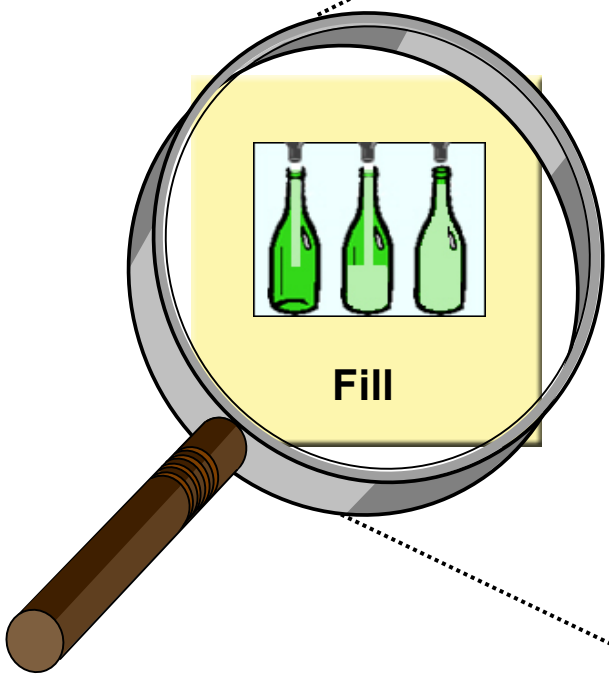


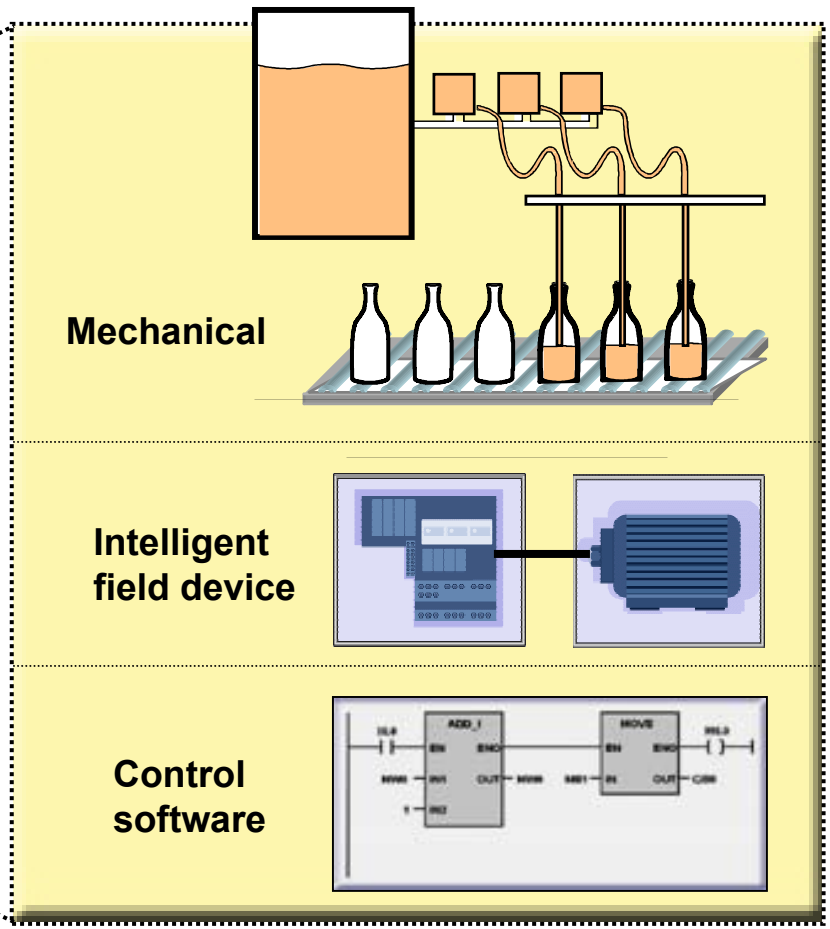

- **Use of devices**
  - on PROFINET
  - on PROFIBUS

# The Technological Module



- **The combination of:**
  - Mechanical
  - electrical and
  - control program

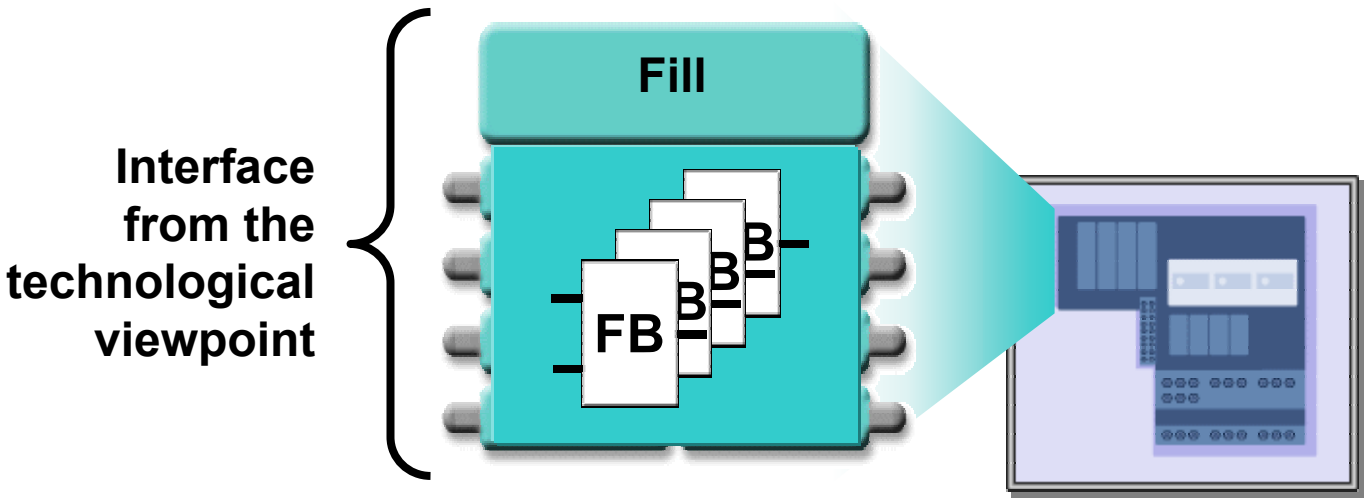


# The PROFINET Component



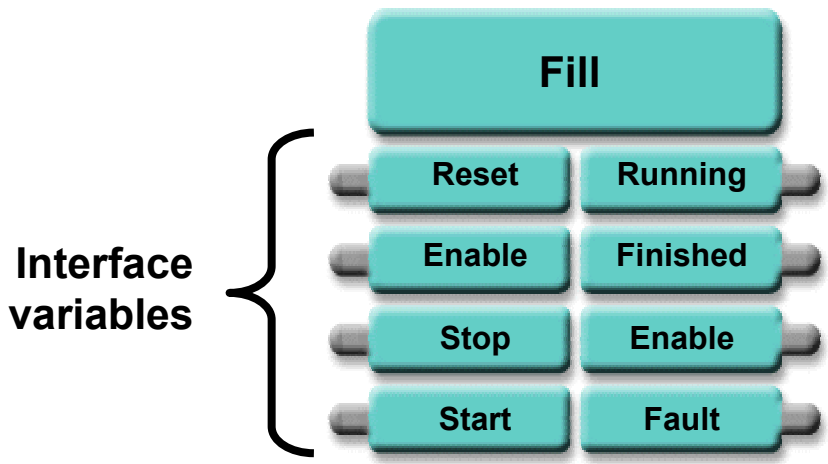
- **The PROFINET components represent the technological module**
  - Encapsulation of automation functionality (application programs) in a software component
  - The PROFINET components possess an interface from the technological viewpoint



# The Component Interface



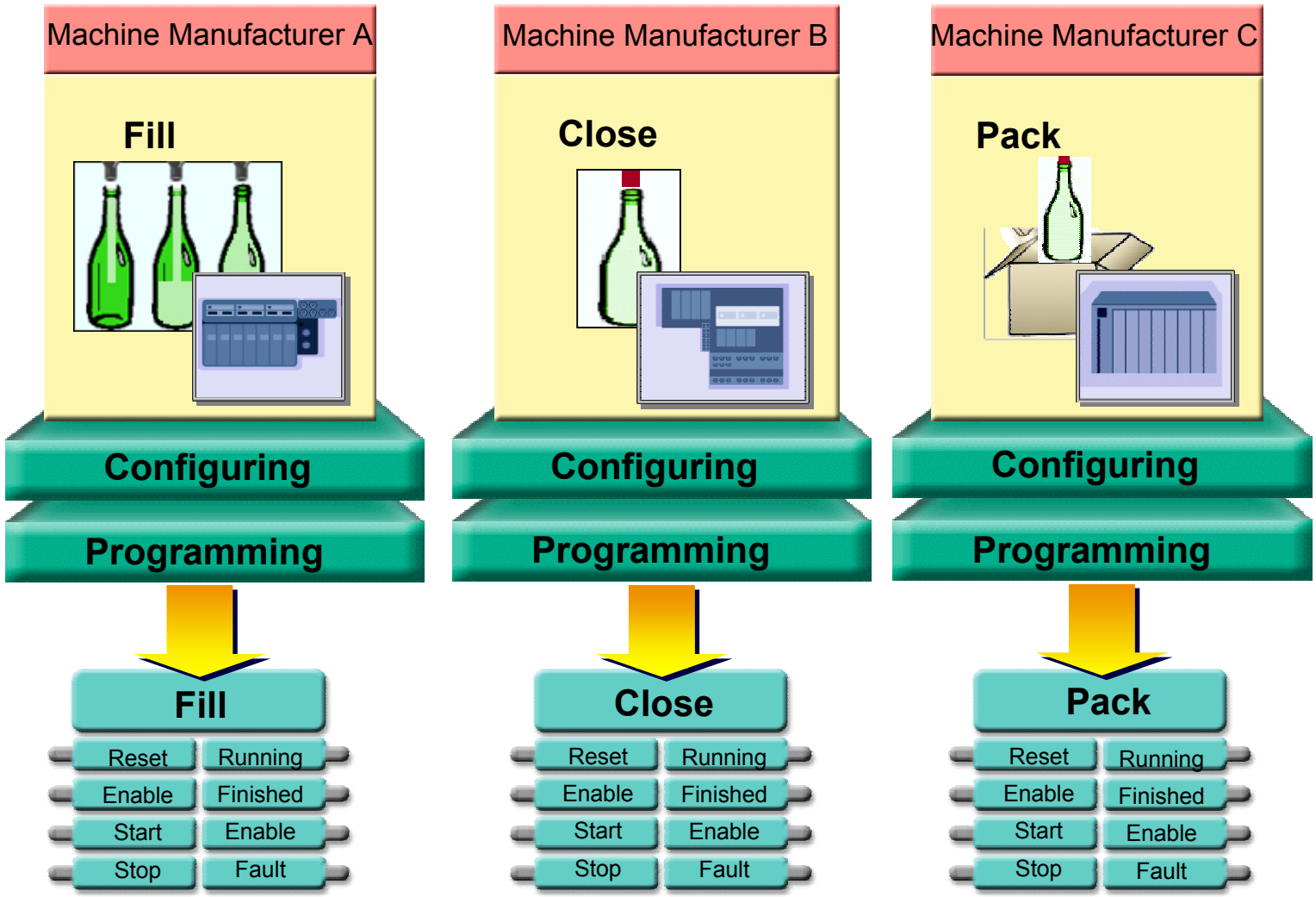
- **The machine vendor defines the interface variables**
- **Only those variables are available externally for which data exchange is required**
  - between the technological modules
  - for visualization, diagnostics, ...
- **Access to the interfaces is standardized in PROFINET**



# PROFINET Component Generation

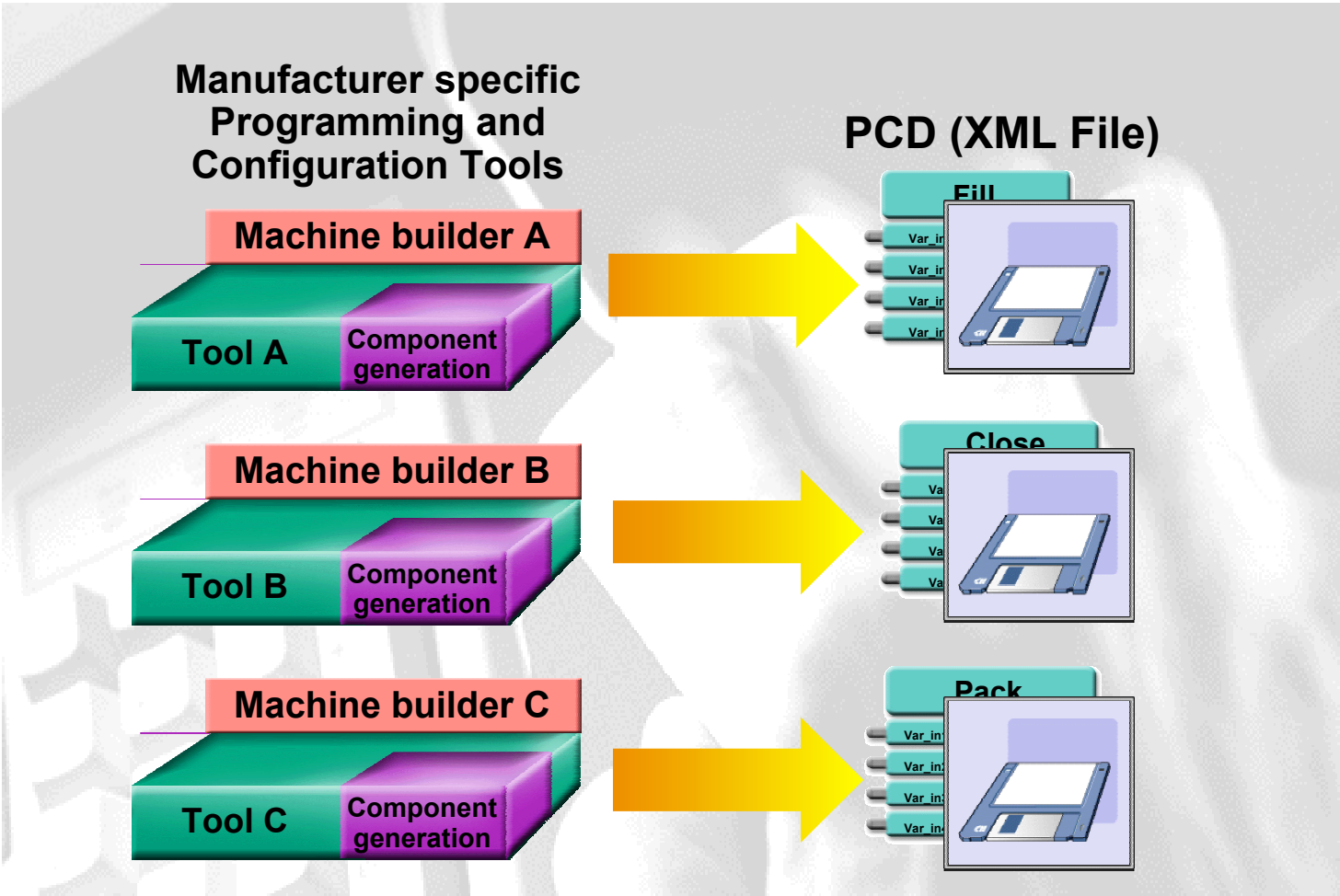
**PROFINET CBA – Distributed Automation**

- Functional Scope
- Component Technology
- PCD
- Engineering
- Runtime
- Diagnostics
- Fieldbus Applications
- Software



# PROFINET Component Description (PCD)





# PROFINET Component Description (PCD)

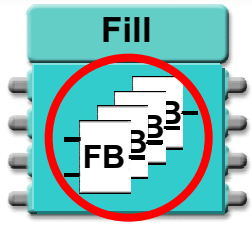


- **The PCD is an XML file which describes the functions and objects of a PROFINET component**

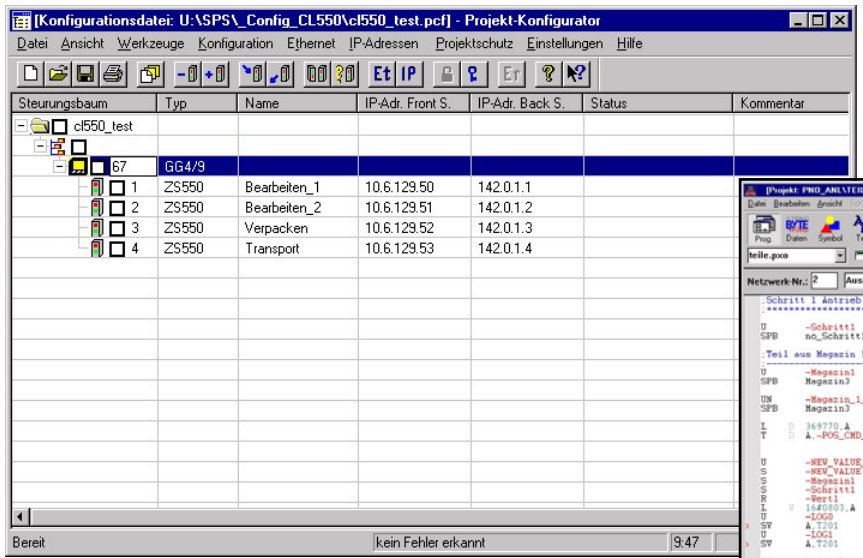
  - **Description of library element**
    - **Component ID**
    - **Component name (e.g. Fill)**
  - **Description of hardware**
    - **Type**
    - **Name**
    - **Manufacturer**
  - **Description of software functionality**
    - **Assignment between software and hardware**
    - **Component interface**
    - **Properties of variables (1..n)**
      - **Name (e.g. Start)**
      - **Data type (e.g. Boolean)**
      - **Direction (e.g. input)**
  - **Storage location of component project**

# Creation of a Component - Step 1

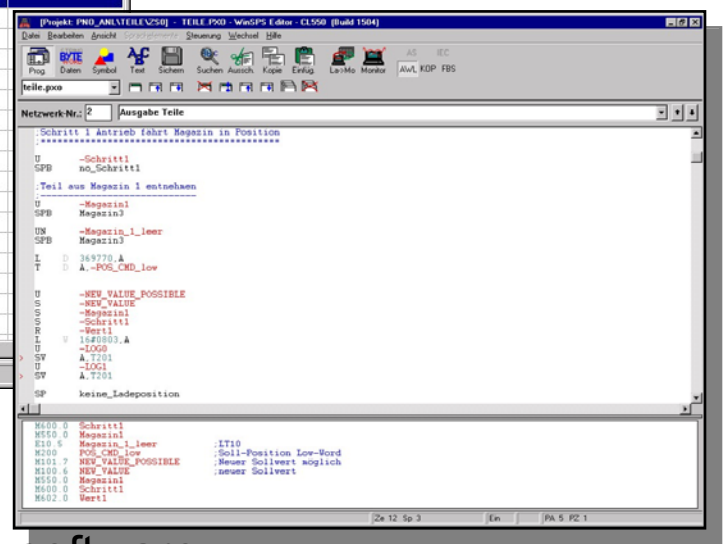





- **Configure and parameterize devices**
  - Use vendor-specific configuring software



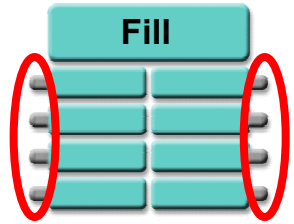

**Example: Bosch**



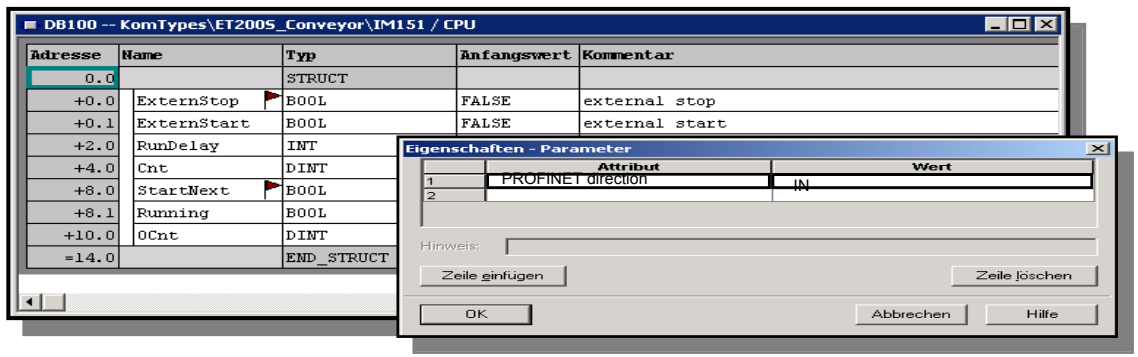
- **Program function**
  - Use existing programming software
  - Utilize existing application software
  - Apply existing know-how

# Creation of a Component - Step 2





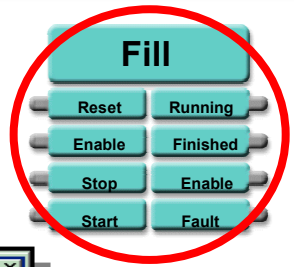

- **Define component interface**
  - Define interface variables
    - Name (e.g. Enable)
    - Type (Boolean, byte, word, ...)
    - PROFINET direction: IN or OUT
    - Comment



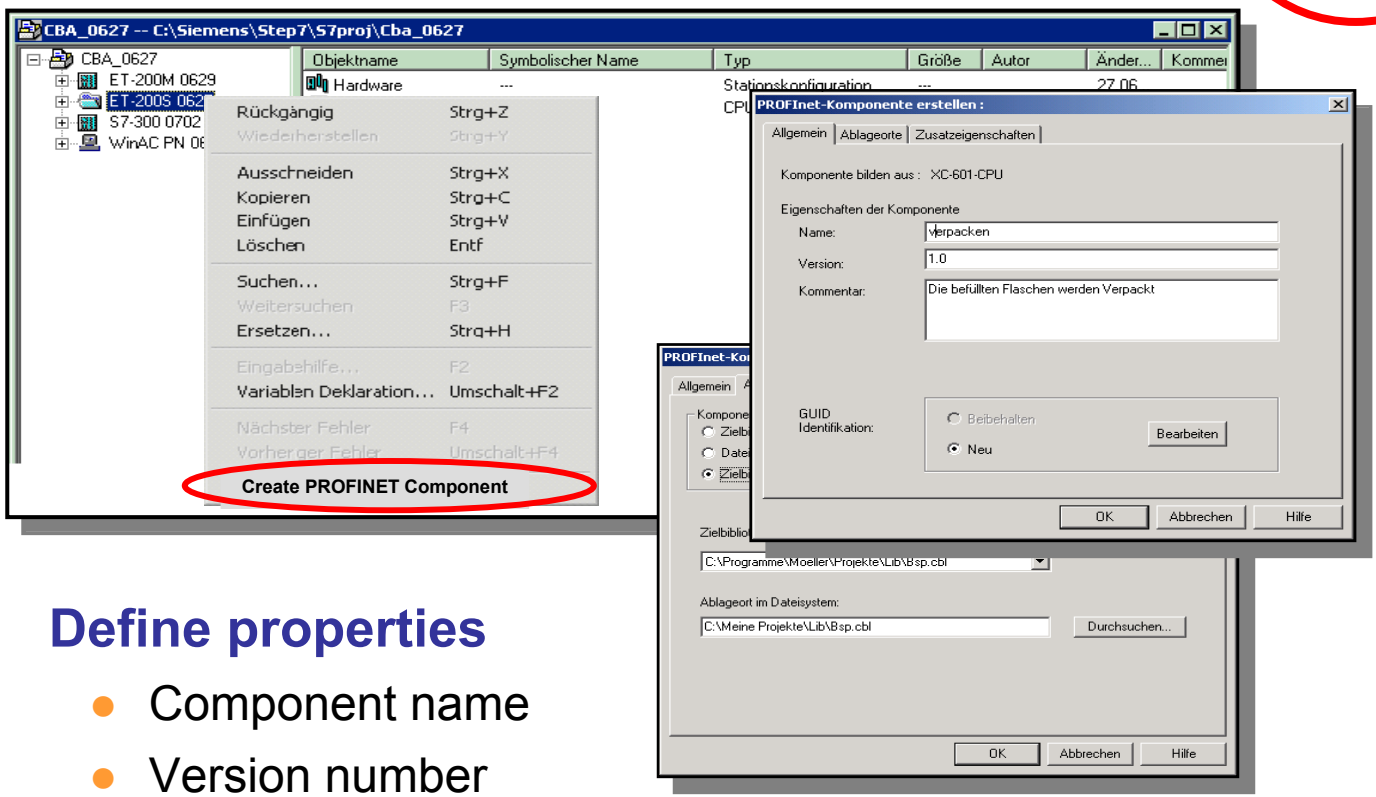

**Example: Siemens (interface data block)**

# Creation of a Component - Step 3






- **Generate PROFINET Component**




**Example: Siemens (STEP7)**

- **Define properties**
  - Component name
  - Version number
  - Storage location

# Plant-Wide Engineering

**PROFINET CBA – Distributed Automation**

- Functional Scope
- Component Technology
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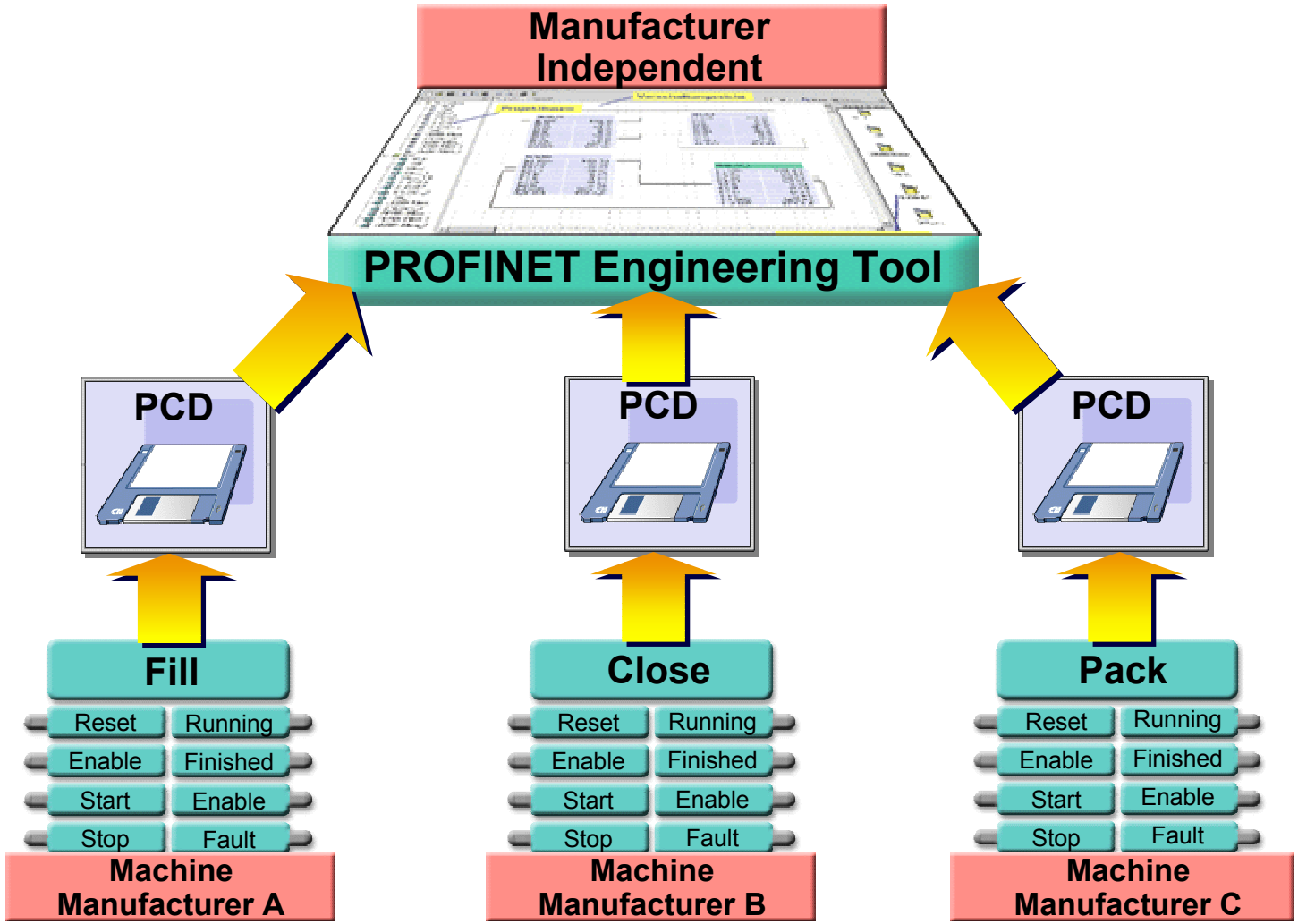
- Engineering
- Runtime
- Diagnostics
- Fieldbus Applications
- Software



# Graphical Configuration

**PROFINET CBA – Distributed Automation**

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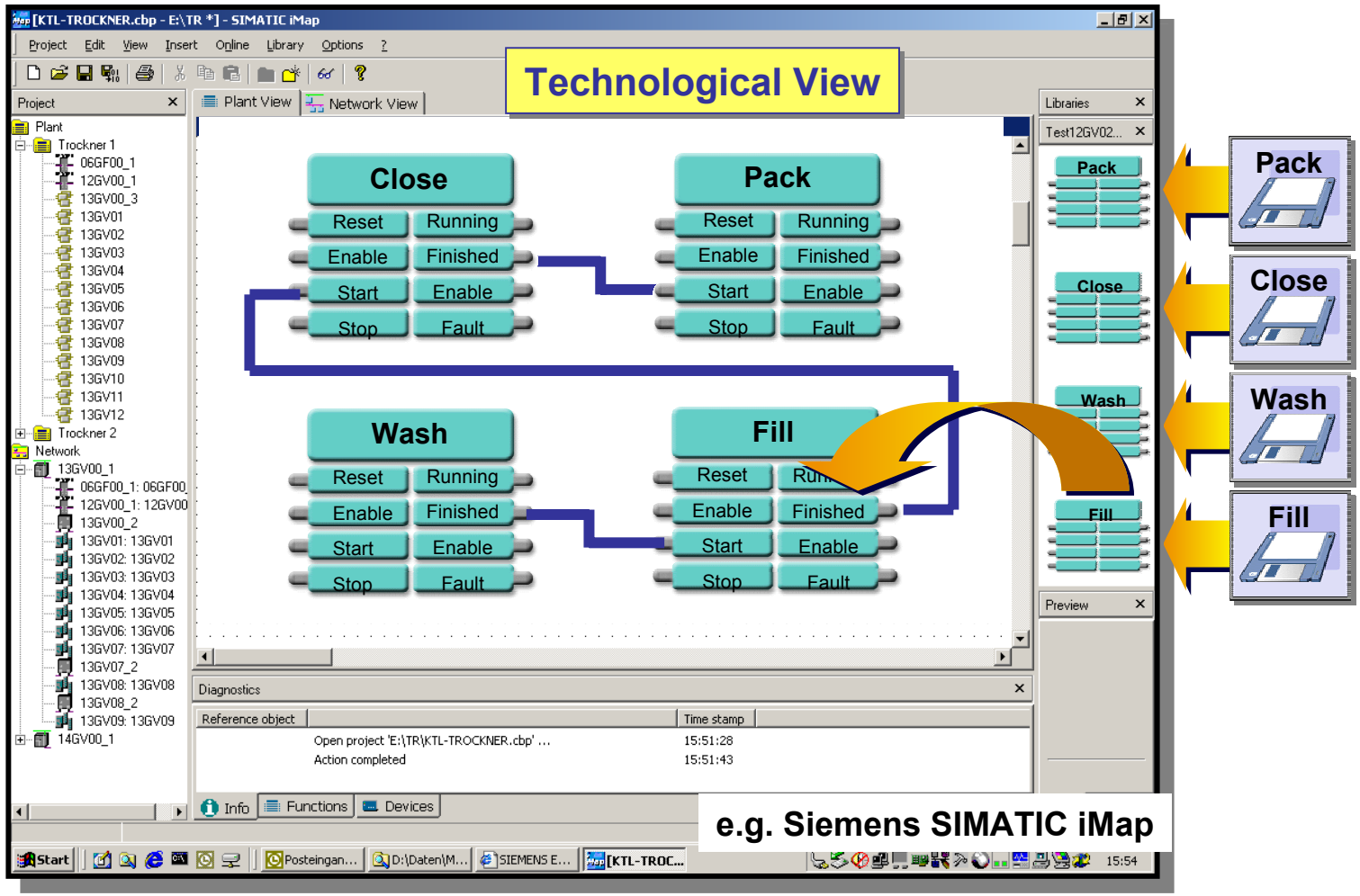

# Assign Devices to the Network

**PROFINET CBA – Distributed Automation**

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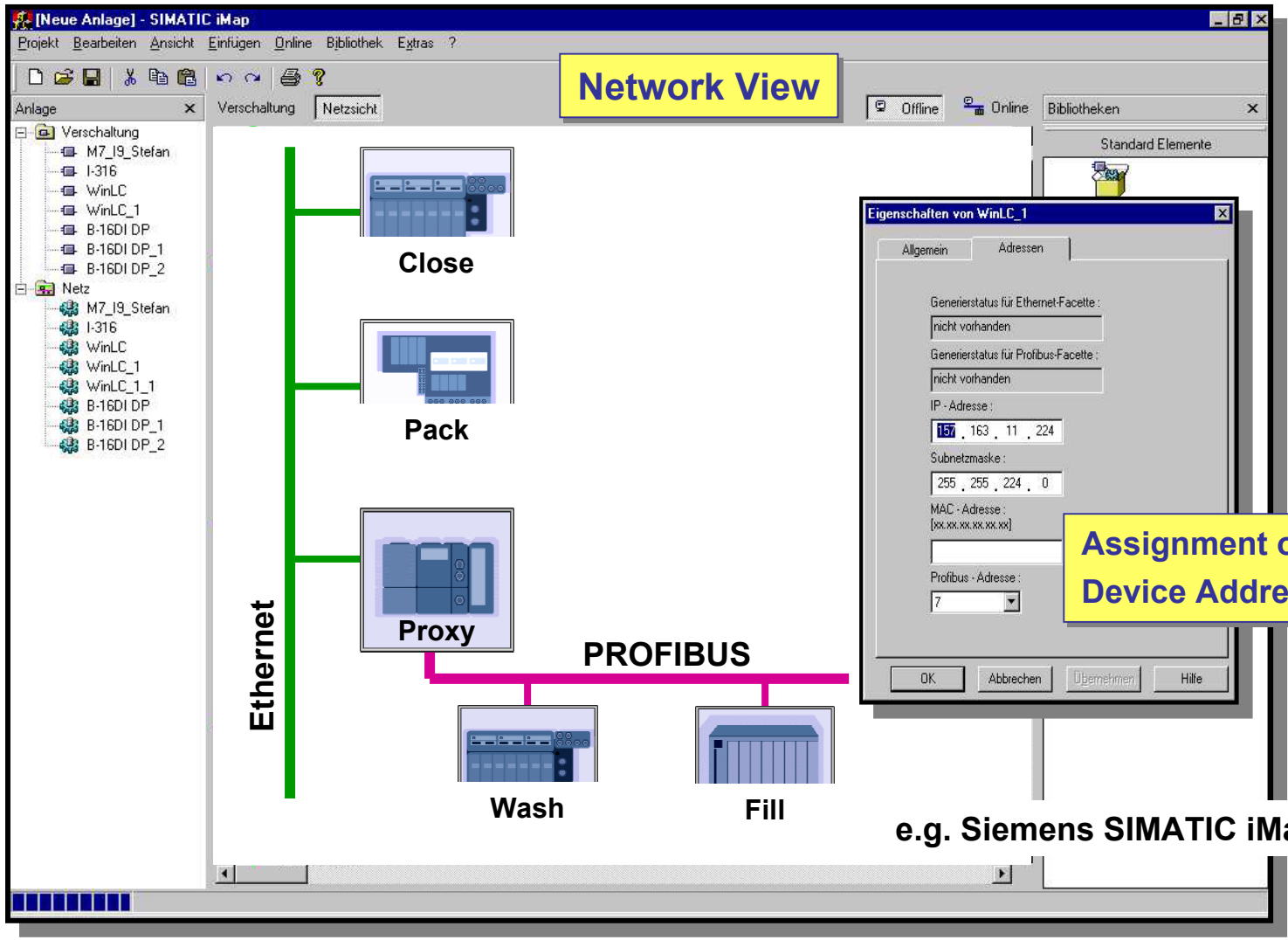


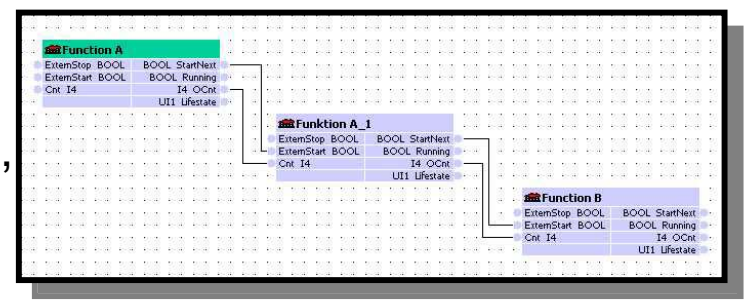
# Configuring of Communication



- **Previously: programming**
  - Detailed knowledge required of connection and sequence of communications functions in the device
  - The devices to communicate with one another must already be defined when programming

```
CALL  "AG_RECV"                  //AG_RECV Bausteinaufruf
 ID    :=1                       //Verdinguns ID
 LADDR :=W#16#200                //Baugruppen Adresse 512 DEZ in Hardware Konfiguration
 RECV  :=P#DB31.DBX 1.0 BYTE 20  //Datenbereich für Empfangsdaten
 NDR   :=M1.0                    //Rückgabeparameter NDR zeigt an ob neue Daten empfangen wurden
 ERROR :=M1.1                    //Rückgabeparameter ERROR
 STATUS:=MW202                   //Rückgabeparameter STATUS gibt den Übertragungsstatus an
 LEN   :=MW10                    //Rückgabeparameter LEN gibt an wie viele Daten empfangen wurden
```

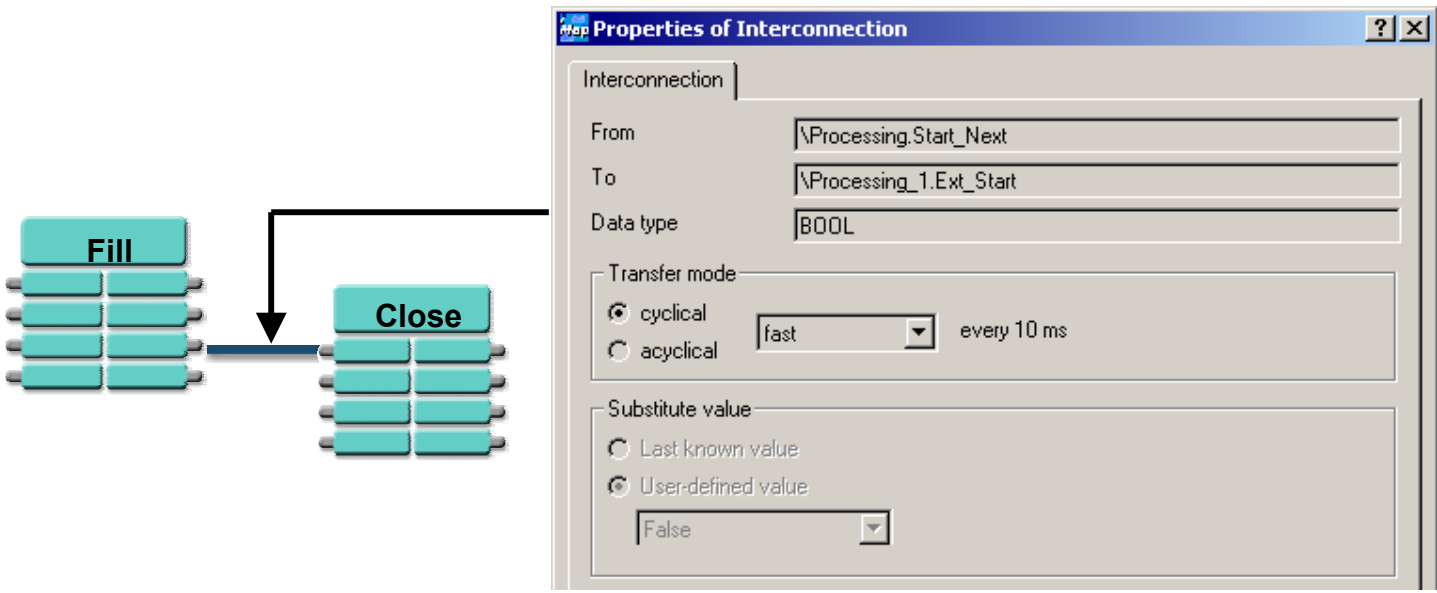
- **With PROFINET: configuring**
  - No knowledge of communications required
  - Configured communications, no programming necessary



# Quality of Service (QoS)



- **Sampling mode of a variable available at the component interface**
  - Cyclic
  - Upon change in value
- **Adjustable in the PROFINET Connection Editor**
- **Configurable for every connection**



# Coupler



**Coupling gives a generic way to bring the vendor-specific side of a component in sync with the PROFINET side**

**Many PROFINET activities on components imply corresponding activities on vendor-specific data associated with a component**

- Instantiation
- Deletion
- Code and Configuration Download
- Diagnosis
- Special Menu entries

**The coupler allows the vendor to integrate his proprietary protocol and mechanism (e.g. for download or diagnosis) seamlessly with the PROFINET connection editor.**

# PROFINET – Download and Communication

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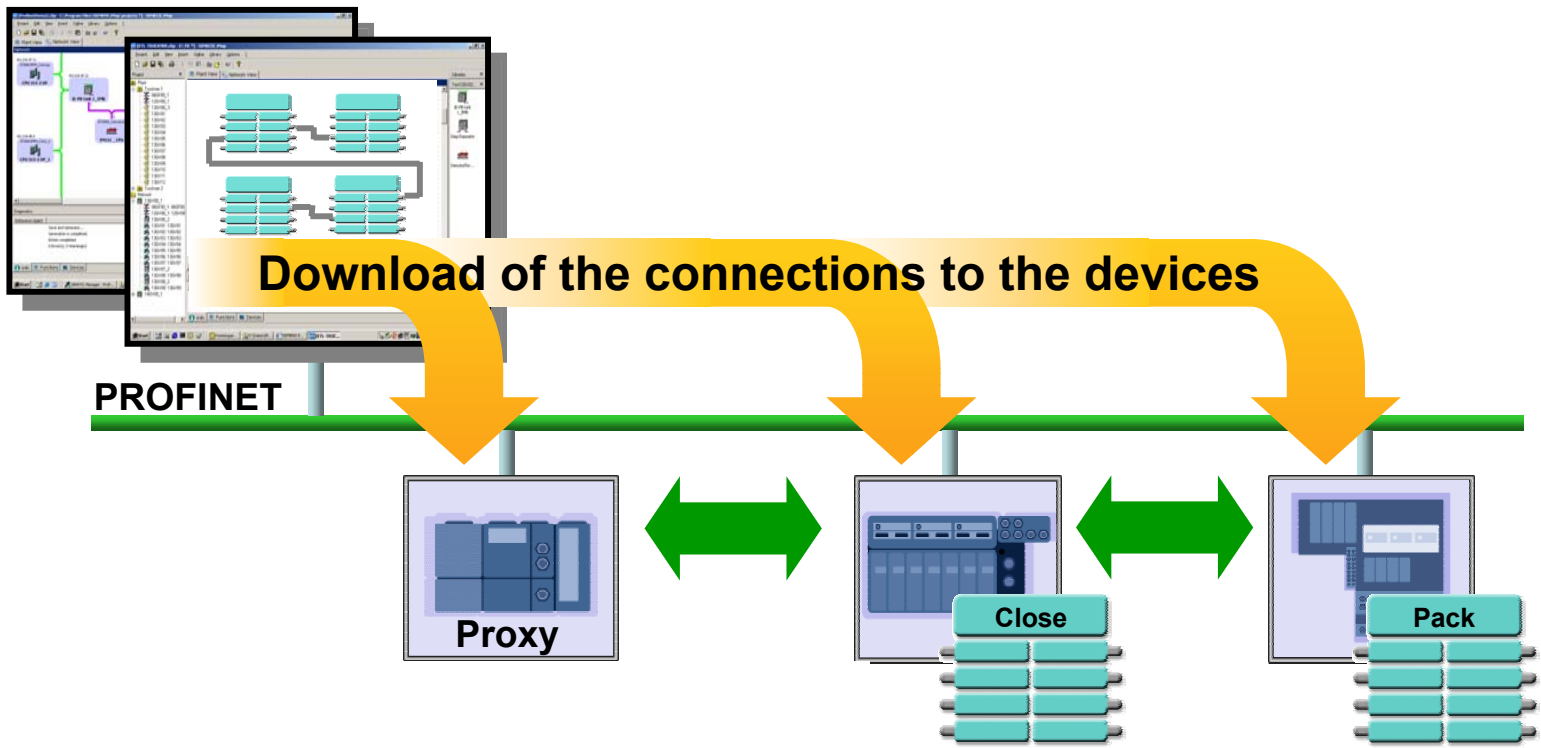
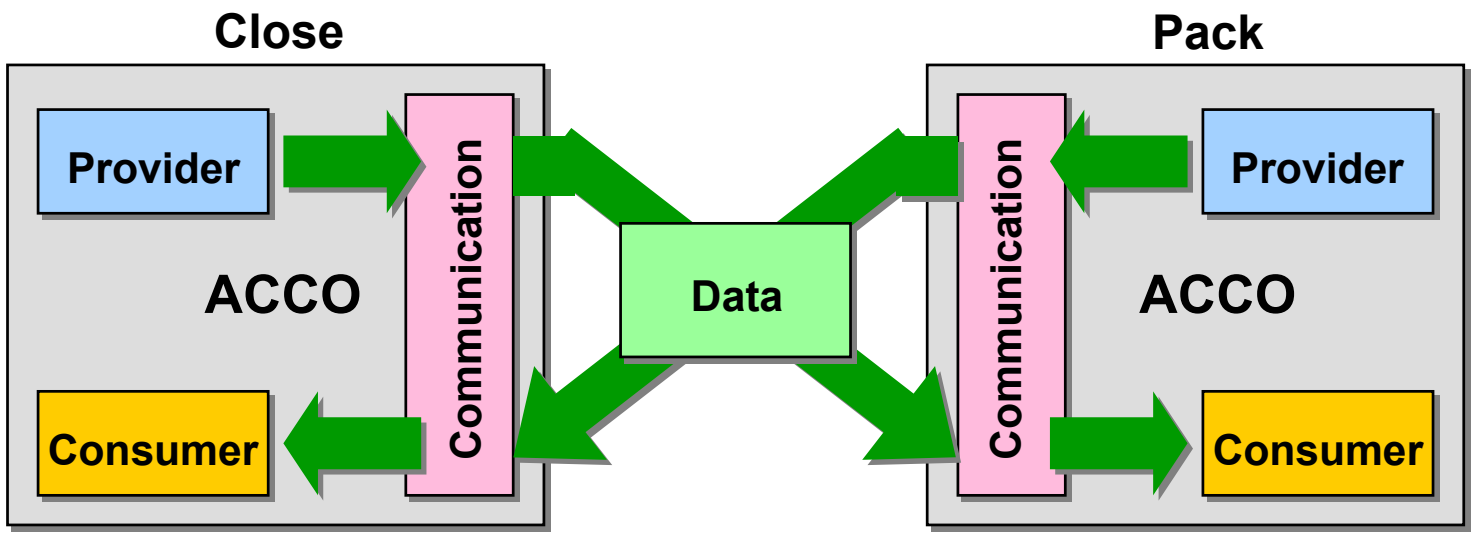



**Automatic start and control of the device communication**

# Connection Control with ACCO (Active Control Connection Object)

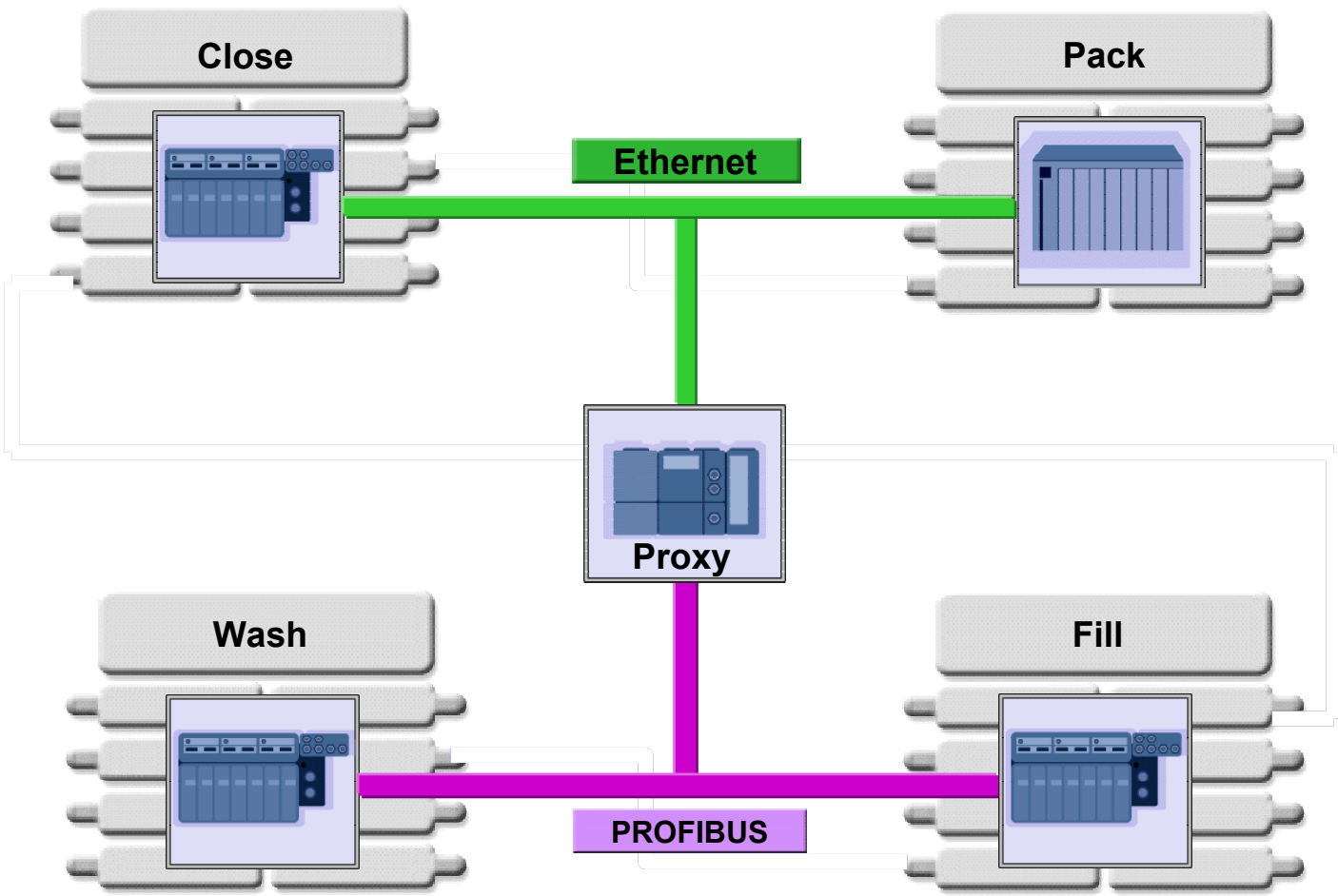


- **This is a component of the PROFINET kernel which establishes and supervises the configured interconnections between the devices**
- **The ACCO implements a consumer provider model**
  - Provider: generation and transmission of data
  - Consumer: establishment of connection to provider, and receipt of data



# The Relationship between Connection and Communication



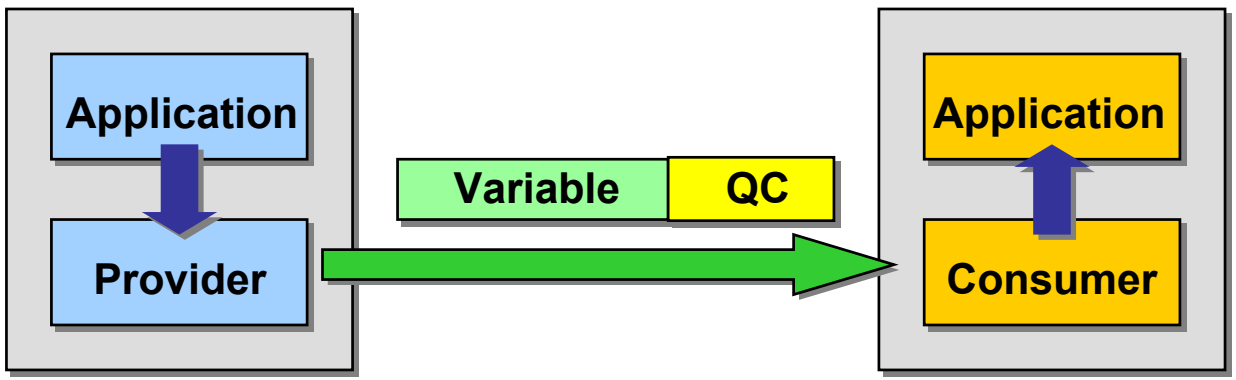


# The quality code (QC)



## The quality code is additional information which describes the quality of a variable

- Provider is provided with QC from the application
- Consumer provides QC for the application
- QC according to definition of PROFIBUS PA and OPC



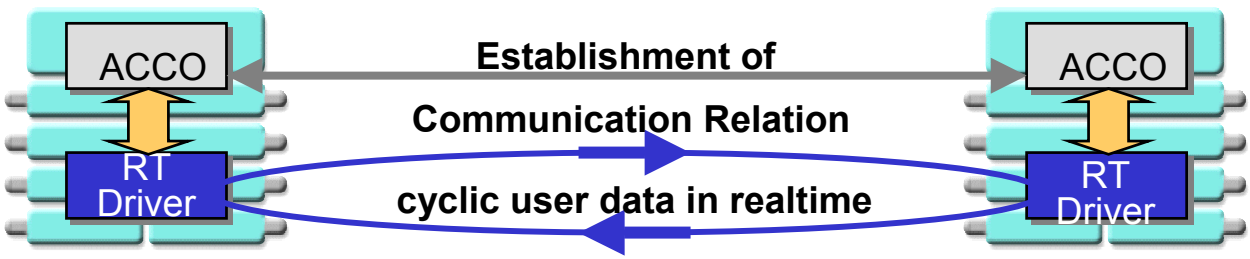

## Samples of quality codes

| | |
|---|---|
| **80** | The value is good |
| **00** | The value is bad |
| **4C** | The value is an initial value |
| **44** | Last valid value is retained |

# Real-Time Data Transmission between two Components



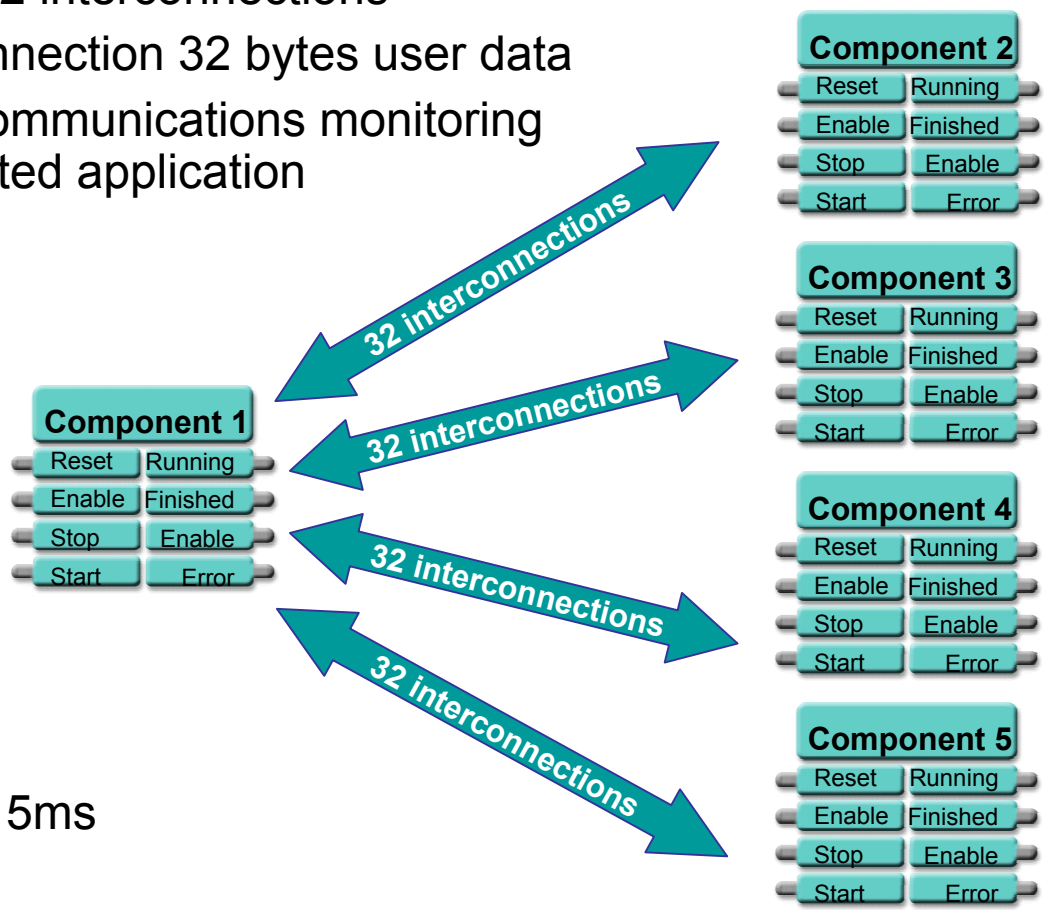
- The Communication relationships between the devices is established over TCP/IP
- Subsequently, process data are transmitted cyclically between devices via the real-time channel



# Performance values



- **Sample Configuration**
  - 4 communication partners
  - each with 32 interconnections
  - per interconnection 32 bytes user data
  - including communications monitoring and integrated application

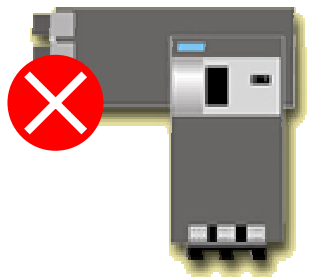



➔ Refresh rate ≤ 5ms

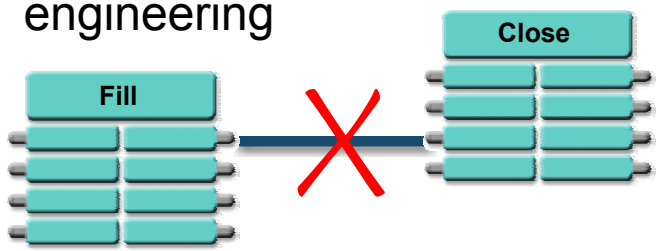
# Online Diagnosis



- **Device diagnosis**
  - Overview diagnosis of components in the PROFINET Connection Editor
    - Current status of device
    - OK, faulty, device not accessible
  - Detailed diagnosis of components using vendor-specific diagnosis tool
    - Slot, channel number, fault text (e.g. short-circuit)
  - Call of the device diagnosis in the PROFINET Connection Editor



- **Connection diagnosis**
  - Status of link in the PROFINET engineering
    - OK, faulty, interrupted



# Online Diagnosis within the Engineering

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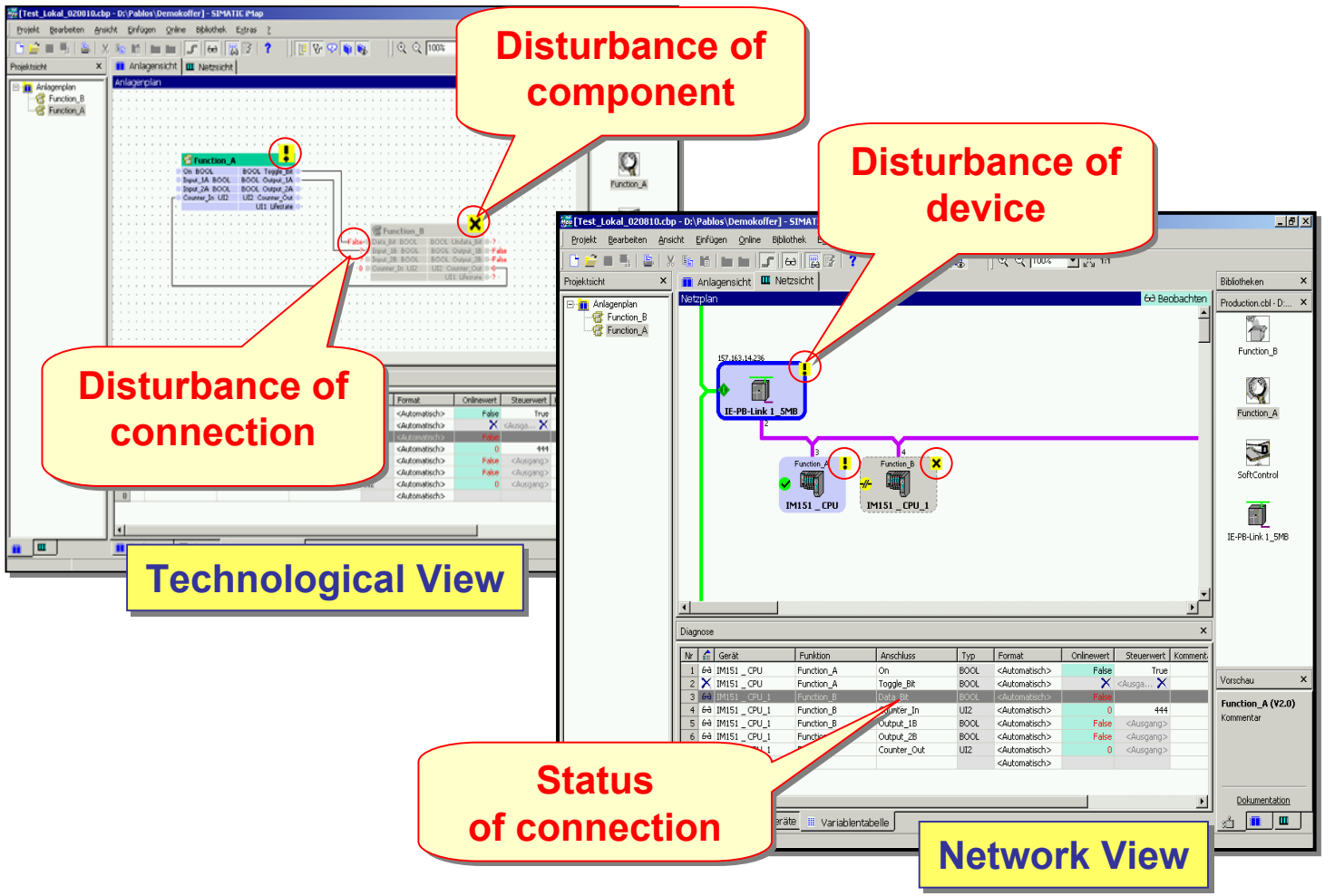

# PROFINET as Modular Technology

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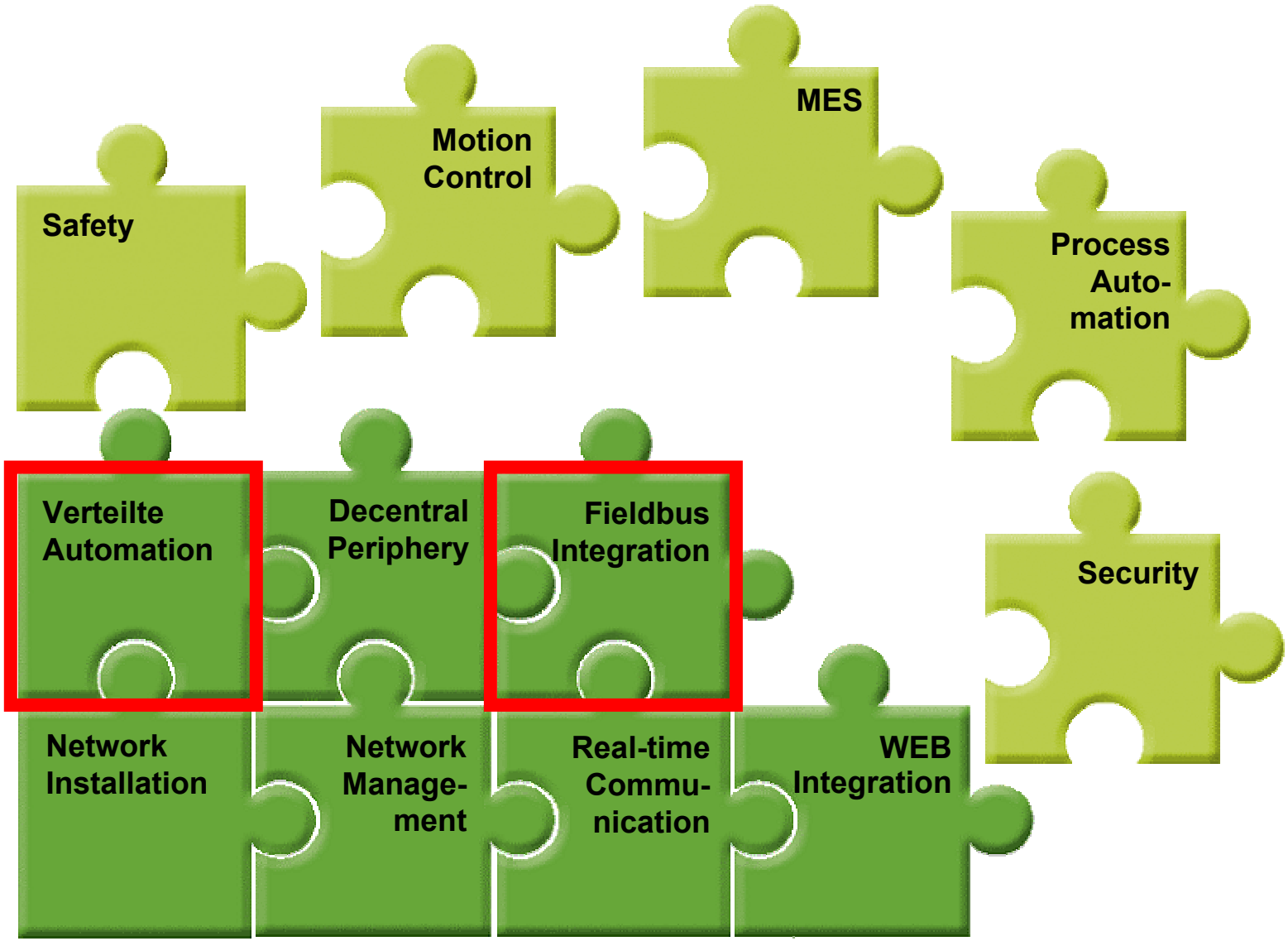

# Communication over PROFINET

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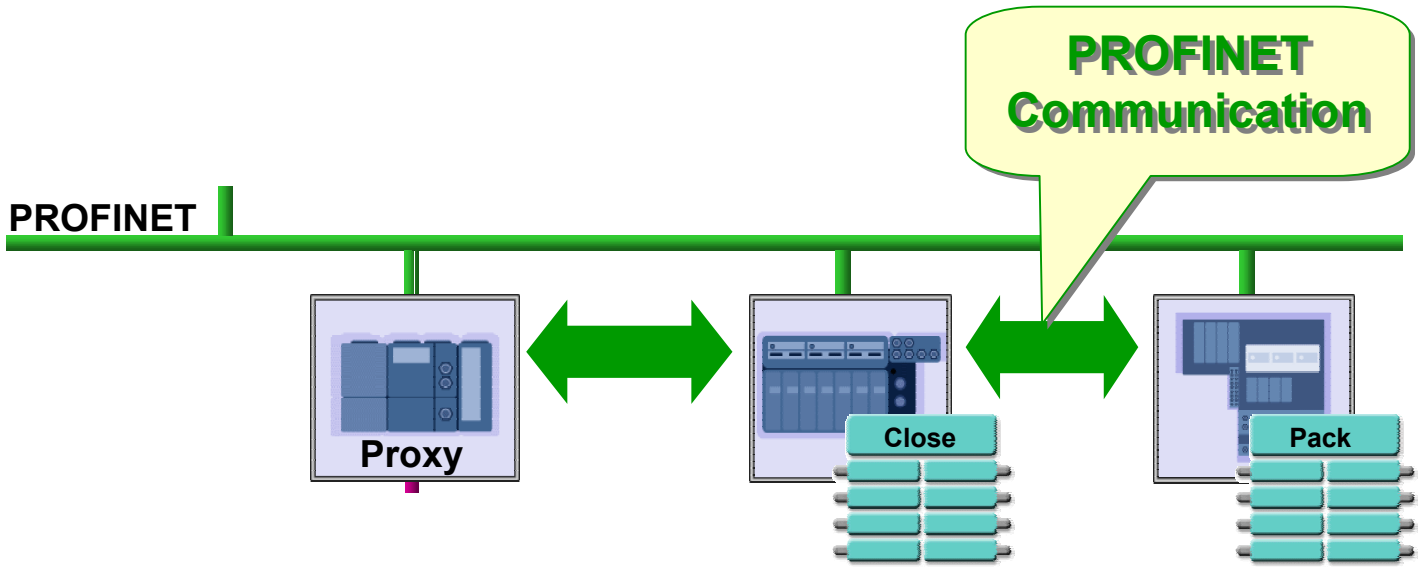

# Communication on PROFIBUS

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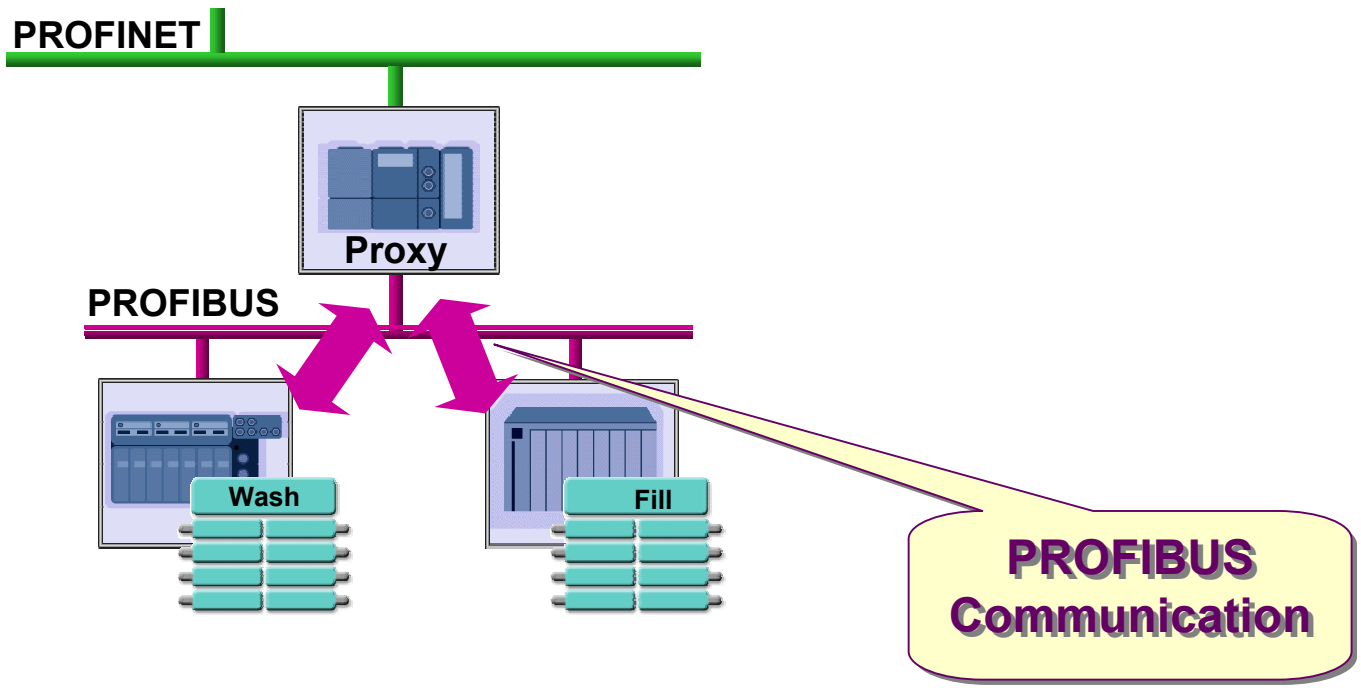
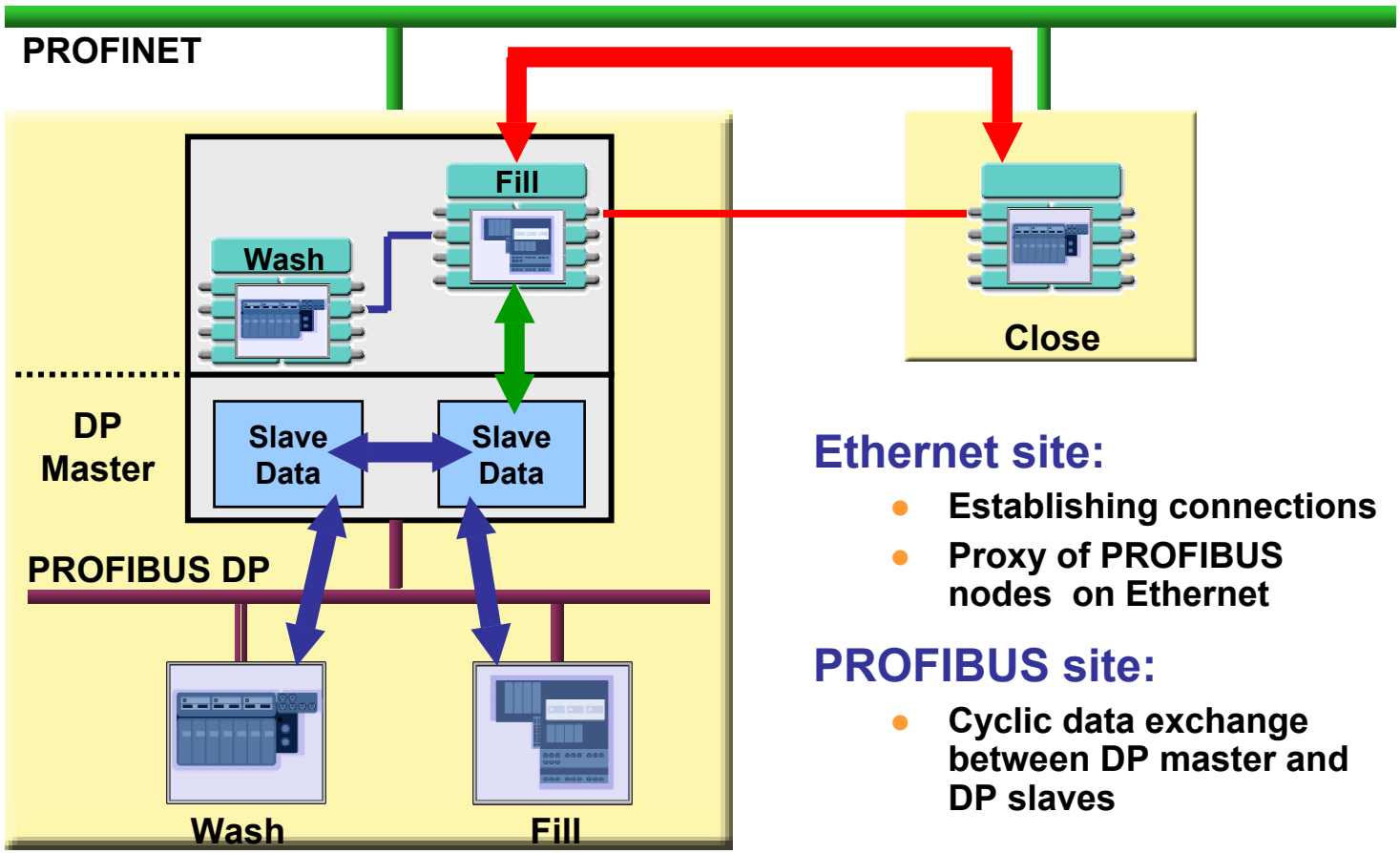
- Engineering
- Runtime
- Diagnostics
- Fieldbus Applications
- Software



# The Function of Proxy



## The Proxy represents the PROFIBUS devices on Ethernet




### Ethernet site:

- Establishing connections
- Proxy of PROFIBUS nodes on Ethernet

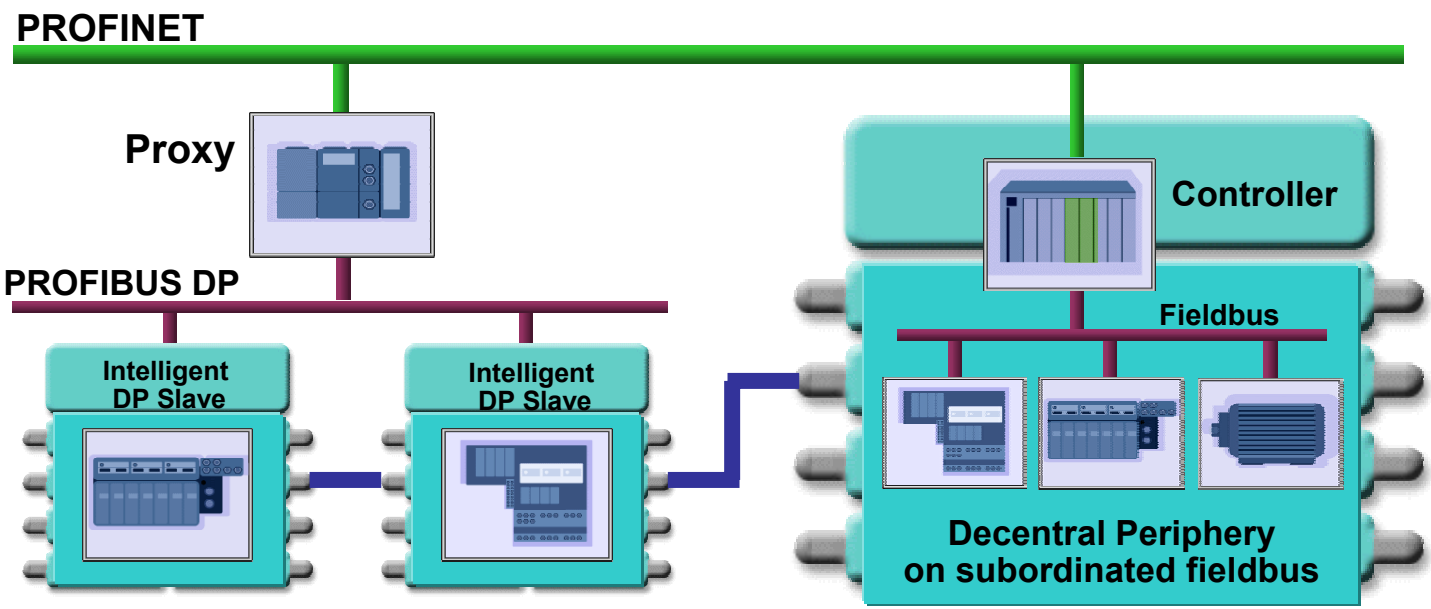
### PROFIBUS site:

- Cyclic data exchange between DP master and DP slaves

# PROFIBUS into PROFINET applications

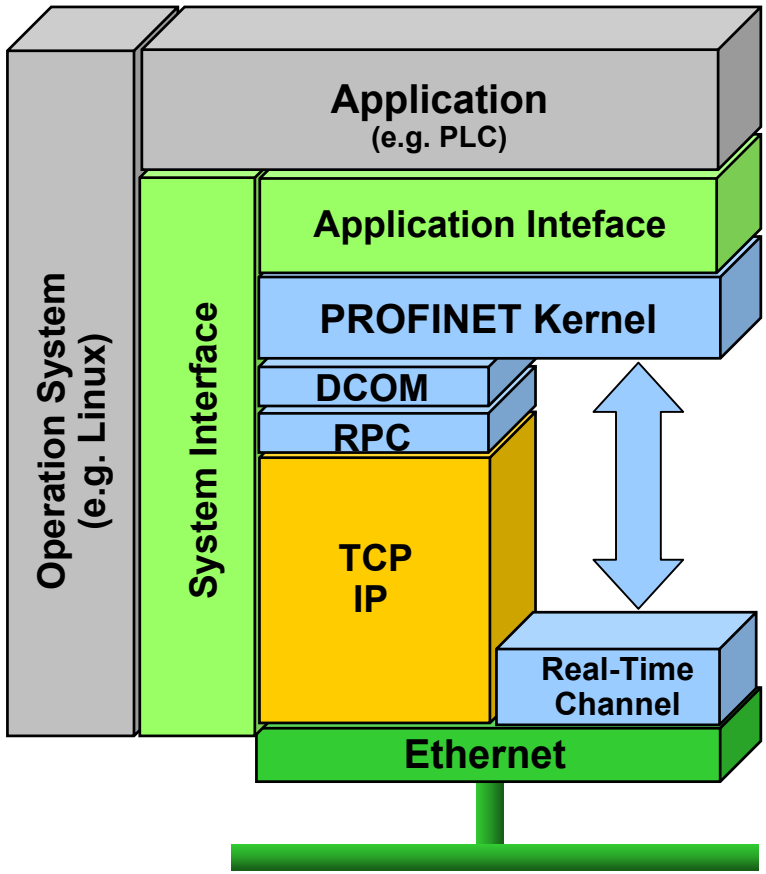


- **Every PROFIBUS device is an autonomous component**
  - ➔ PROFIBUS devices are integrated using a proxy
- **The existing PROFIBUS application is a component**
  - ➔ Controller as PROFINET device with subordinated fieldbus



# PROFINET Runtime Software






**Scope of PROFINET Runtime Software as source code**

**Described in Implementation Guideline**

**Standard TCP/IP stack**

# Summary



- **PROFINET components represent the technological modules**
- **Technological modules are configured and programmed by the machine builder**
- **The machine builder provides the PROFINET Component Description (PCD) file**
- **Components of different machine builders are interconnected in a plant wide engineering tool**

**The concept for Distributed Automation with PROFINET is called:**

**PROFINET CBA**