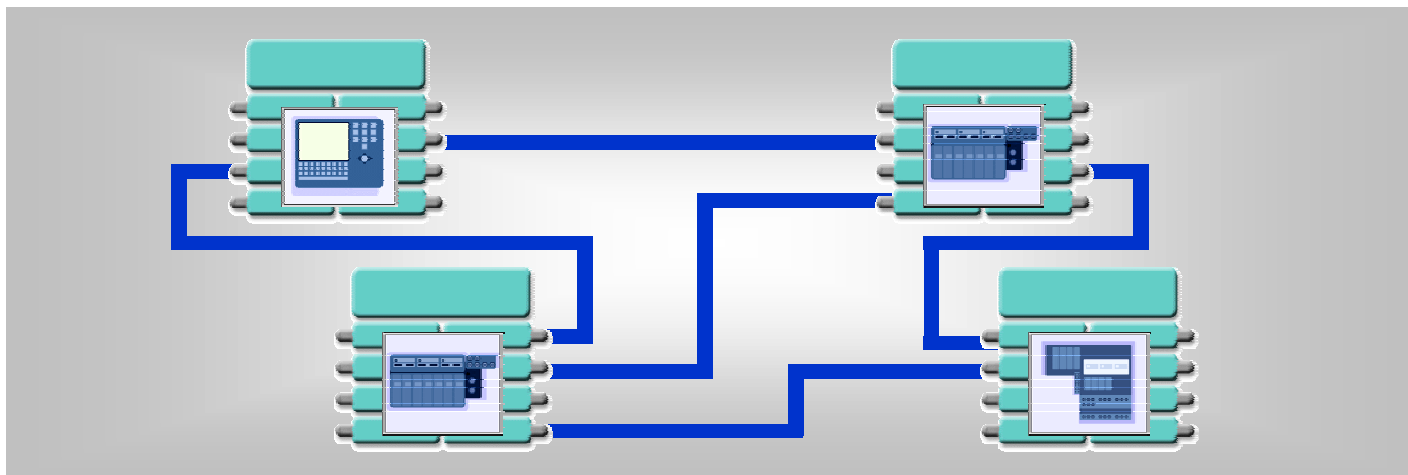


PROFINET CBA



Distributed Automation

PROFINET CBA – Distributed Automation

Functional Scope

Component
Technology

PCD

Engineering

Runtime

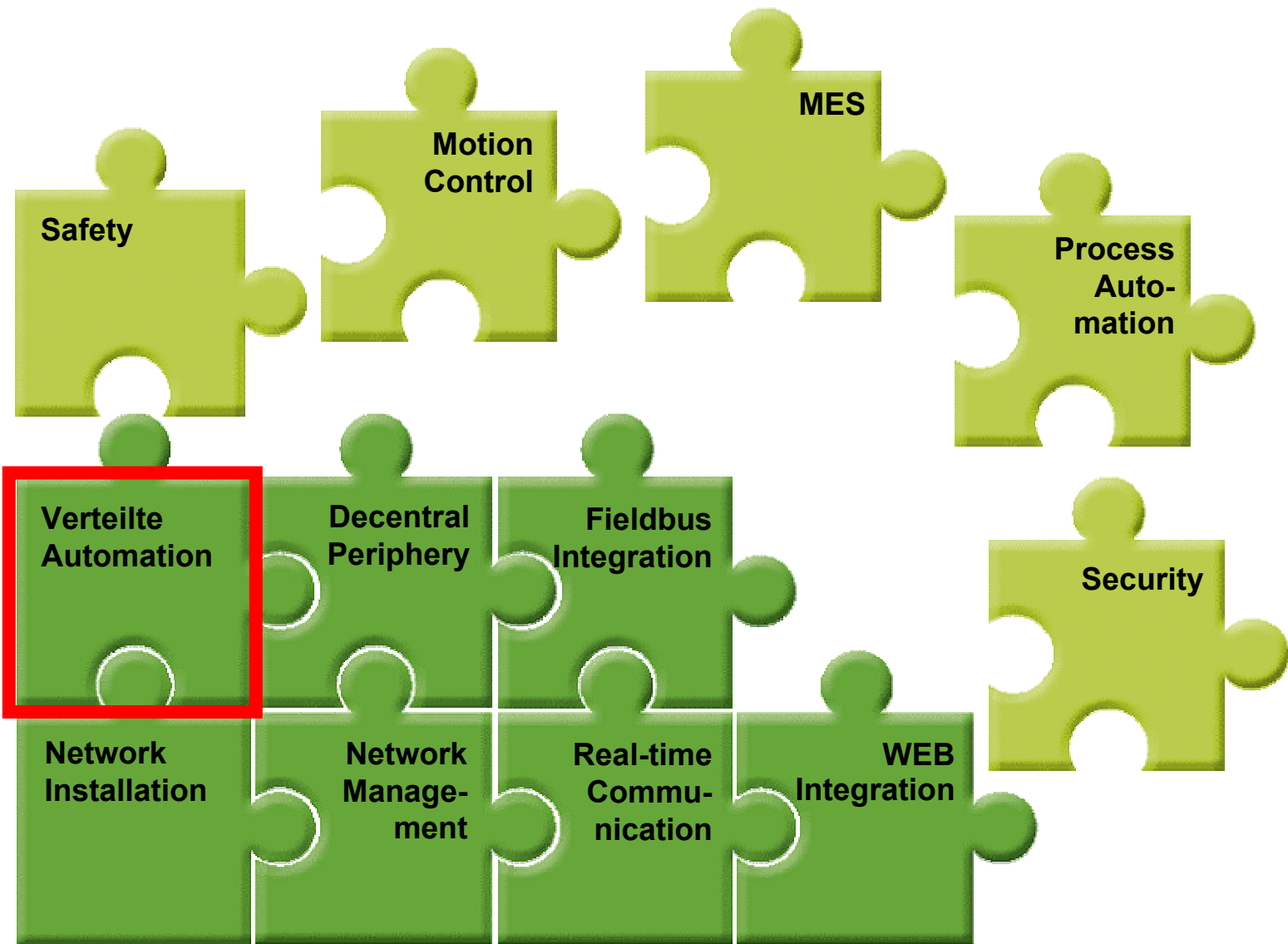
Diagnostics

Fieldbus
Applications

Software

PROFINET CBA – Distributed Automation

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



PROFINET CBA – Distributed Automation

Functional Scope

Component Technology

PCD

Engineering

Runtime

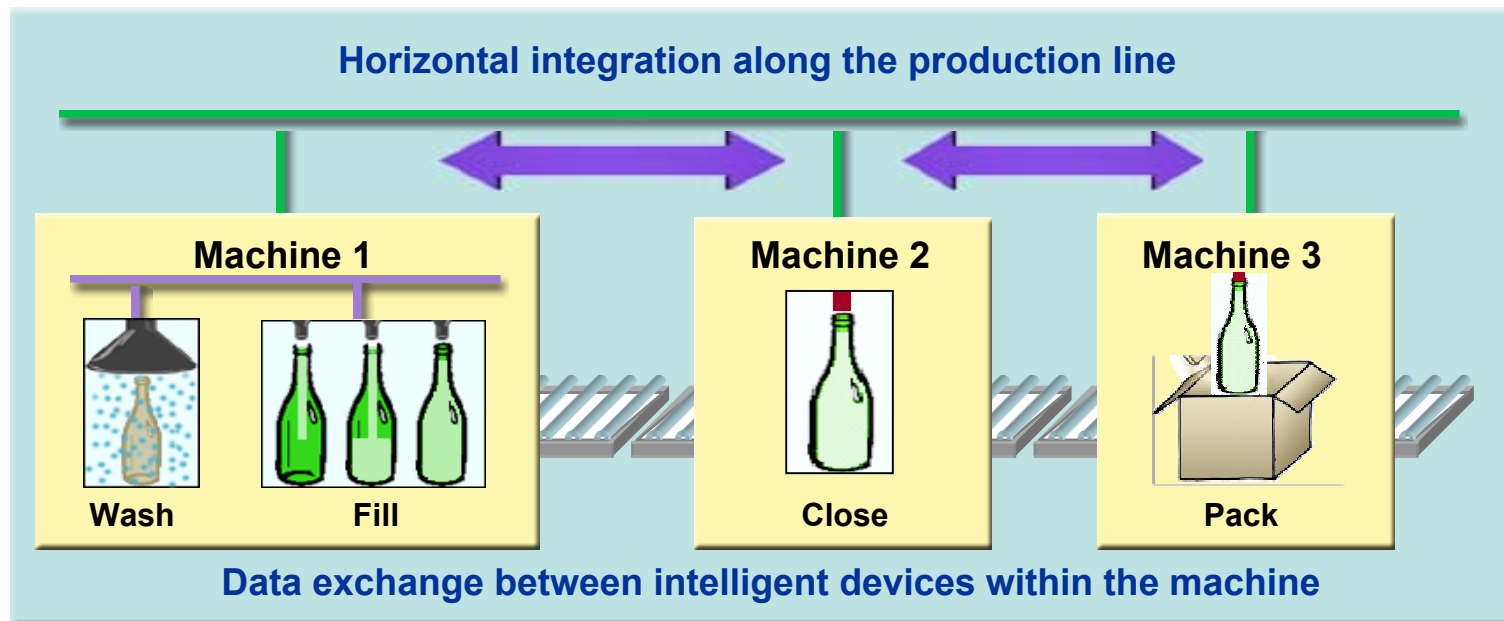
Diagnostics

Fieldbus Applications

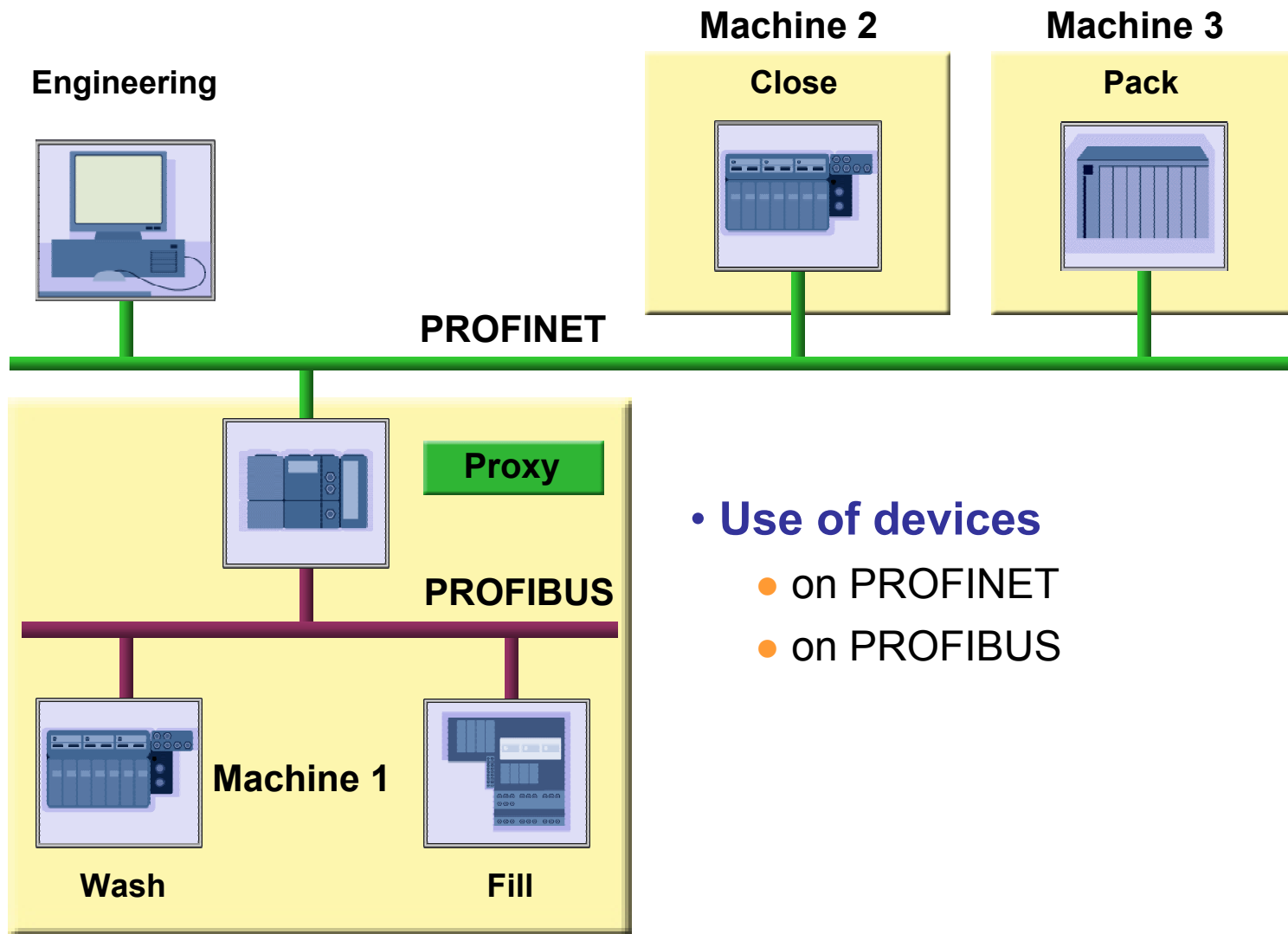
Software

• Example from the food & beverage industry:

- Wash bottles
- Fill bottles
- Close bottles
- Pack bottles



- PROFINET CBA – Distributed Automation**
- Functional Scope
 - Component Technology
 - PCD
 - Engineering
 - Runtime
 - Diagnostics
 - Fieldbus Applications
 - Software



- **Use of devices**

- on PROFINET
- on PROFIBUS

PROFINET CBA – Distributed Automation

Functional Scope

● Component Technology

PCD

Engineering

Runtime

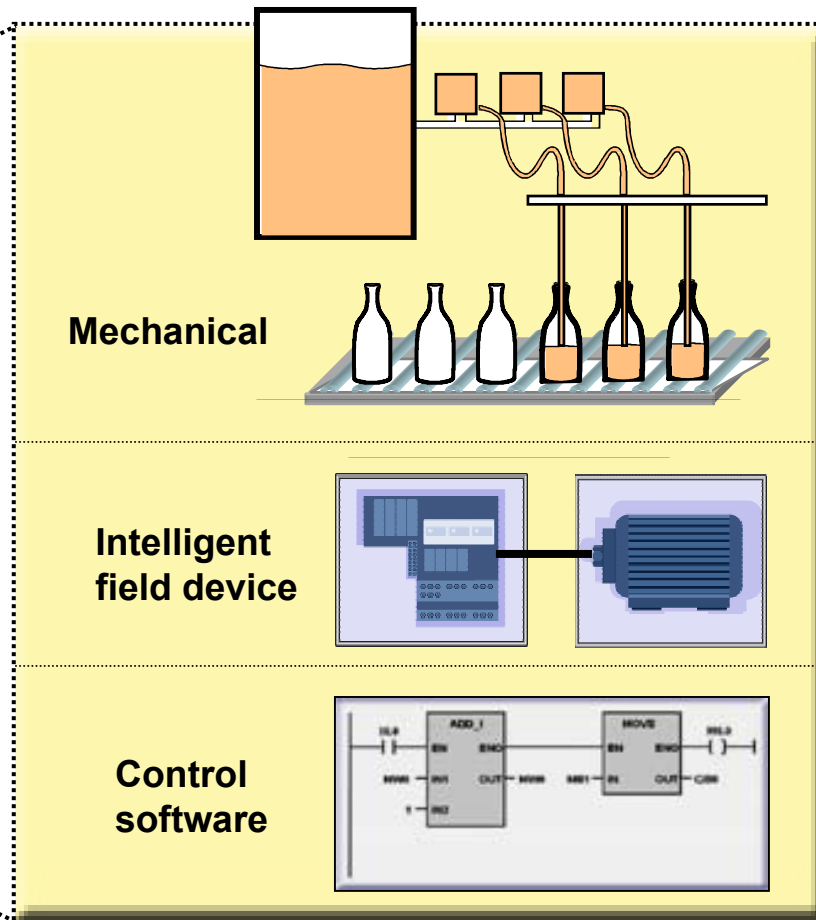
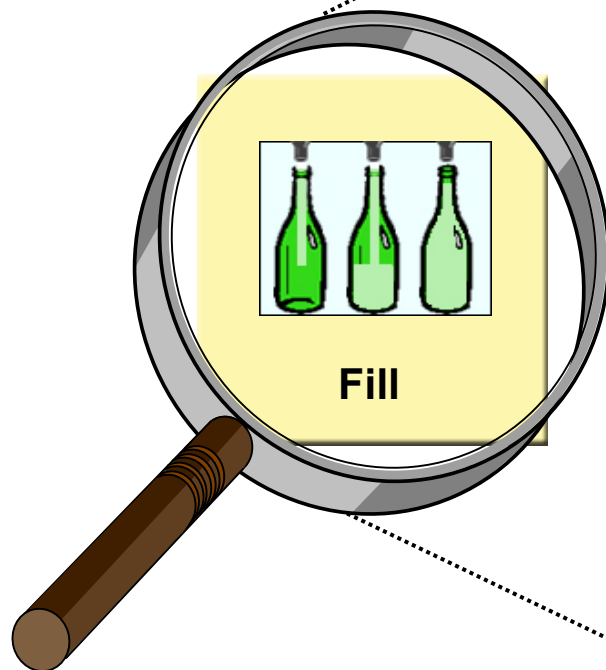
Diagnostics

Fieldbus Applications

Software

• The combination of:

- Mechanical
- electrical and
- control program



PROFINET CBA – Distributed Automation

Functional Scope

● Component
Technology

PCD

Engineering

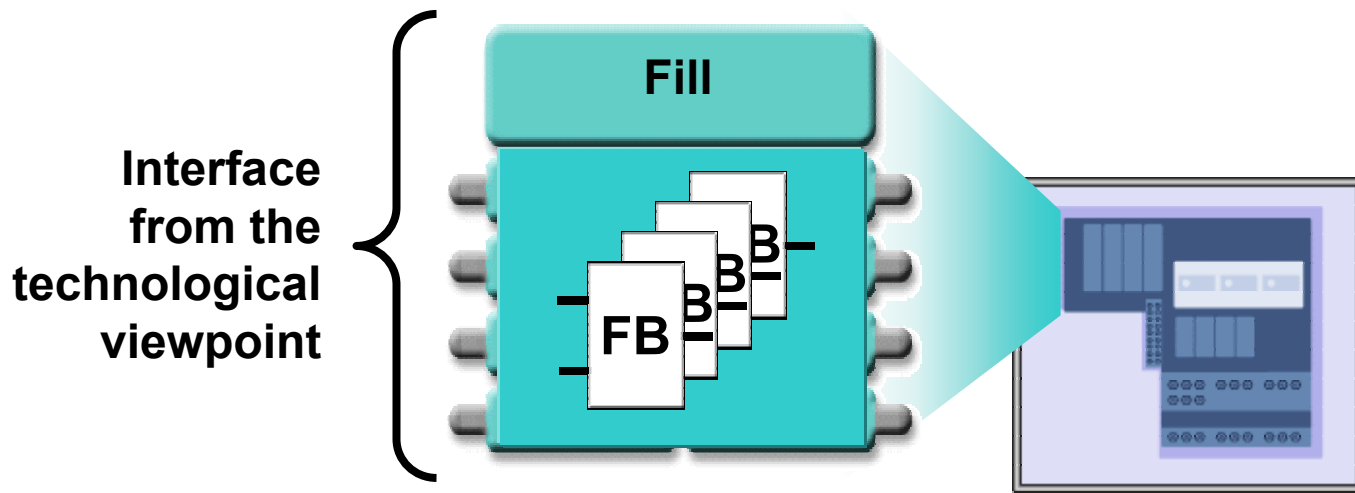
Runtime

Diagnostics

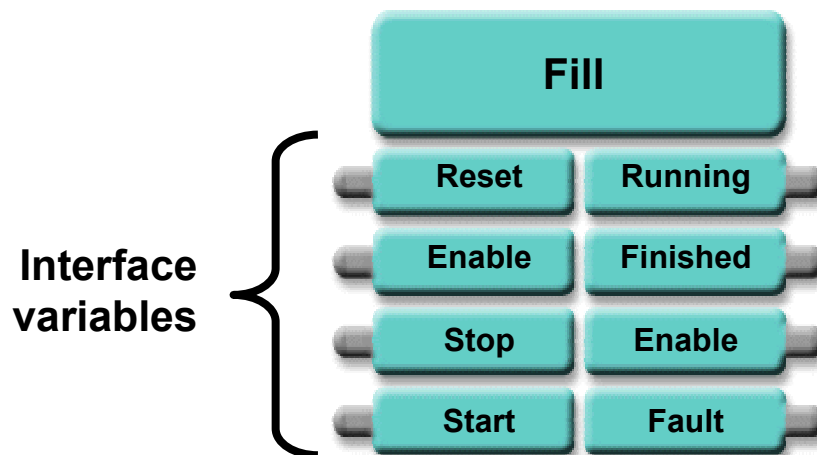
Fieldbus
Applications

Software

- 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 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 CBA – Distributed Automation

Functional Scope

Component Technology

PCD

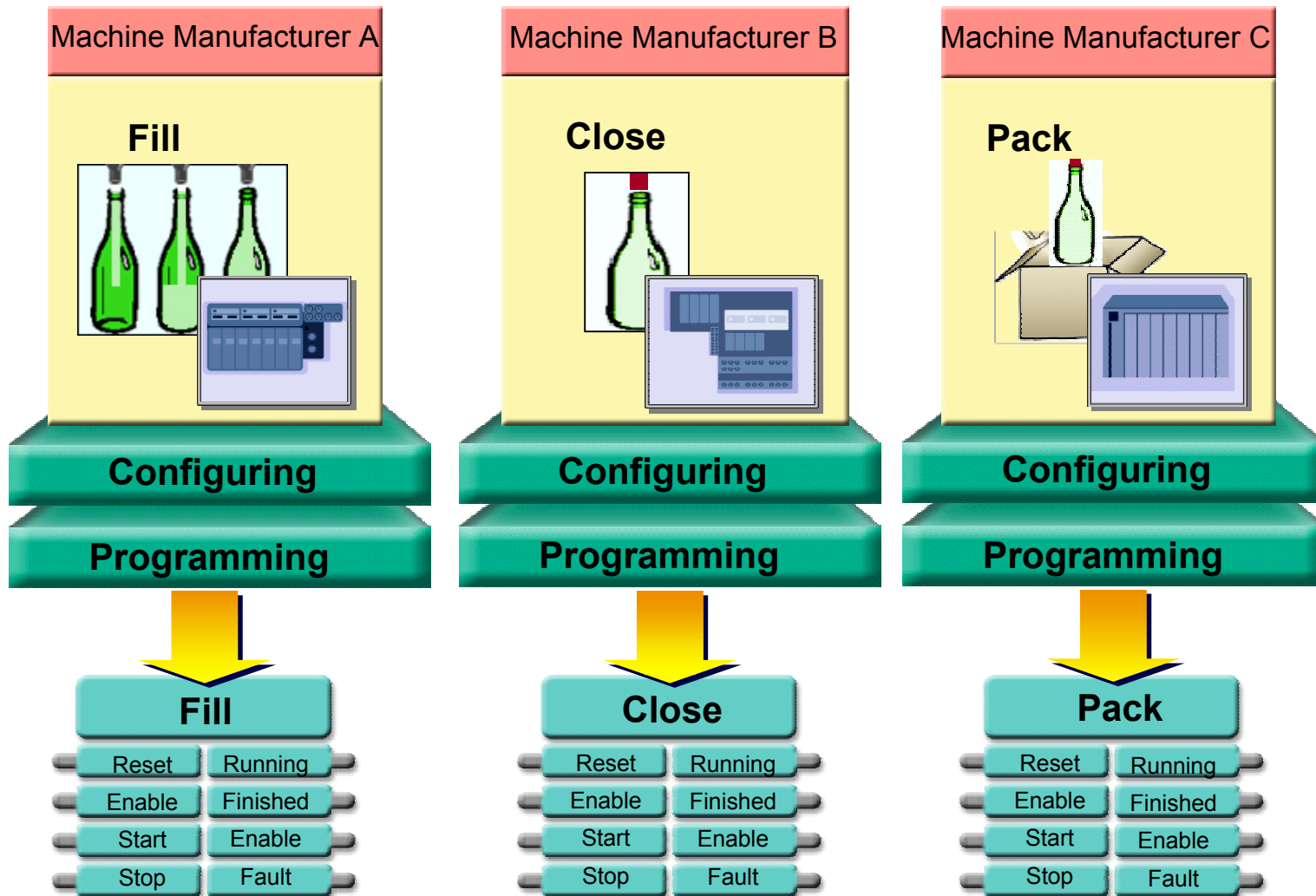
Engineering

Runtime

Diagnostics

Fieldbus Applications

Software



PROFINET CBA – Distributed Automation

Functional Scope

Component Technology

PCD

Engineering

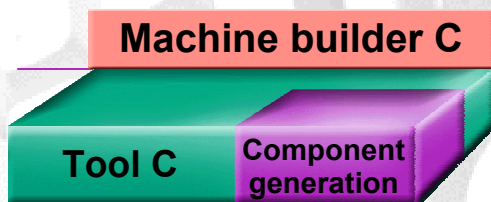
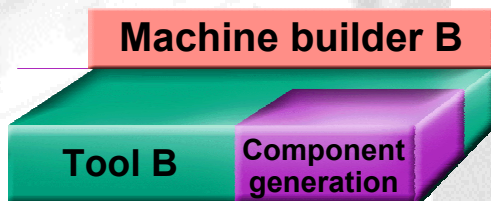
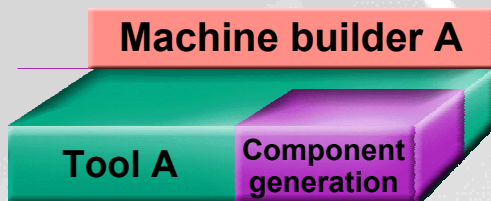
Runtime

Diagnostics

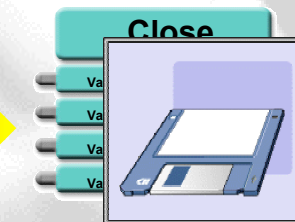
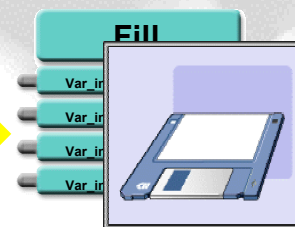
Fieldbus Applications

Software

Manufacturer specific Programming and Configuration Tools



PCD (XML File)



PROFINET CBA – Distributed Automation

Functional Scope

Component
Technology

PCD

Engineering

Runtime

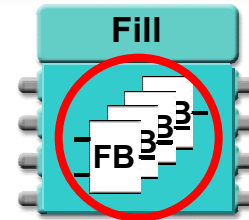
Diagnostics

Fieldbus
Applications

Software

- 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**



PROFINET CBA – Distributed Automation

Functional Scope

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Fieldbus Applications

Software

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

[Konfigurationsdatei: U:\SPS\Config_CL550\cl550_test.pcf] - Projekt-Konfigurator

Datei Ansicht Werkzeuge Konfiguration Ethernet IP-Adressen Projektschutz Einstellungen Hilfe

Steuersbaum	Typ	Name	IP-Adr. Front S.	IP-Adr. Back S.	Status	Kommentar
cl550_test						
67	GG4/9					
1	ZS550	Bearbeiten_1	10.6.129.50	142.0.1.1		
2	ZS550	Bearbeiten_2	10.6.129.51	142.0.1.2		
3	ZS550	Verpacken	10.6.129.52	142.0.1.3		
4	ZS550	Transport	10.6.129.53	142.0.1.4		

Bereit | kein Fehler erkannt | 9:47

Example: Bosch

Projekt: PMD_AHLSTERLENSCH - LELE PDD - WinCCS Editor - CL550 (Build 104)

Netzwerk-Nr.: 2 | Ausgabe Teile

```

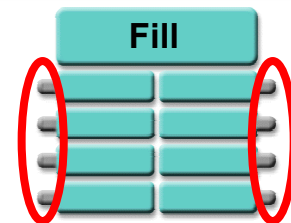
Schritt 1 Antrieb fährt Magazin in Position
-----
U -Schritt1
SFB no_Schritt1
:Teil aus Magazin 1 entnehmen
U -Magazin1
SFB Magazin3
UN -Magazin_1_leer
SFB Magazin3
I D 369770.A
T D A.-POS_CMD_low

U -NEW_VALUE_POSSIBLE
S -NEW_VALUE
S -Magazin1
S -Schritt1
S R -Wert1
I V 146003.A
S W -LOGO
U A T101
U -LOG1
SV A.T101
SP keine_Ladeposition
    
```

M650 0 Schritt1
M550 0 Magazin1
E10 5 Magazin_1_leer
M200 POS_CMD_low
M101 7 NEW_VALUE_POSSIBLE
M100 6 NEW_VALUE
M550 0 Magazin1
M600 0 Schritt1
M602 0 Wert1

LT10 Soll-Position Low-Word
neuer Sollwert möglich
neuer Sollwert

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



**PROFINET CBA –
Distributed
Automation**

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

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

Adresse	Name	Typ	Anfangswert	Kommentar
0.0		STRUCT		
+0.0	ExternStop	BOOL	FALSE	external stop
+0.1	ExternStart	BOOL	FALSE	external start
+2.0	RunDelay	INT		
+4.0	Cnt	DINT		
+8.0	StartNext	BOOL		
+8.1	Running	BOOL		
+10.0	OCnt	DINT		
=14.0		END_STRUCT		

Eigenschaften - Parameter	
Attribut	Wert
1	PROFINET direction
2	IN

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



PROFINET CBA – Distributed Automation

Functional Scope

Component Technology

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Software

- **Generate PROFINET Component**

The screenshot shows the Siemens STEP7 interface. A context menu is open over a component, with the option 'Create PROFINET Component' circled in red. The 'PROFINET-Komponente erstellen' dialog box is open, showing the following details:

- Komponente bilden aus:** XC-601-CPU
- Eigenschaften der Komponente:**
 - Name: Verpacken
 - Version: 1.0
 - Kommentar: Die befüllten Flaschen werden Verpackt
- GUID Identifikation:**
 - Beibehalten
 - Neu

Example: Siemens (STEP7)

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

PROFINET CBA – Distributed Automation

Functional Scope

Component Technology

PCD

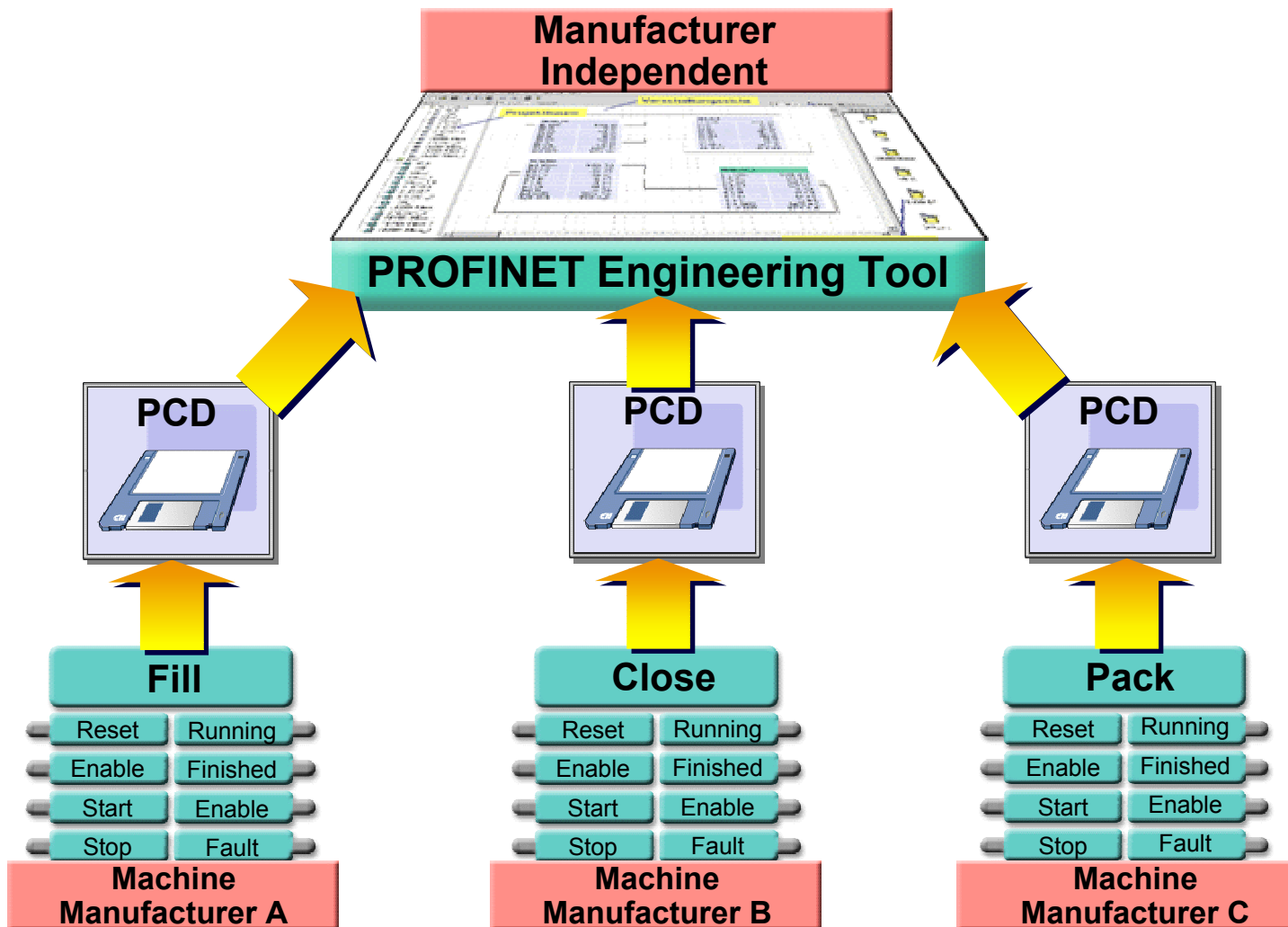
● Engineering

Runtime

Diagnostics

Fieldbus Applications

Software



PROFINET CBA – Distributed Automation

Functional Scope

Component Technology

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Software

The screenshot shows the SIMATIC iMap software interface. The main window is titled "Technological View" and displays a control system diagram with four main functional blocks: "Close", "Pack", "Wash", and "Fill". Each block contains a set of control buttons: "Reset", "Running", "Enable", "Finished", "Start", "Enable", "Stop", and "Fault". Blue lines connect the "Start" buttons of the "Close" and "Pack" blocks to the "Start" buttons of the "Wash" and "Fill" blocks. On the right side, there is a "Libraries" panel showing a list of components: "Pack", "Close", "Wash", and "Fill". Each component in the library is represented by a small icon and a set of control buttons. Yellow arrows point from the library components to the main diagram, indicating that these components are being used in the configuration. At the bottom right of the screenshot, the text "e.g. Siemens SIMATIC iMap" is displayed.

Assign Devices to the Network

PROFINET CBA – Distributed Automation

Functional Scope

Component
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PCD

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Fieldbus
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Software

The screenshot shows the SIMATIC iMap software interface. The main window displays a network diagram with a vertical green line labeled "Ethernet" on the left. Three PLC icons are connected to this line, labeled "Close", "Pack", and "Proxy". A horizontal pink line labeled "PROFIBUS" extends from the "Proxy" PLC to two other PLC icons labeled "Wash" and "Fill". A yellow box labeled "Network View" is positioned above the diagram. On the right, a dialog box titled "Eigenschaften von WinLC_1" is open, showing the "Adressen" tab. It contains fields for "Generierstatus für Ethernet-Facette" (nicht vorhanden), "Generierstatus für Profibus-Facette" (nicht vorhanden), "IP-Adresse" (167, 163, 11, 224), "Subnetzmaske" (255, 255, 224, 0), "MAC-Adresse" (xx.xx.xx.xx.xx.xx), and "Profibus-Adresse" (7). A yellow box labeled "Assignment of Device Address" points to the IP address field. The bottom right of the screenshot is labeled "e.g. Siemens SIMATIC iMap".

PROFINET CBA – Distributed Automation

Functional Scope

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Previously: programming

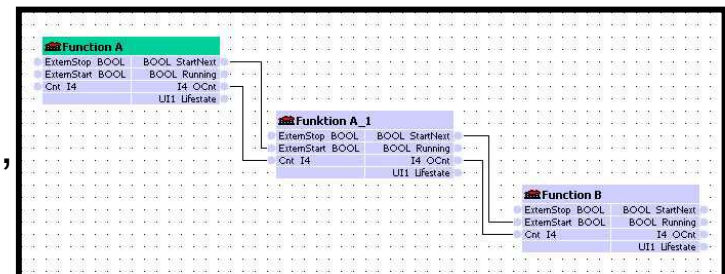
- Detailed knowledge required of connection and sequence of communications functions in the device
- The devices to communicate with one another must already be defined when programming

```

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



PROFINET CBA – Distributed Automation

Functional Scope

Component Technology

PCD

● Engineering

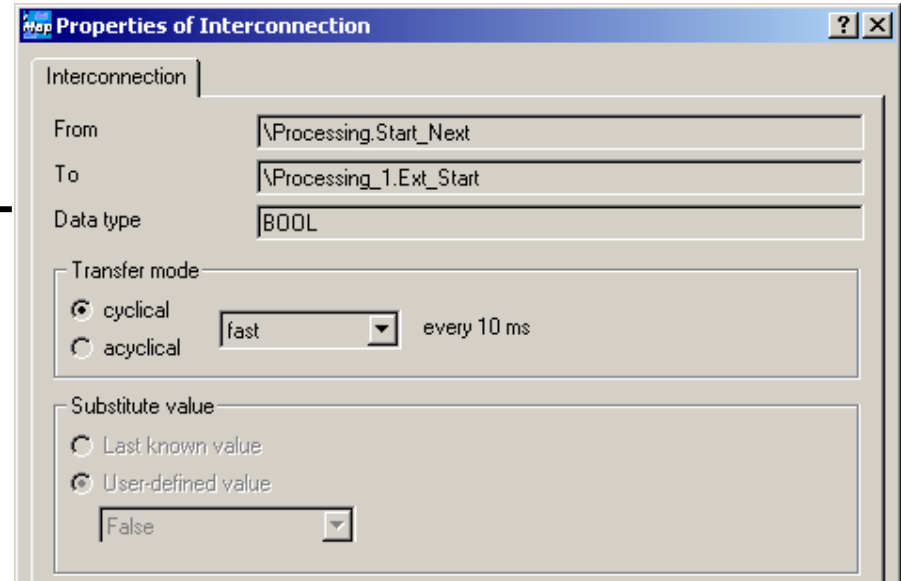
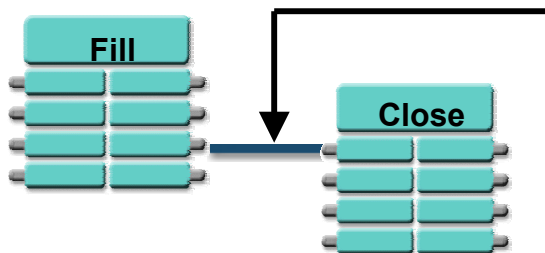
Runtime

Diagnostics

Fieldbus Applications

Software

- **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**



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 CBA –
Distributed
Automation

Functional Scope

Component
Technology

PCD

● Engineering

Runtime

Diagnostics

Fieldbus
Applications

Software

PROFINET CBA – Distributed Automation

Functional Scope

Component
Technology

PCD

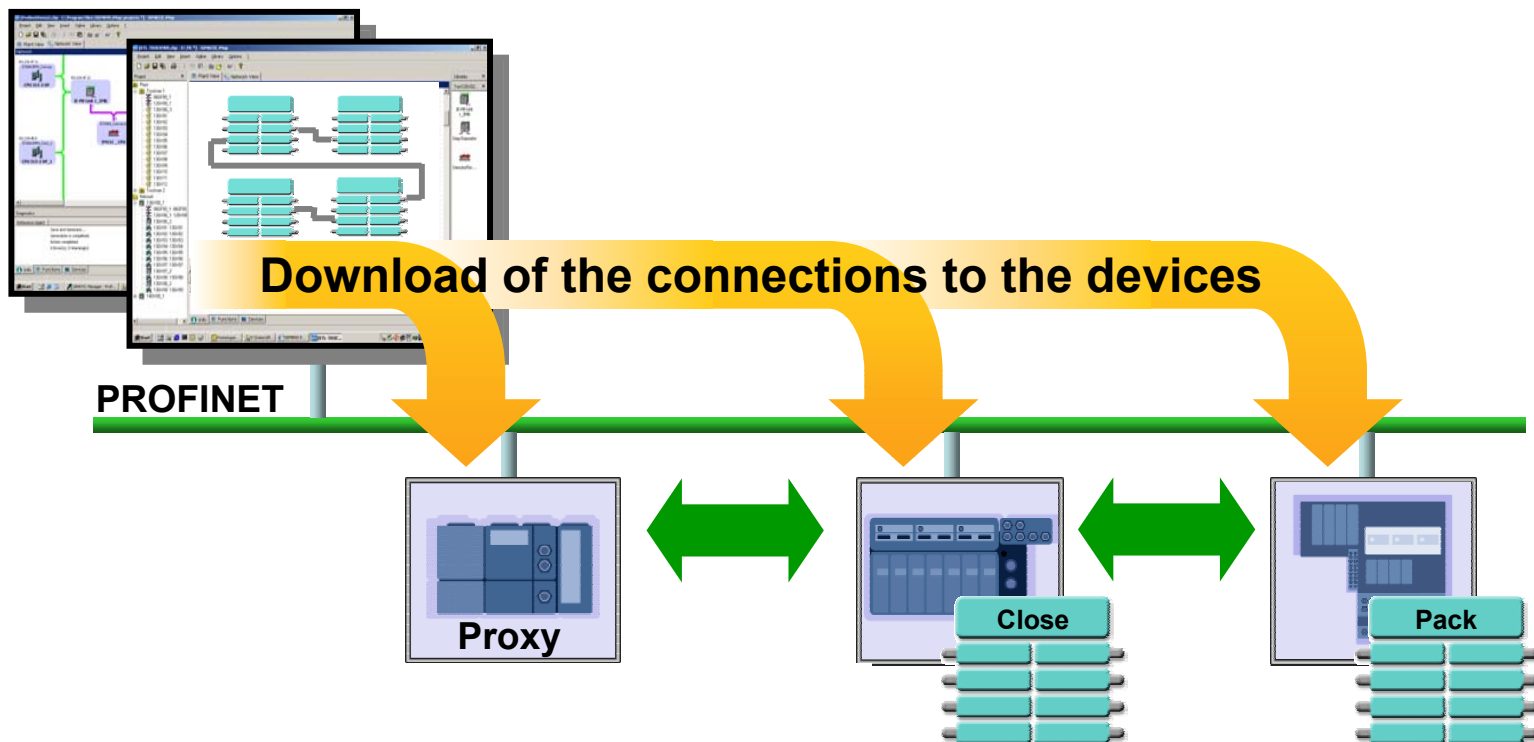
● Engineering

Runtime

Diagnostics

Fieldbus
Applications

Software



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

Connection Control with ACCO (Active Control Connection Object)

PROFINET CBA –
Distributed
Automation

Functional Scope

Component
Technology

PCD

● Engineering

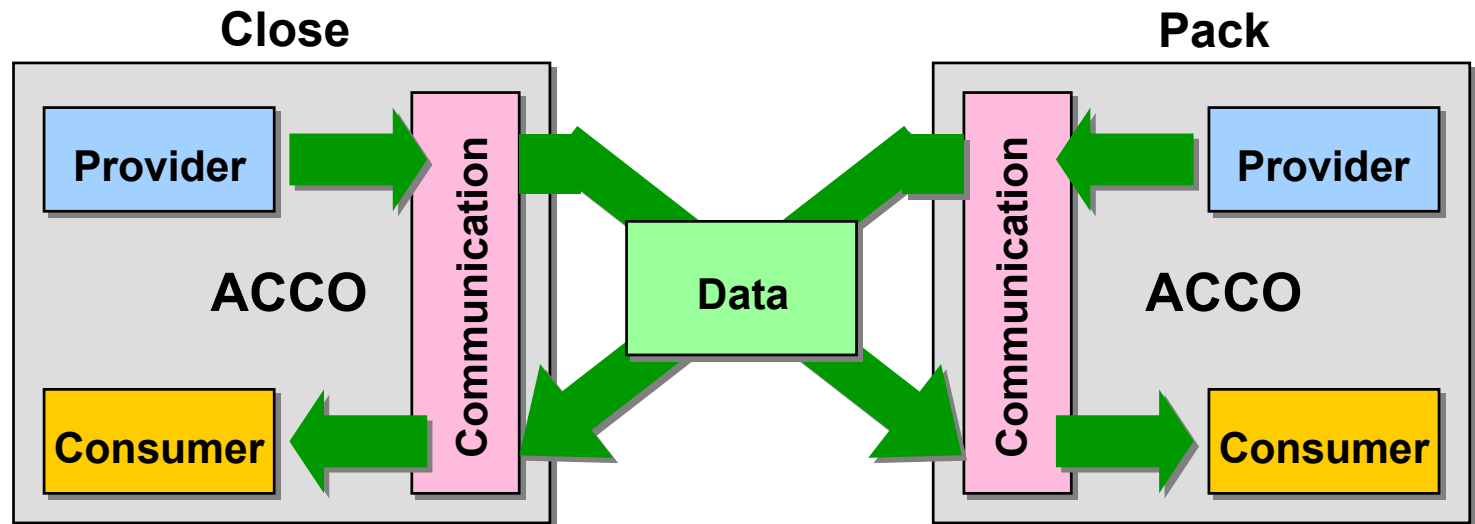
Runtime

Diagnostics

Fieldbus
Applications

Software

- 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

PROFINET CBA – Distributed Automation

Functional Scope

Component Technology

PCD

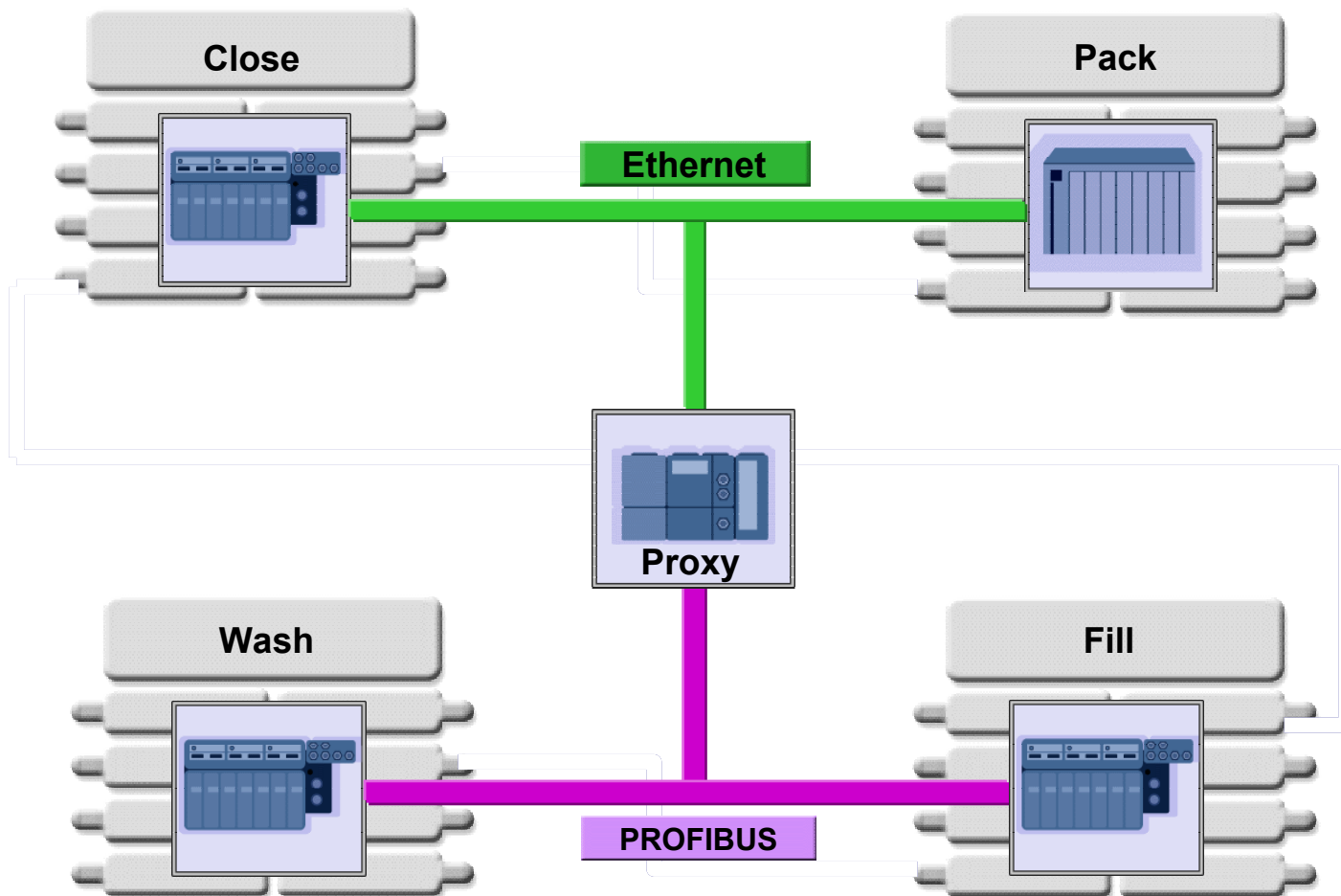
● Engineering

Runtime

Diagnostics

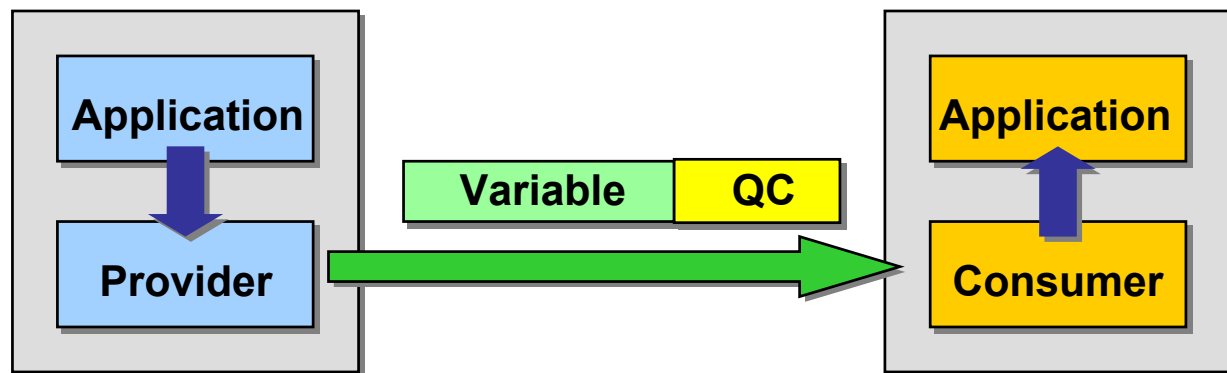
Fieldbus Applications

Software



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

PROFINET CBA – Distributed Automation

Functional Scope

Component Technology

PCD

Engineering

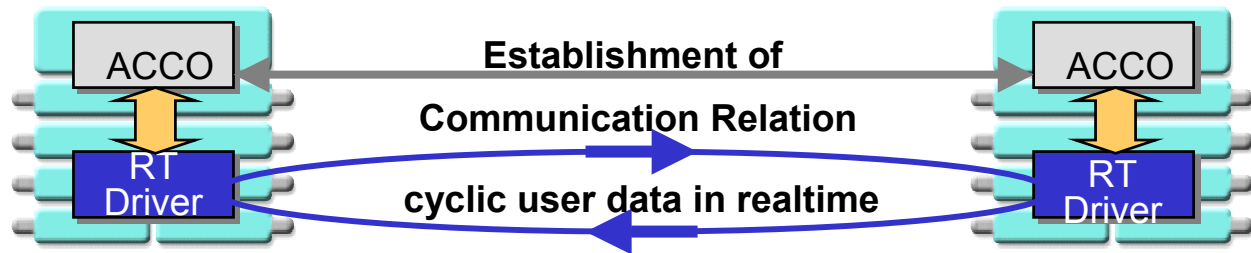
● Runtime

Diagnostics

Fieldbus Applications

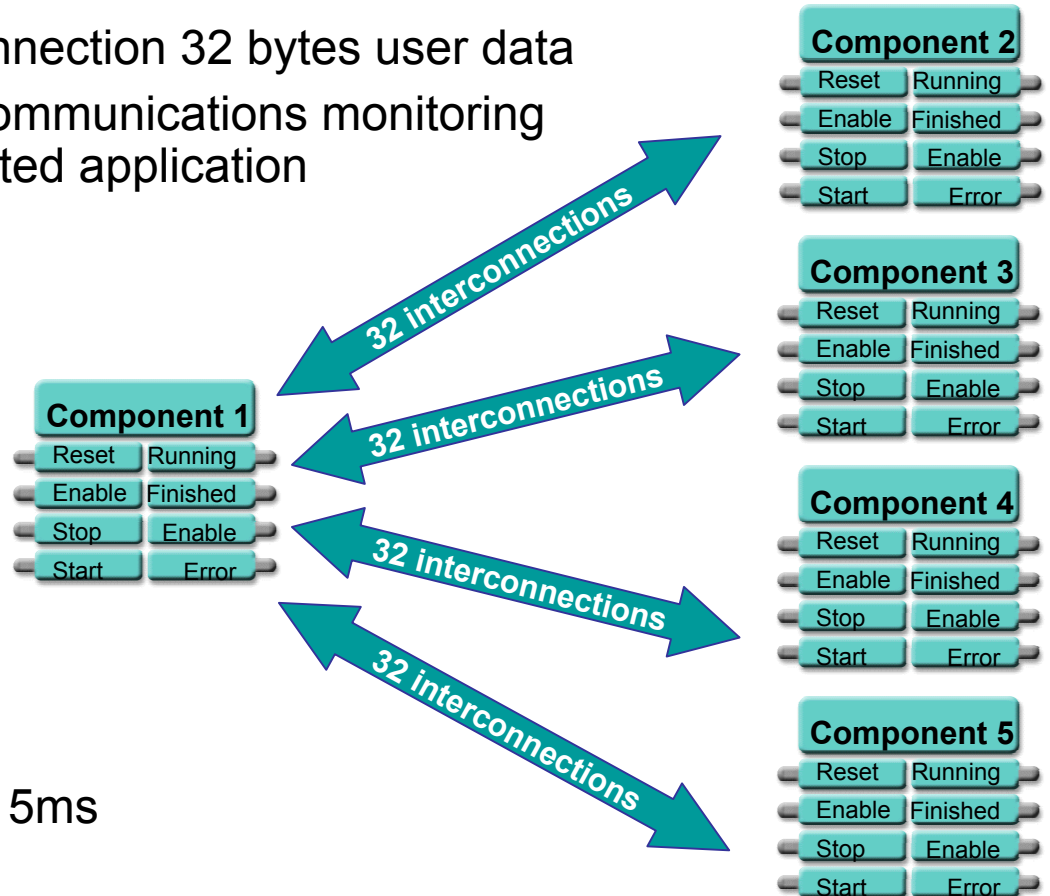
Software

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



• Sample Configuration

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



➔ Refresh rate $\leq 5\text{ms}$

PROFINET CBA – Distributed Automation

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● Runtime

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Fieldbus
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PROFINET CBA – Distributed Automation

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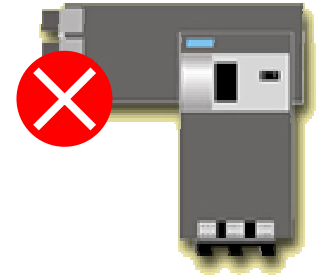
● Diagnostics

Fieldbus
Applications

Software

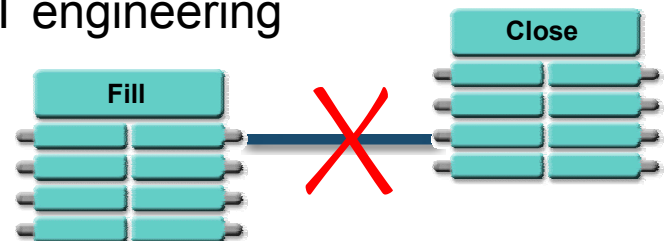
• Device diagnosis

- 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



PROFINET CBA – Distributed Automation

Functional Scope

Component Technology

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Runtime

● Diagnostics

Fieldbus Applications

Software

Disturbance of component

Disturbance of device

Disturbance of connection

Technological View

Network View

Status of connection

Nr	Gerät	Funktion	Anschluss	Typ	Format	Onlinewert	Steuerwert	Komment.
1	IM151_CPU	Function_A	On	BOOL	<Automatisch>	False	True	
2	IM151_CPU	Function_A	Toggle_Bit	BOOL	<Automatisch>	X	<Ausg...>	
3	IM151_CPU_1	Function_B	Data_Bit	BOOL	<Automatisch>	False		
4	IM151_CPU_1	Function_B	Counter_In	UI2	<Automatisch>	0	444	
5	IM151_CPU_1	Function_B	Output_1B	BOOL	<Automatisch>	False	<Ausgang>	
6	IM151_CPU_1	Function_B	Output_2B	BOOL	<Automatisch>	False	<Ausgang>	
			Counter_Out	UI2	<Automatisch>	0	<Ausgang>	

PROFINET CBA – Distributed Automation

Functional Scope

Component Technology

PCD

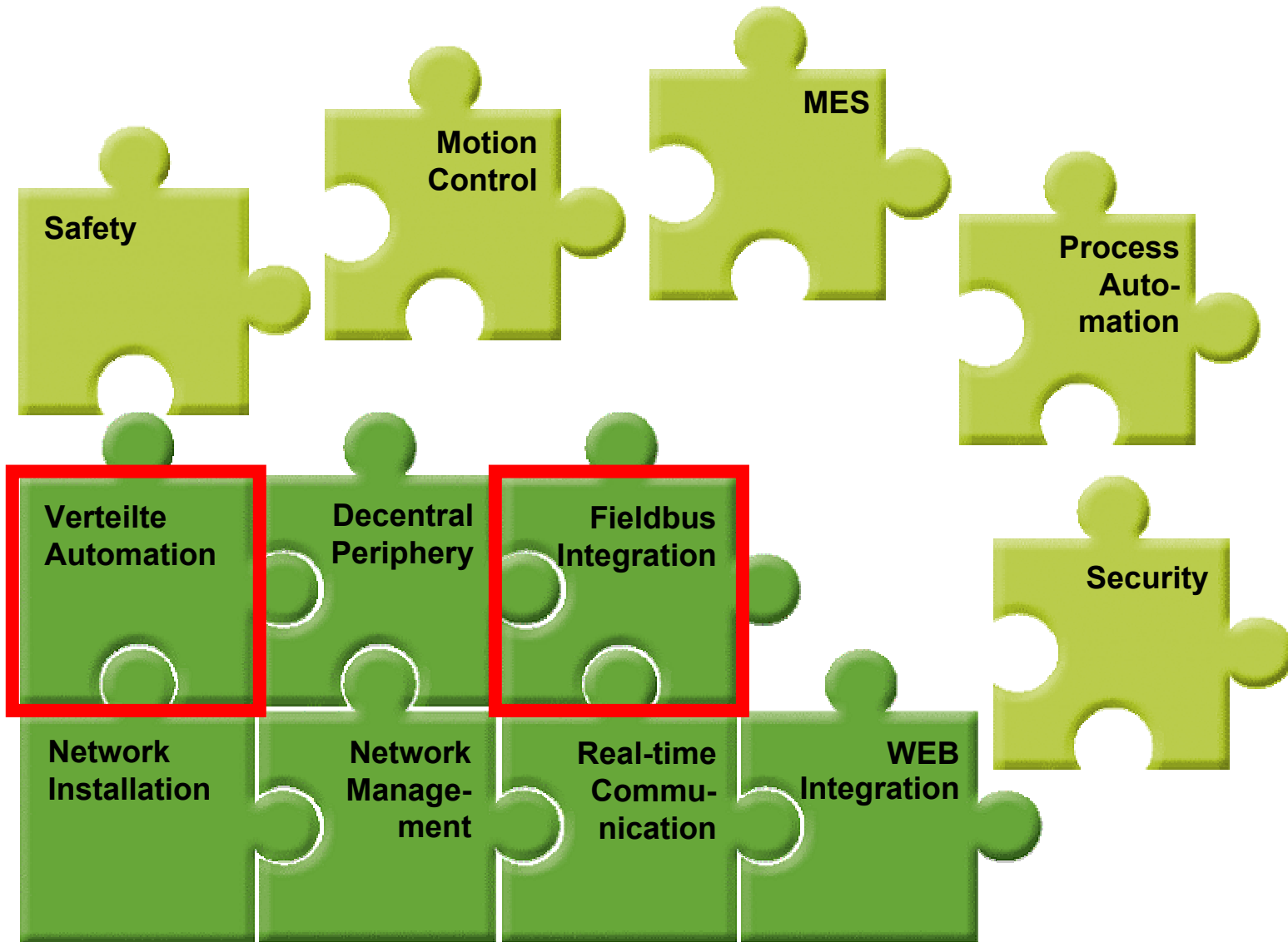
Engineering

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Diagnostics

● Fieldbus Applications

Software



PROFINET CBA – Distributed Automation

Functional Scope

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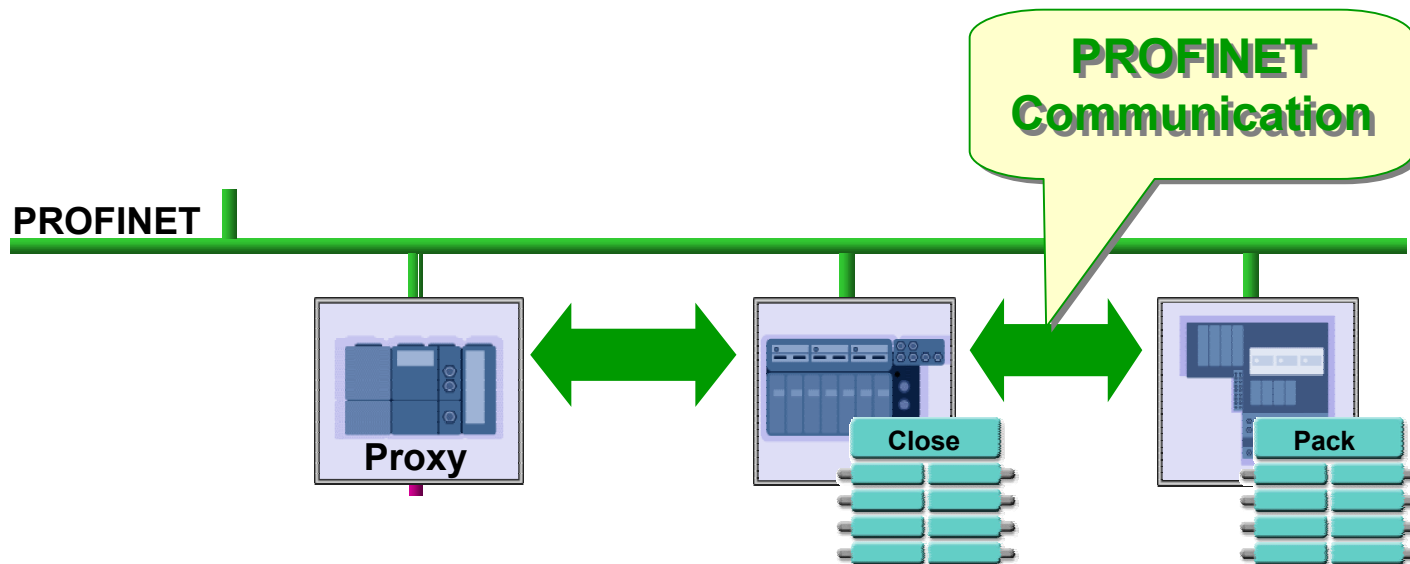
Engineering

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● Fieldbus Applications

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**PROFINET CBA –
Distributed
Automation**

Functional Scope

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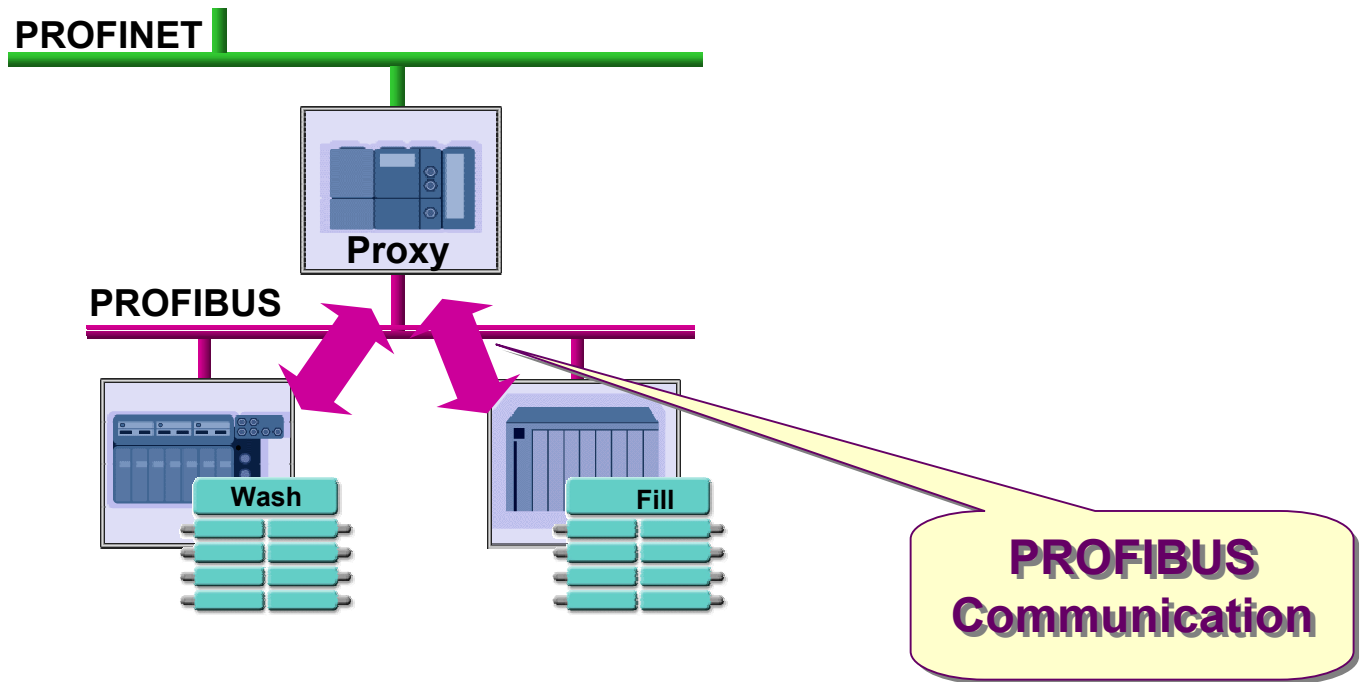
Engineering

Runtime

Diagnostics

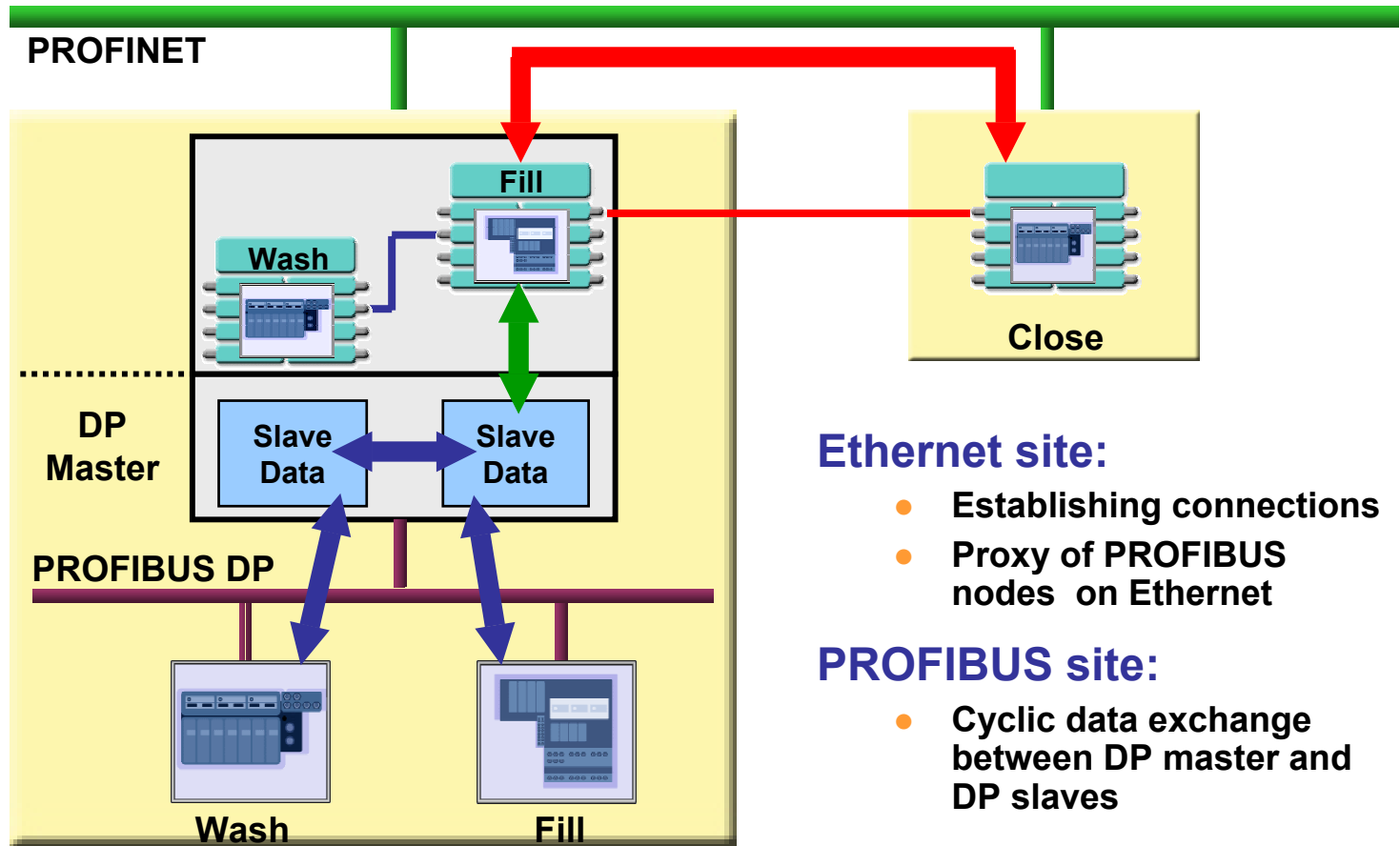
● Fieldbus
Applications

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

PROFINET CBA –
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PROFINET CBA – Distributed Automation

Functional Scope

Component Technology

PCD

Engineering

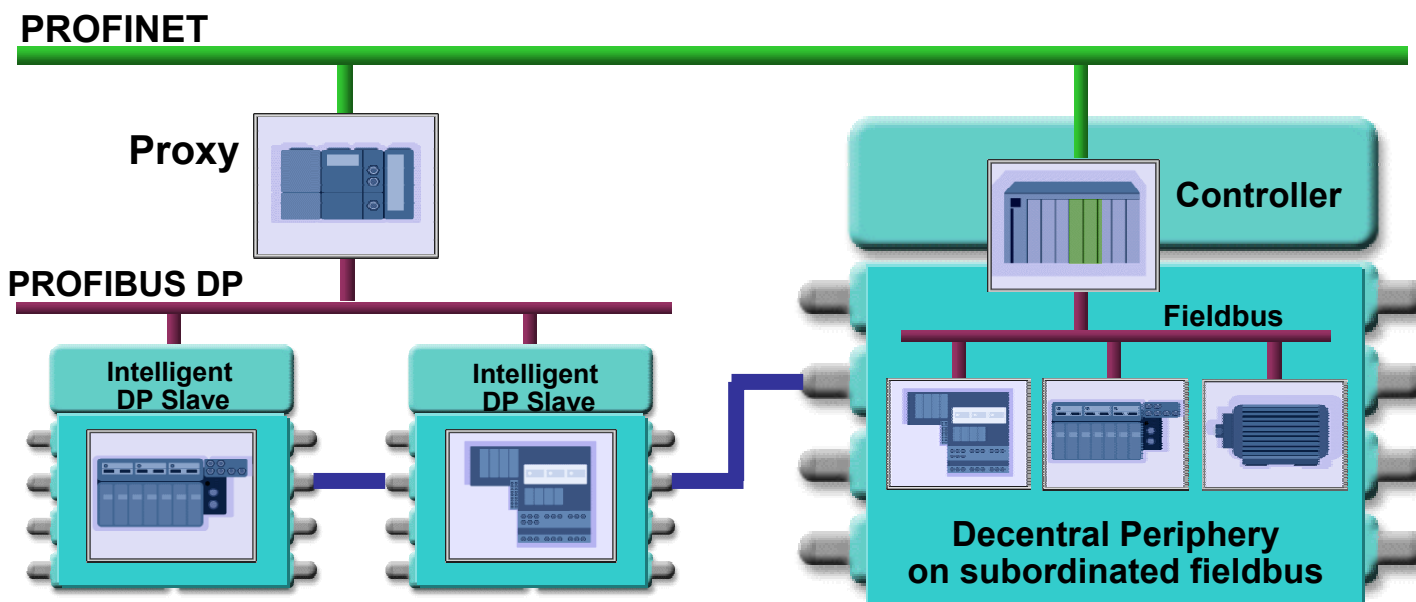
Runtime

Diagnostics

Fieldbus Applications

Software

- **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 CBA – Distributed Automation

Functional Scope

Component
Technology

PCD

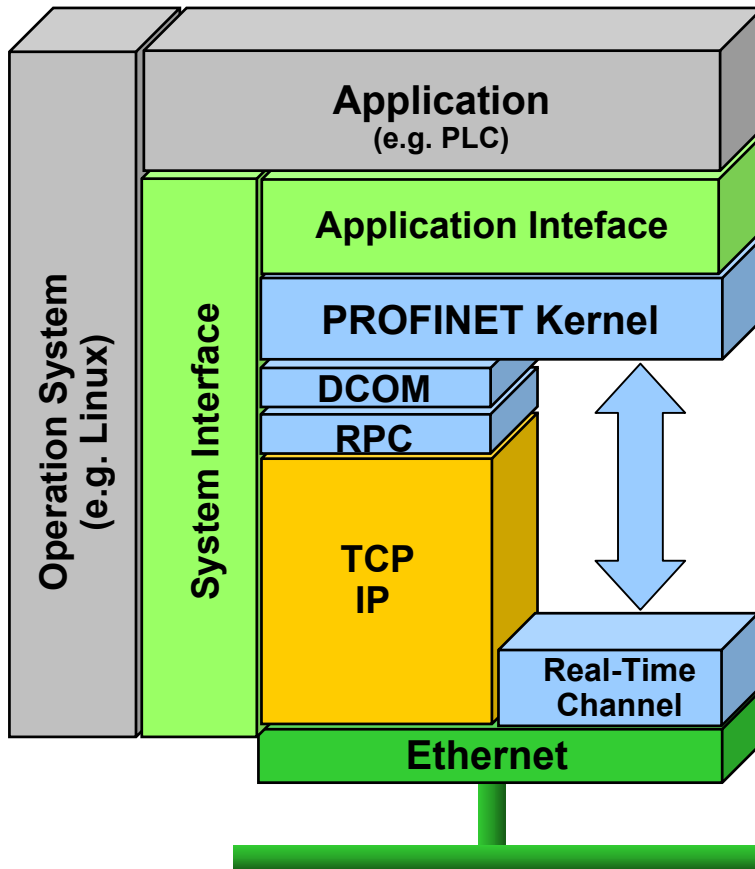
Engineering

Runtime

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Applications

Software



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



**Described in Implementation
Guideline**



Standard TCP/IP stack

PROFINET CBA – Distributed Automation

Functional Scope

Component
Technology

PCD

Engineering

Runtime

Diagnostics

Fieldbus
Applications

Software

- **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