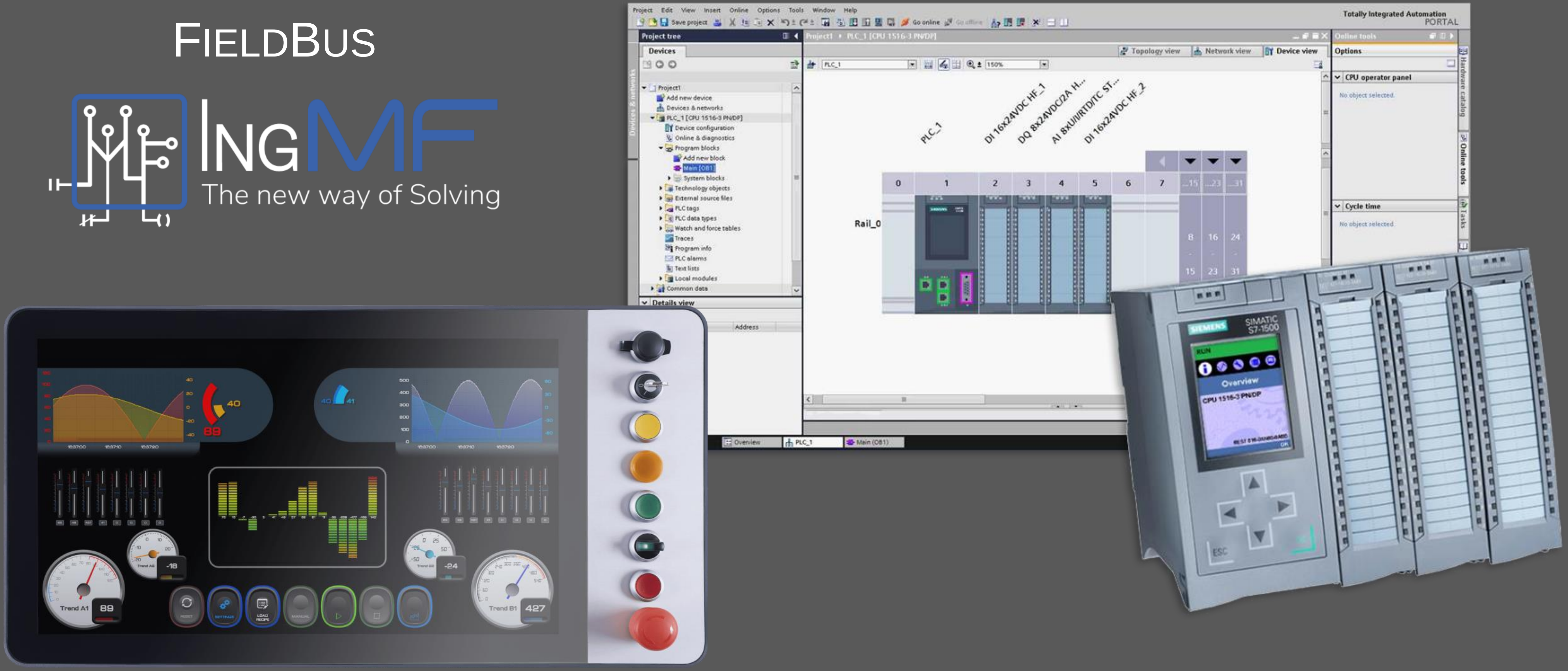
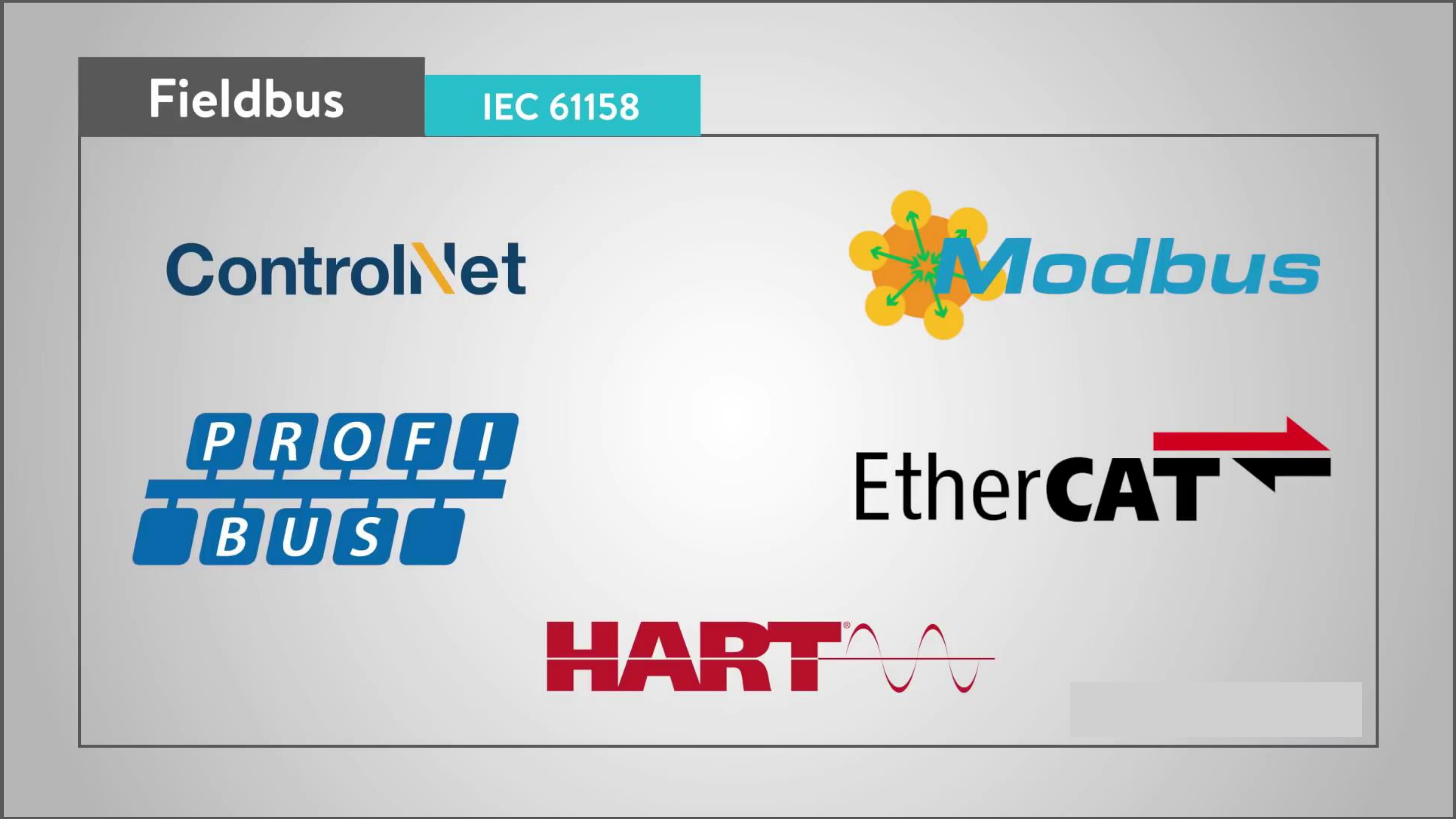
BUS DI CAMPO
FIELDBUS

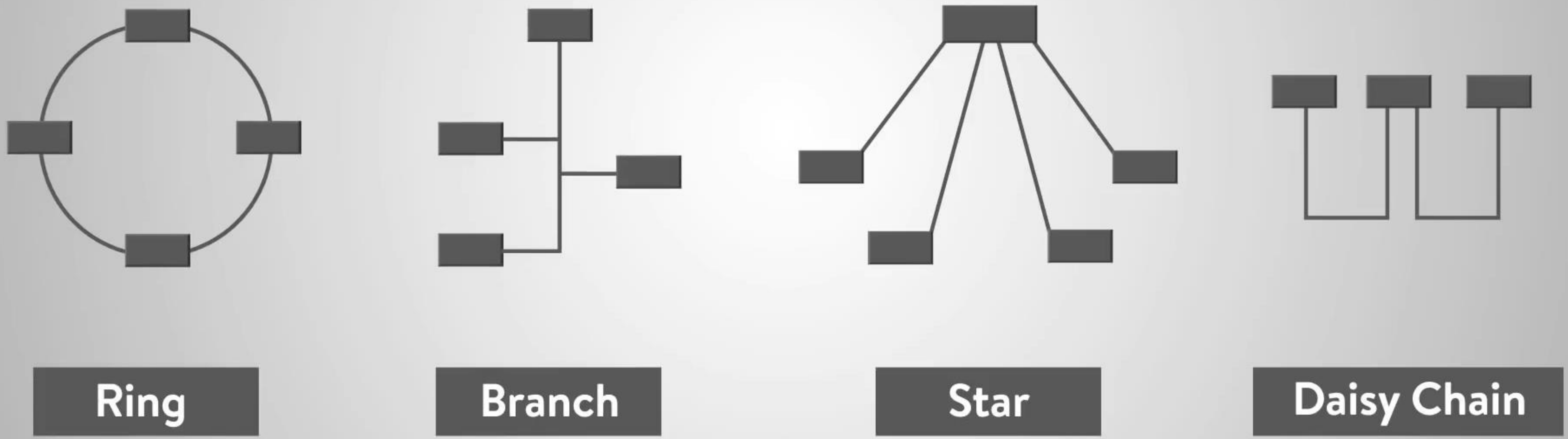
IngMF
The new way of Solving


Totally Integrated Automation
PORTAL
Project tree
Devices
Project1
Add new device
Devices & networks
PLC_1 [CPU 1516-3 PN/DP]
Device configuration
Online & diagnostics
Program blocks
Add new block
Main [OB1]
System blocks
Technology objects
External source files
PLC tags
PLC data types
Watch and force tables
Traces
Program info
PLC alarms
Text lists
Local modules
Common data
Details view
Topology view
Network view
Device view
Online tools
Options
CPU operator panel
No object selected.
Cycle time
No object selected.
PLC_1
DI 16x24VDC HF_1
DQ 8x24VDC/2A H...
AI 8xU/I/RTD/TC ST...
DI 16x24VDC HF_2
Rail_0
Overview
Main (OB1)
SIEMENS
SIMATIC S7-1500
RUN
Overview
CPU 1516-3 PN/DP
ESC
Trend A1
89
Trend B1
427
-18
-24
40

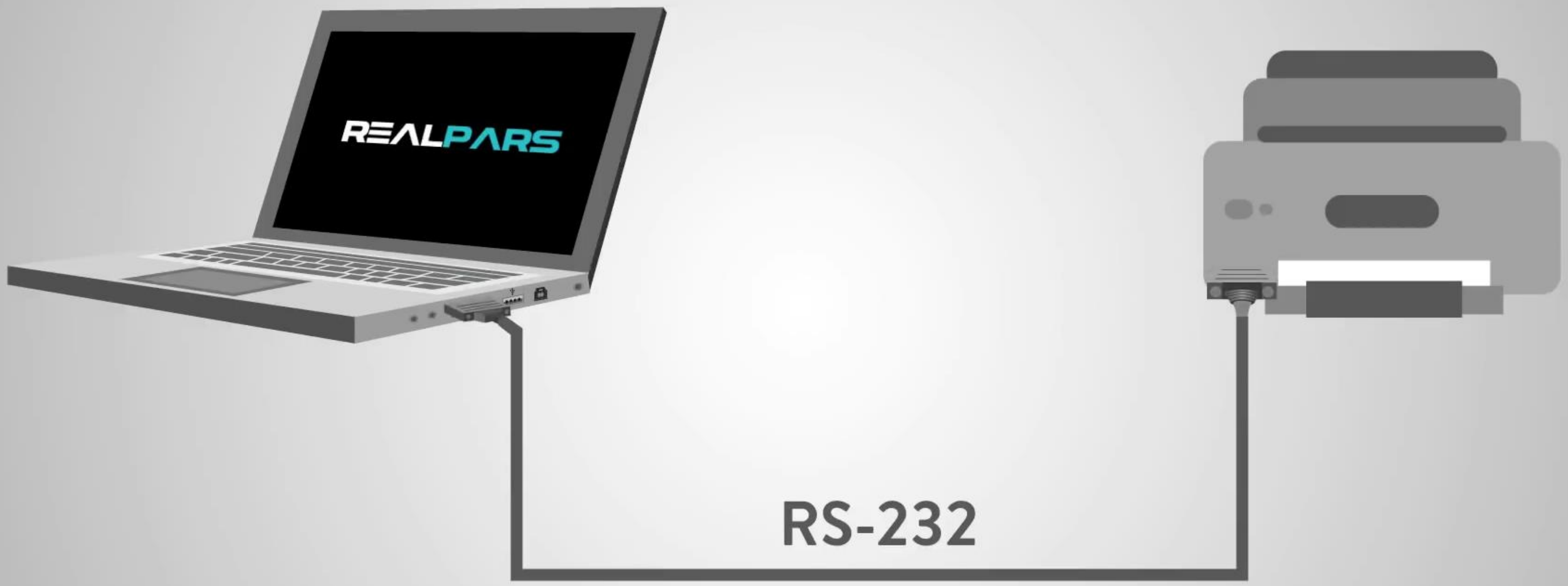
Cos’è un Bus di Campo


Fieldbus
IEC 61158
ControlNet
Modbus
PROFI BUS
EtherCAT
HART

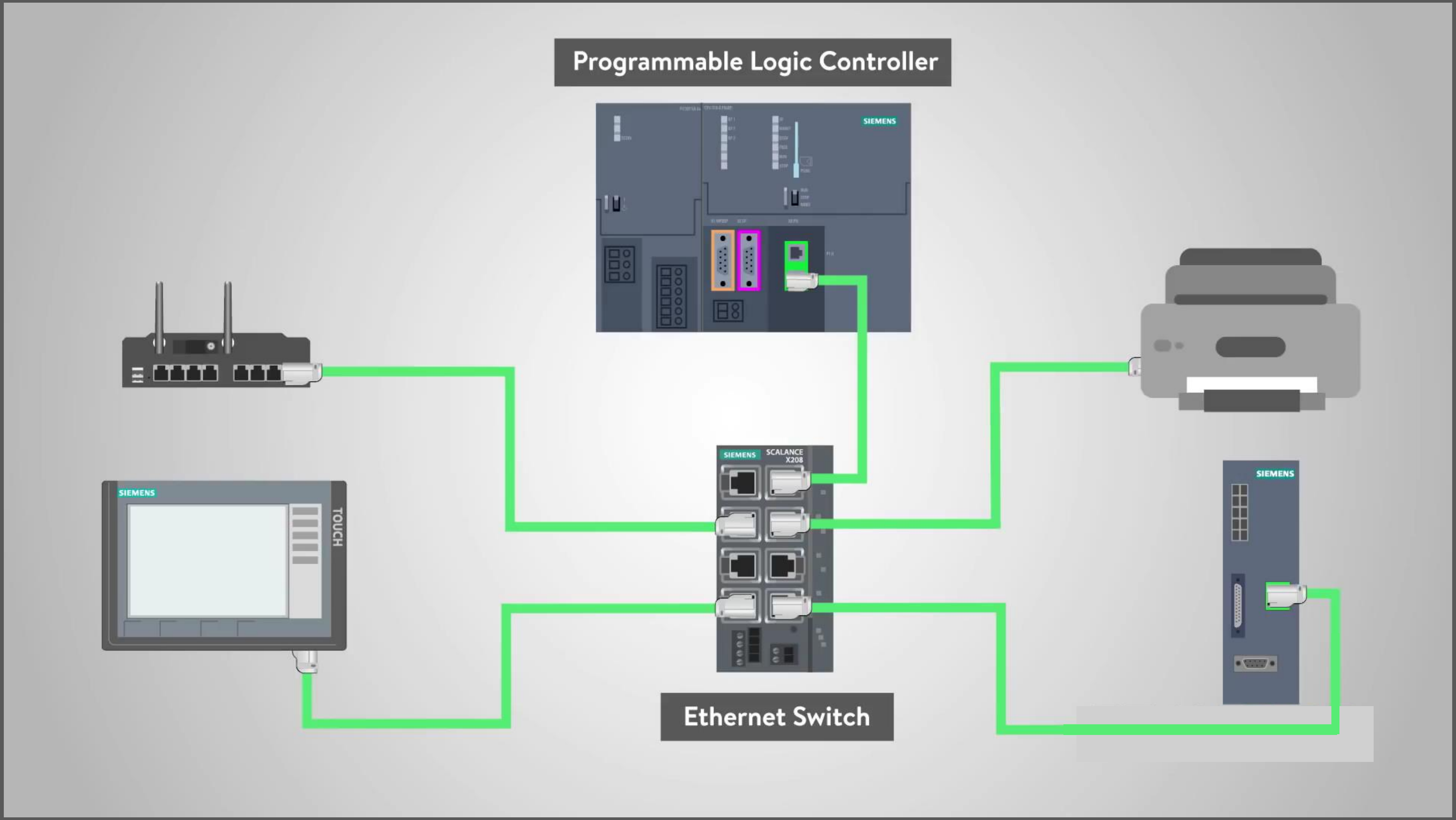
BUS DI CAMPO - TOPOLOGIA


Ring
Branch
Star
Daisy Chain

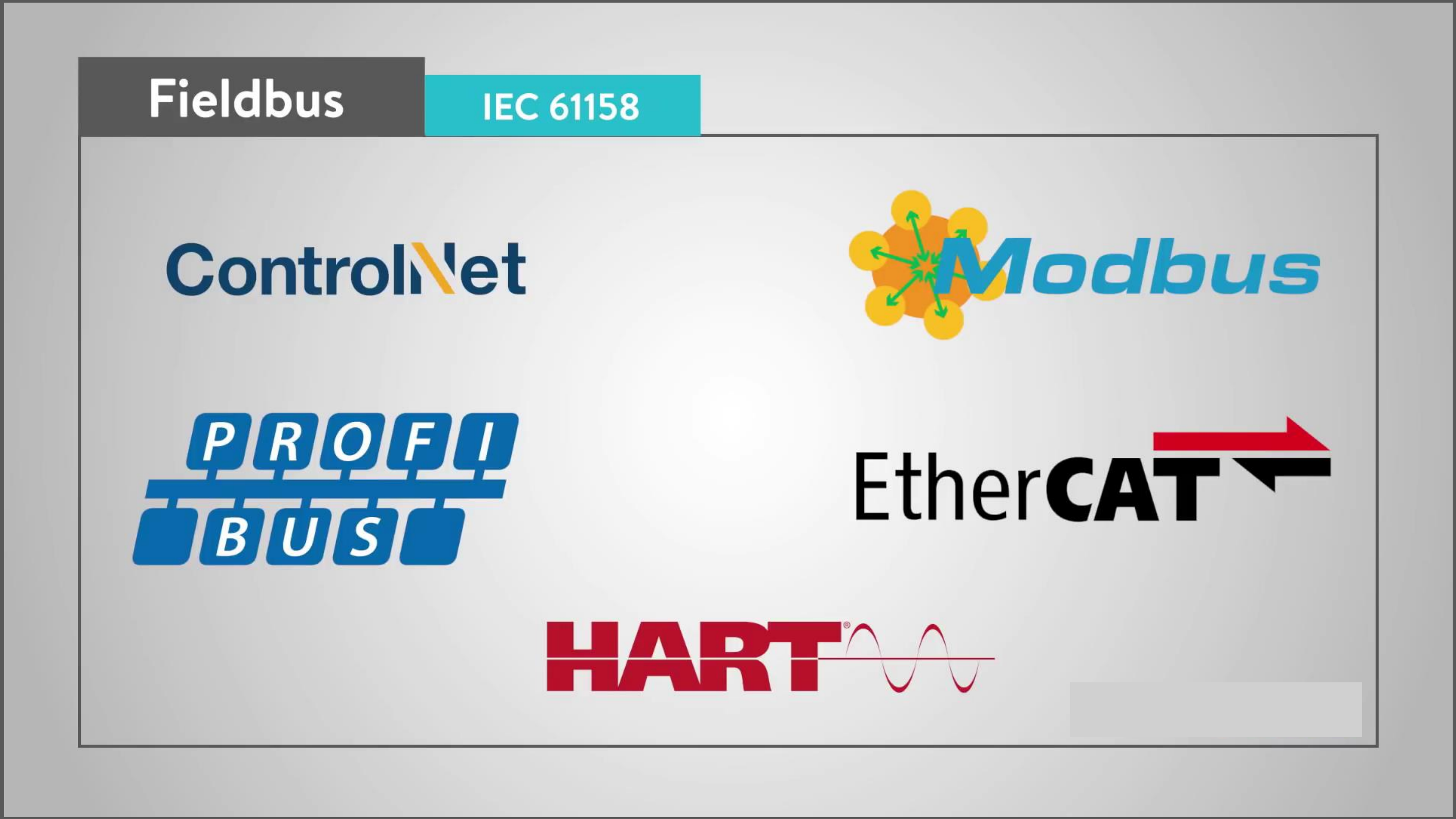
BUS DI CAMPO – RS 232


REALPARS
RS-232

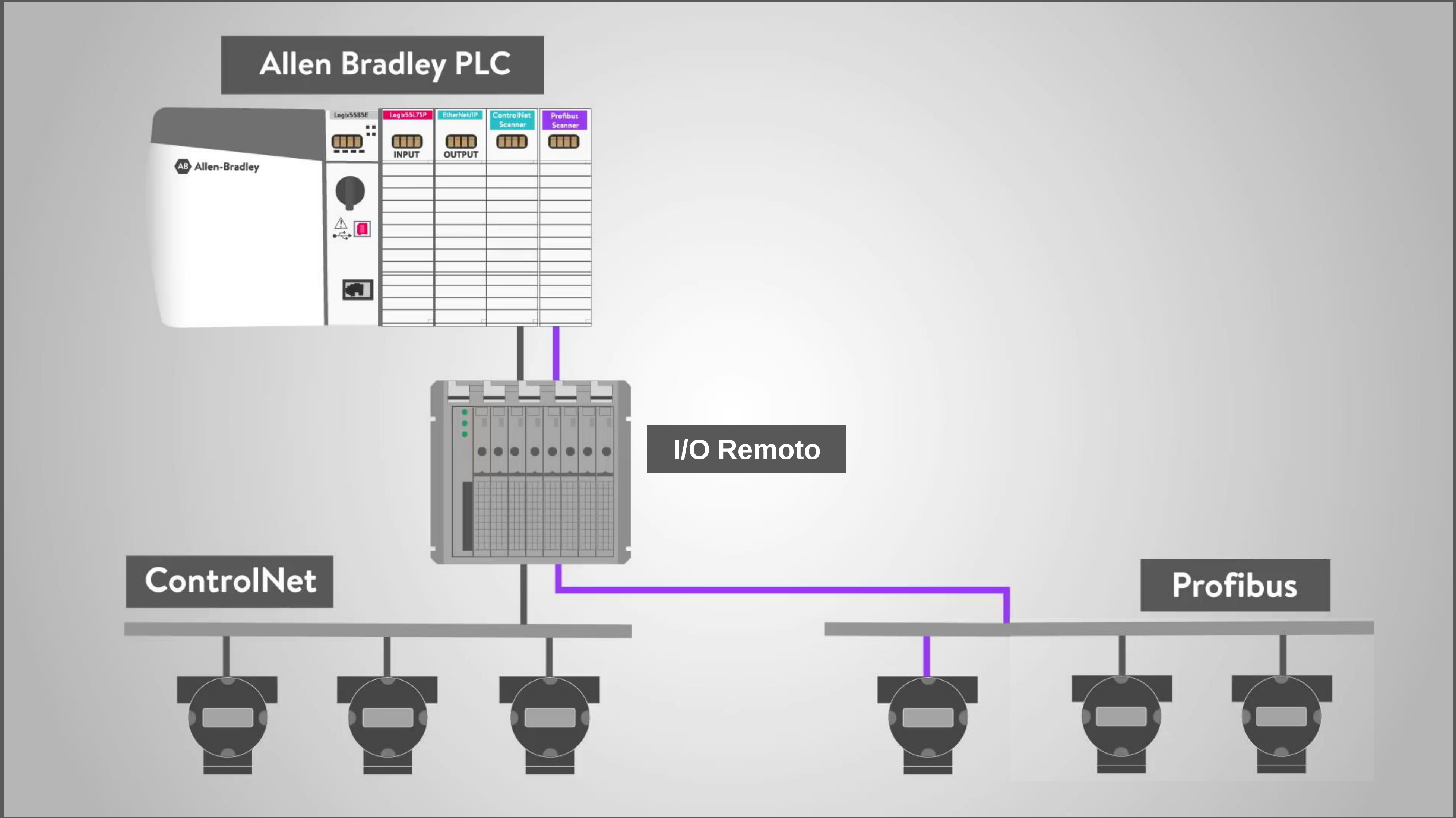
Bus di Campo – Oggi


Programmable Logic Controller
SIEMENS
SIEMENS
TOUCH
SIEMENS
SCALANCE
X208
SIEMENS
Ethernet Switch

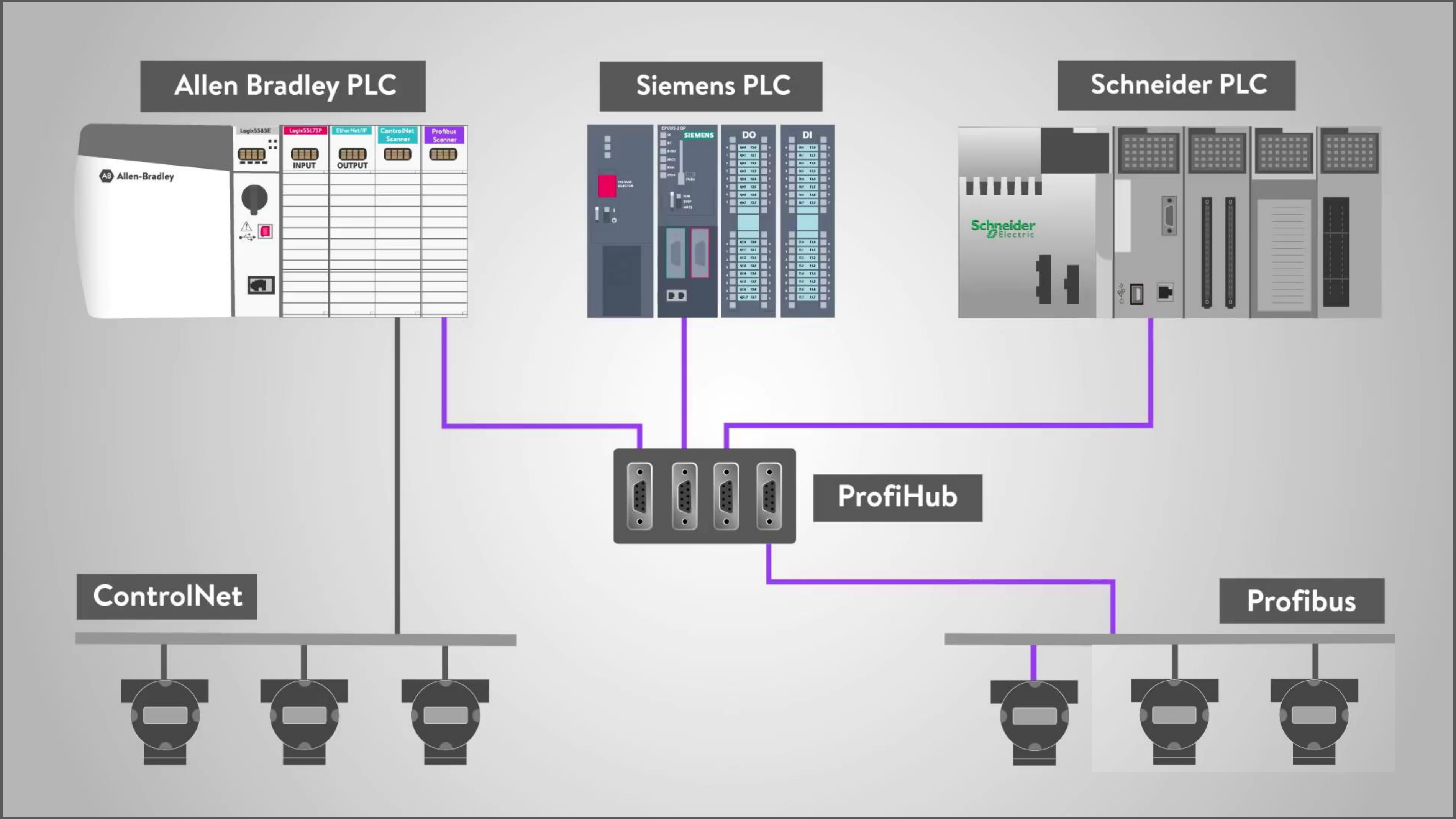
COS'È UN BUS DI CAMPO


Fieldbus
IEC 61158
ControlNet
Modbus
PROFIBUS
EtherCAT
HART

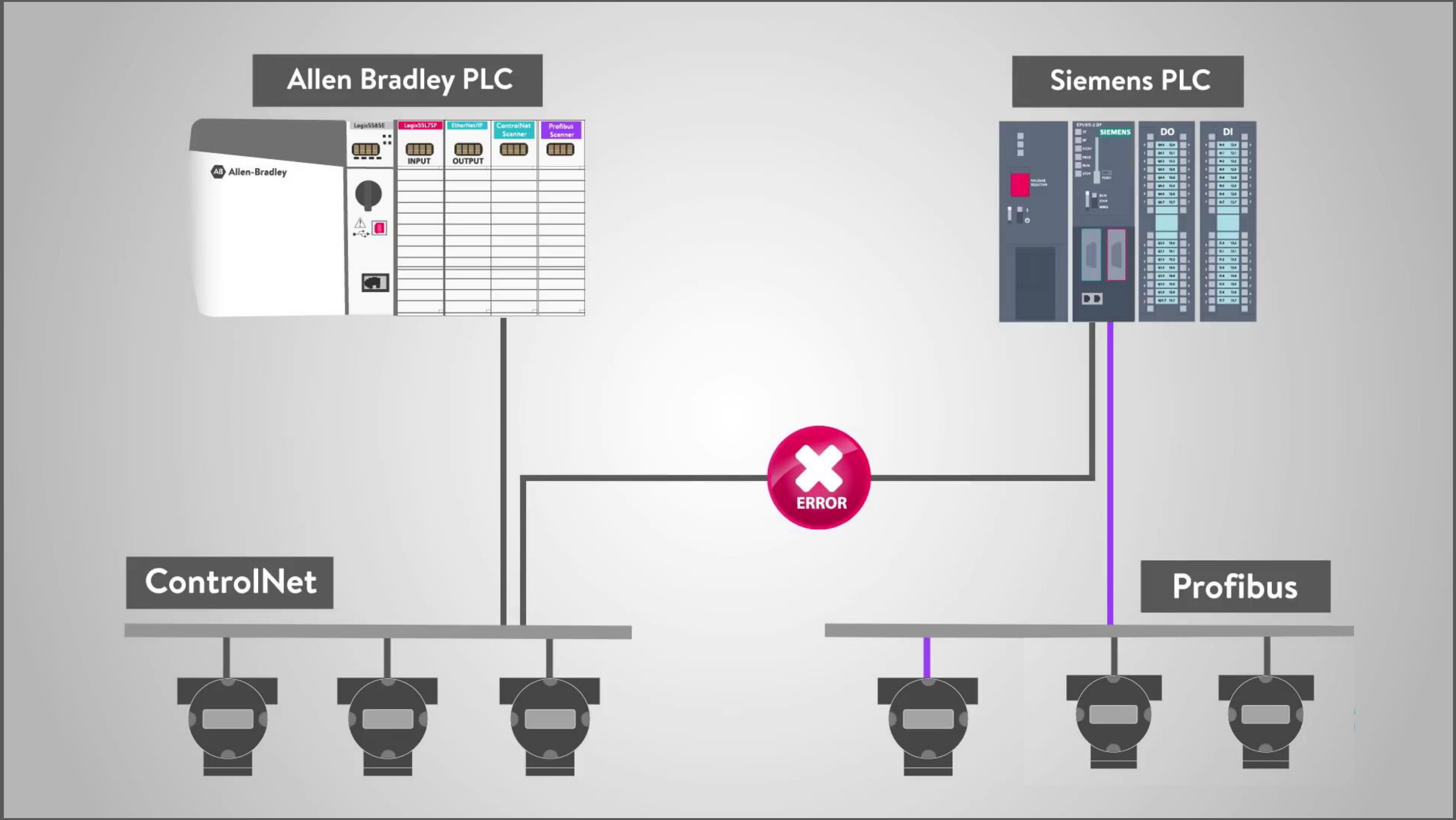
Cos'è un Bus di Campo


Allen Bradley PLC
Allen-Bradley
Logix5585E
EtherNet/IP
ControlNet Scanner
Profibus Scanner
INPUT
OUTPUT
I/O Remoto
ControlNet
Profibus

COS'È UN BUS DI CAMPO


Allen Bradley PLC
Siemens PLC
Schneider PLC
ProfiHub
ControlNet
Profibus

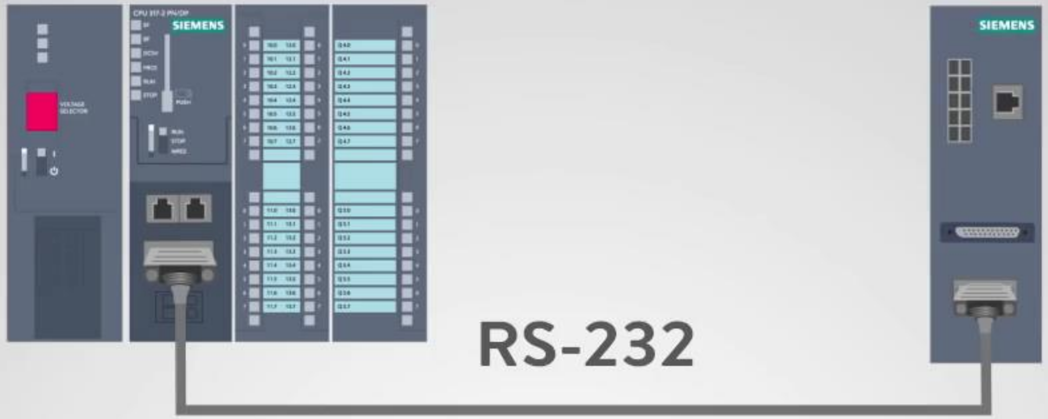
COS'È UN BUS DI CAMPO

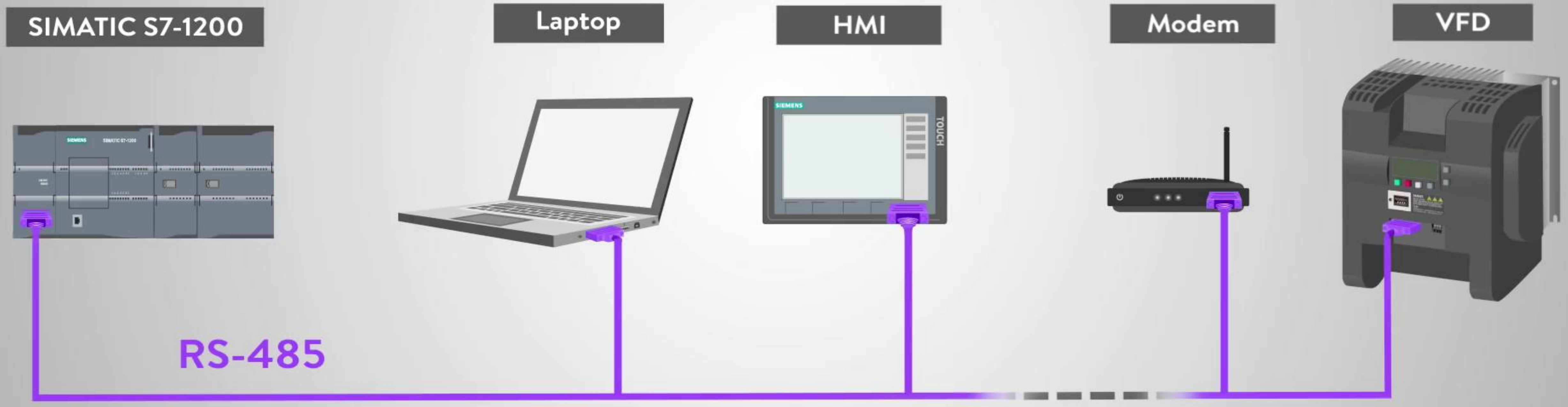

Allen Bradley PLC
Siemens PLC
INPUT
OUTPUT
ControlNet Scanner
Profibus Scanner
Allen-Bradley
SIEMENS
DO
DI
ERROR
ControlNet
Profibus

PROFIBUS-DP

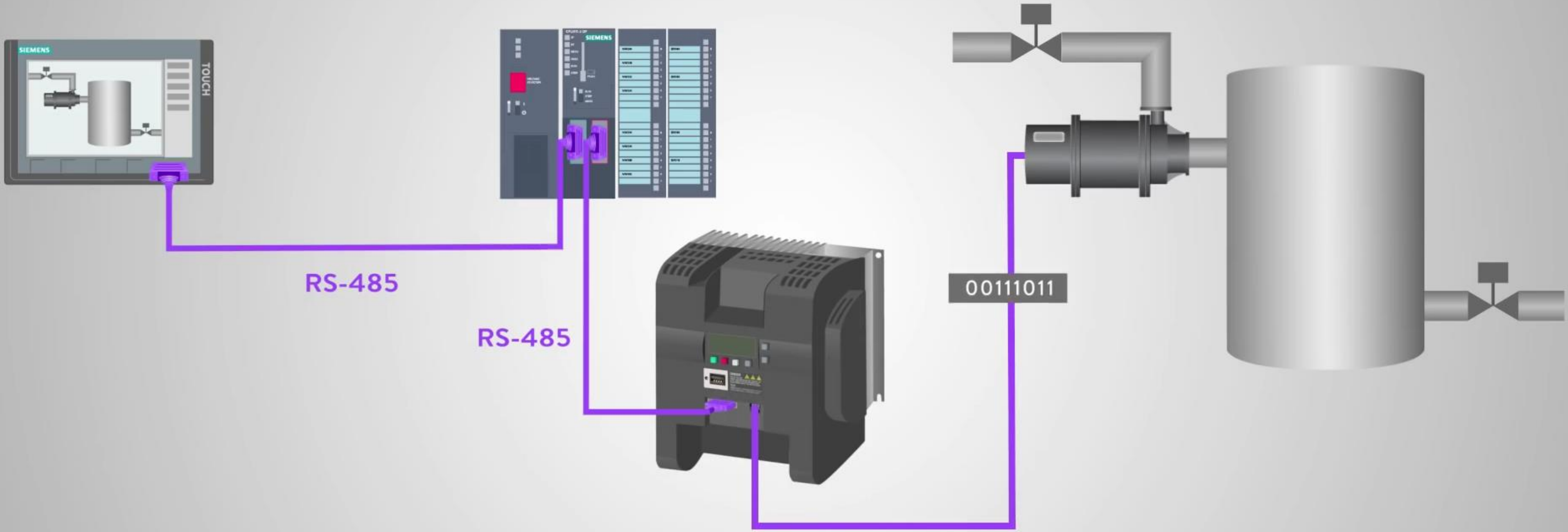
Profibus: Process Field Bus

DP: Decentralized Peripherals

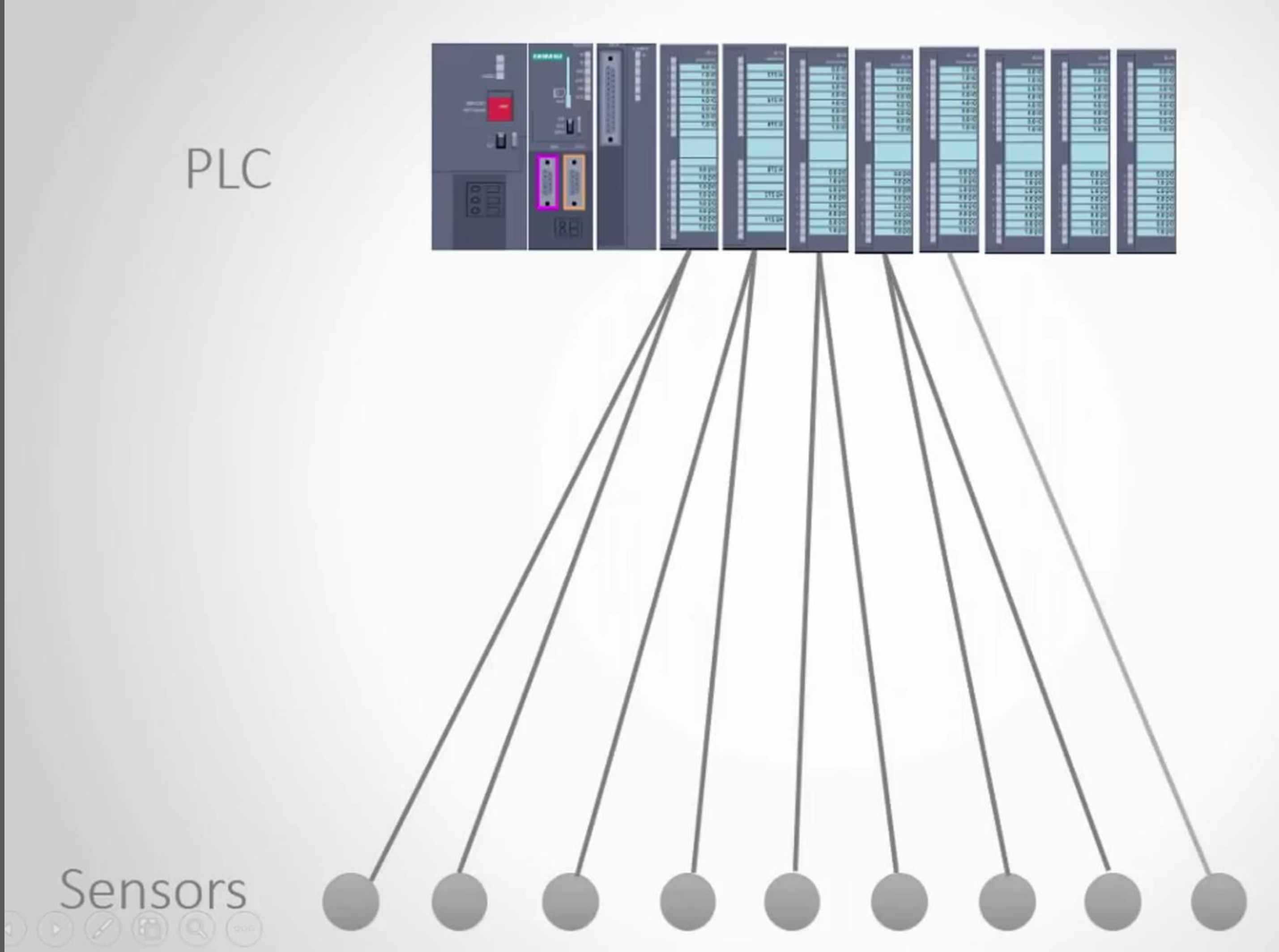

SIEMENS
RS-232
SIEMENS


SIMATIC S7-1200
Laptop
HMI
Modem
VFD
SIEMENS
TOUCH
RS-485

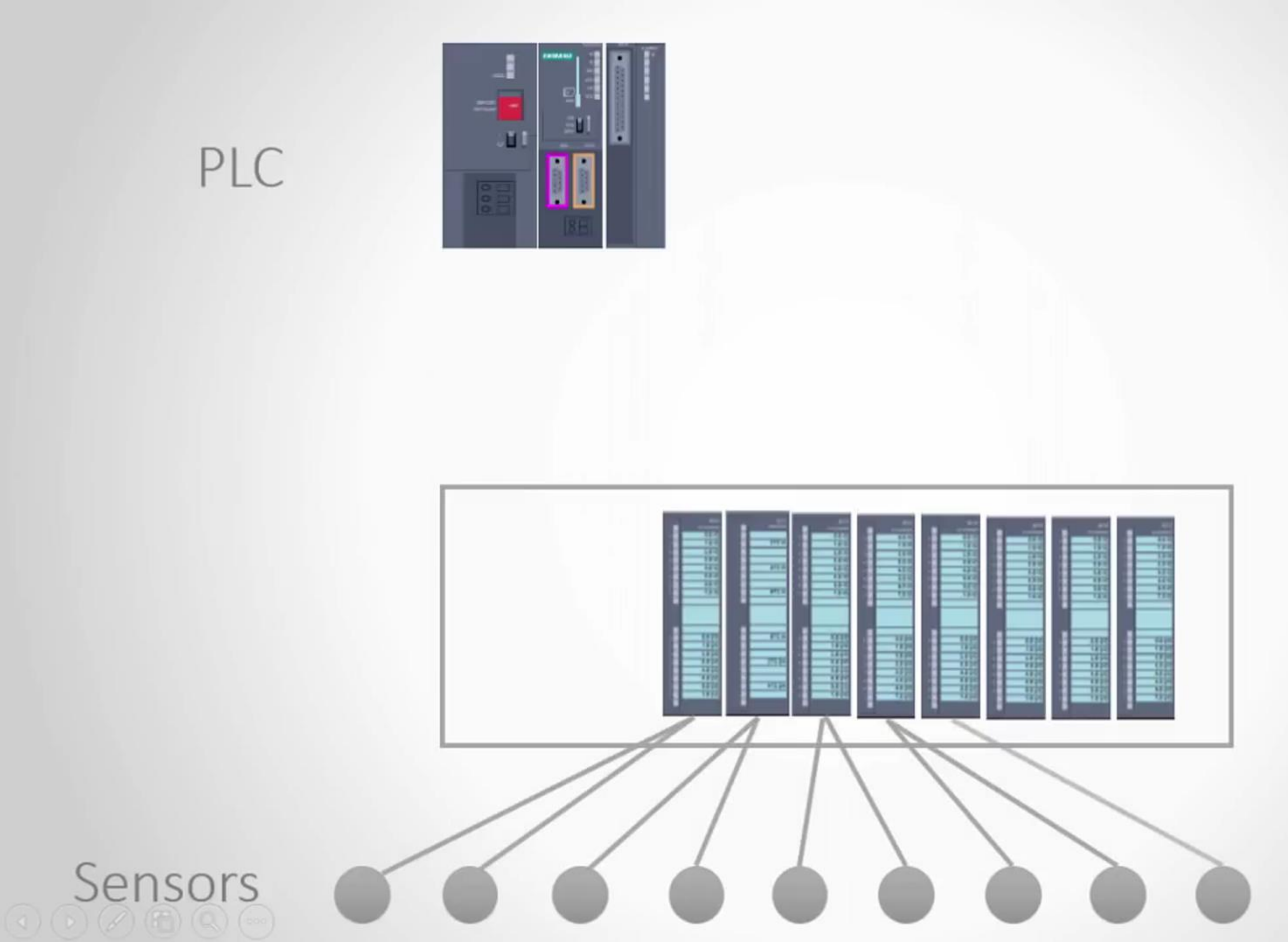
BUS DI CAMPO


SIEMENS
TOUCH
SIEMENS
RS-485
RS-485
00111011

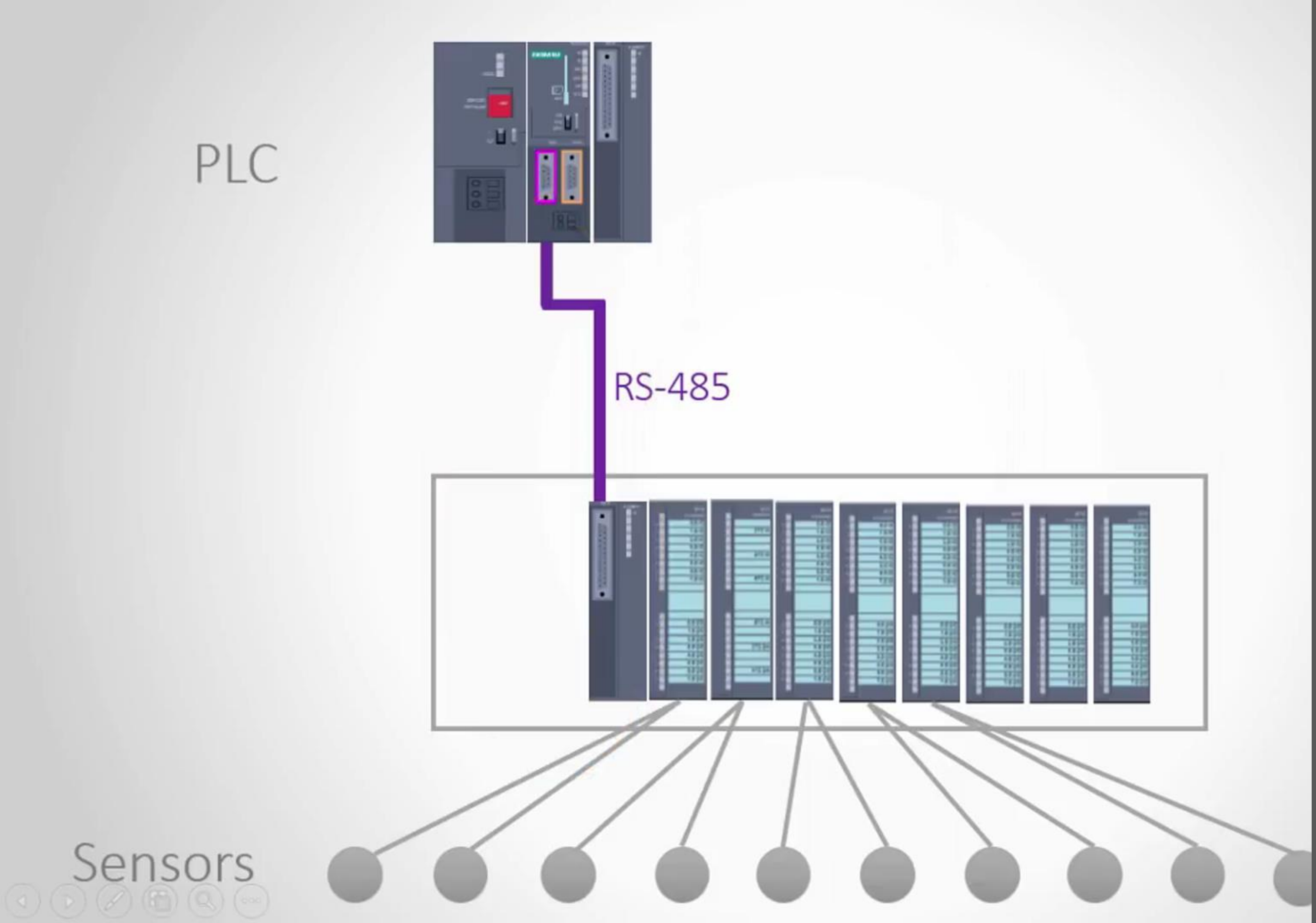
PROFIBUS-DP


PLC
Sensors

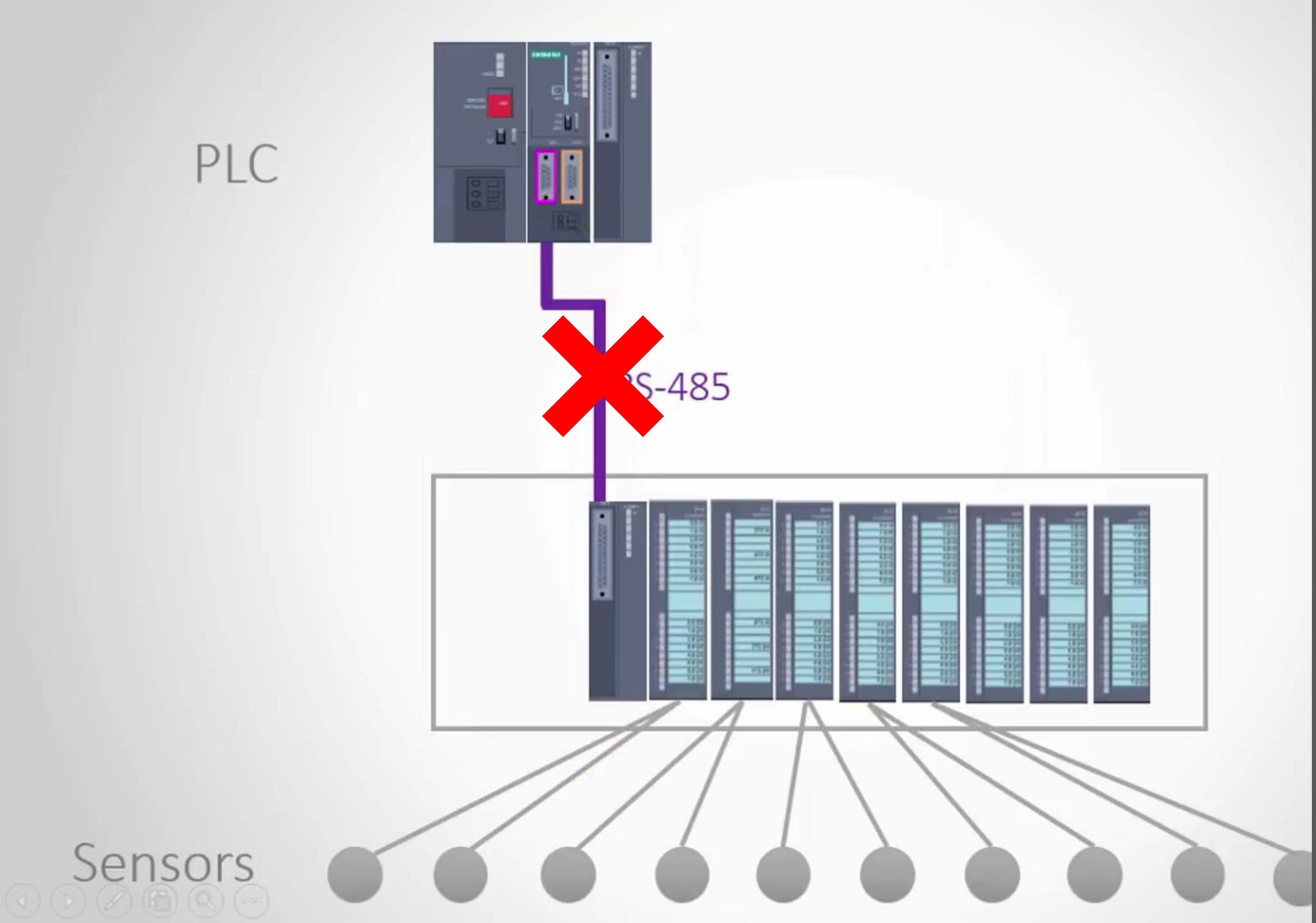
PROFIBUS-DP


PLC
Sensors

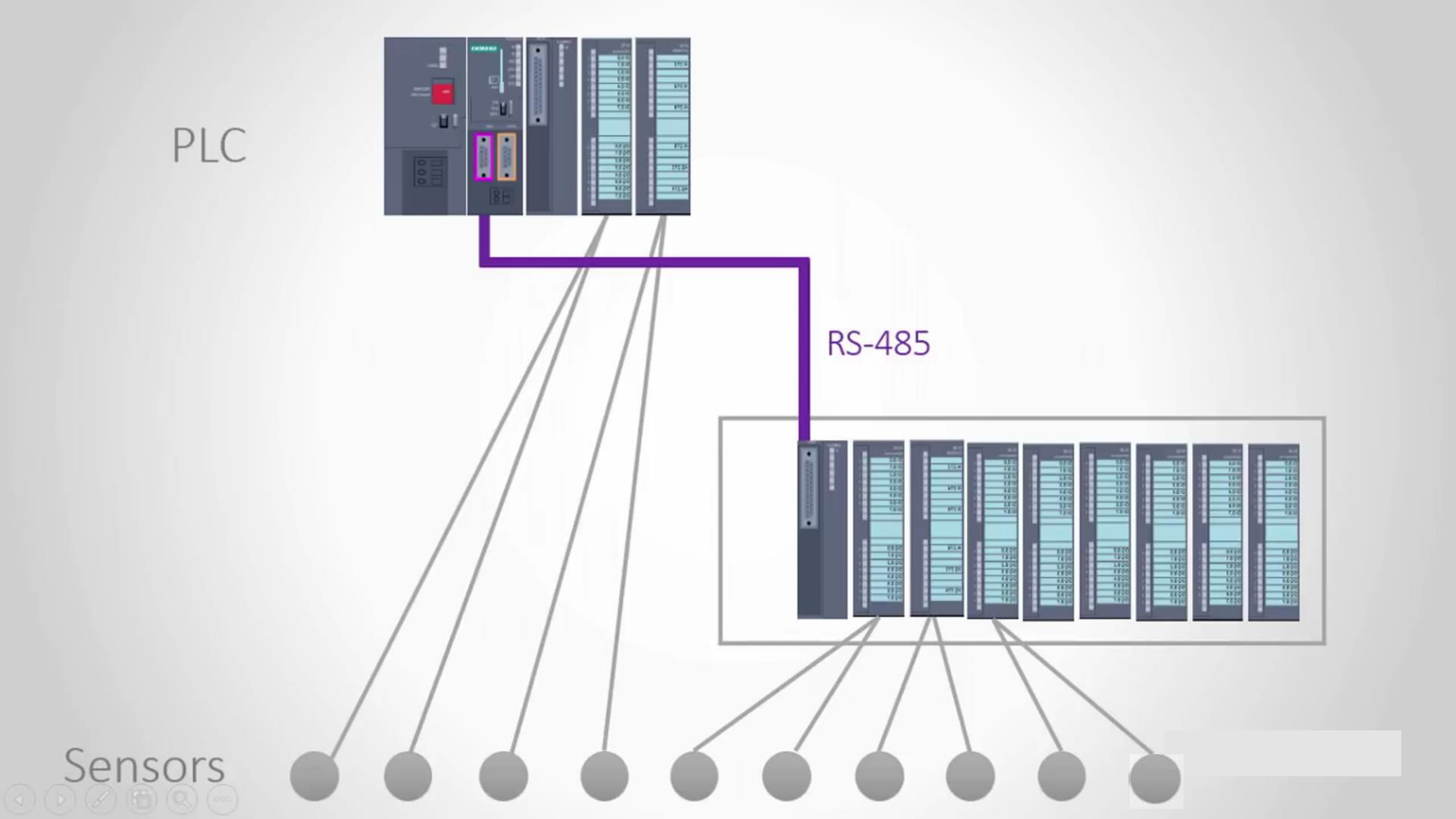
PROFIBUS-DP


PLC
RS-485
Sensors

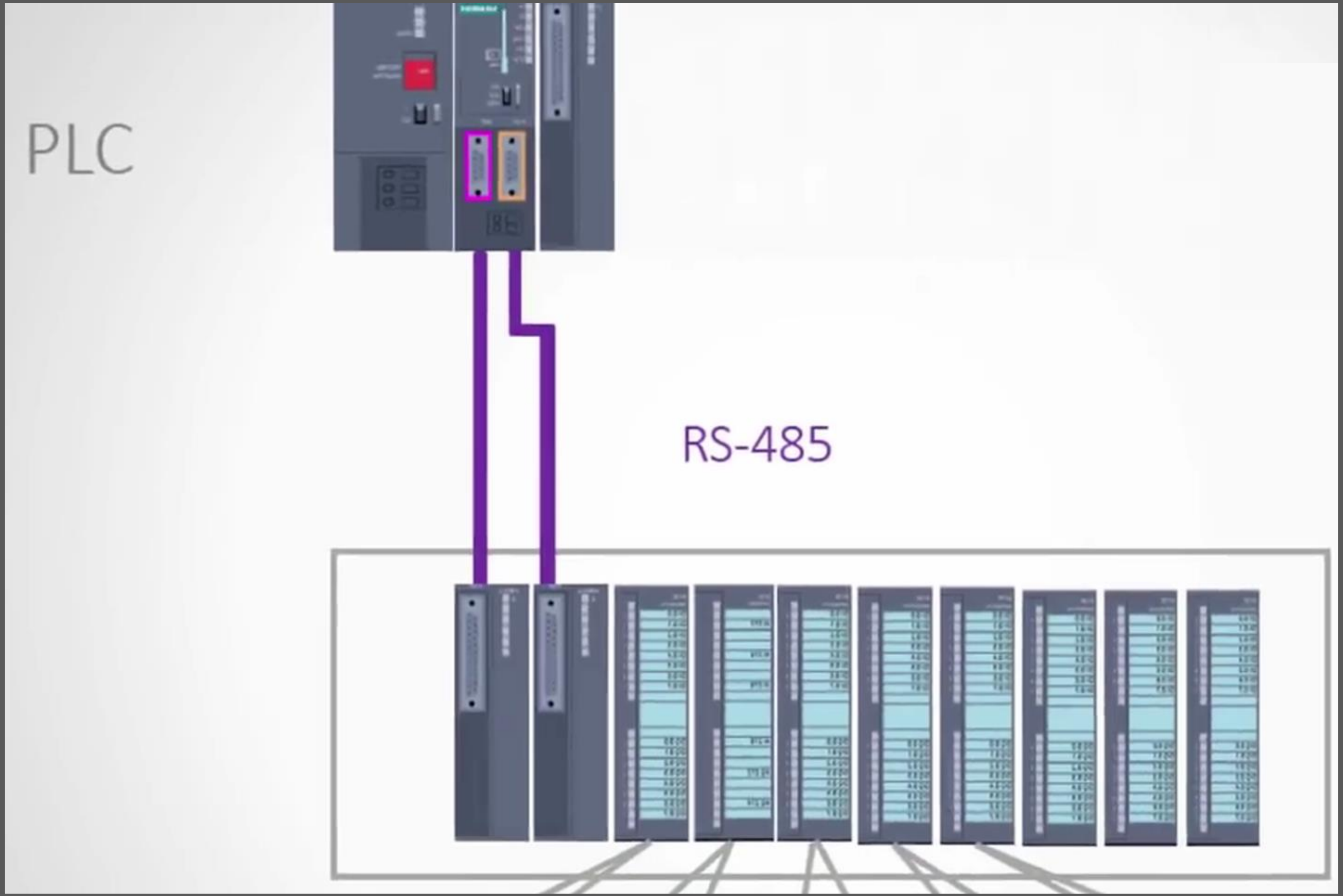
Profibus-DP


PLC
S-485
Sensors

PROFIBUS-DP


PLC
RS-485
Sensors

PROFIBUS-DP



PROFIBUS VS PROFINET

Bus di Campo

PROFI BUS

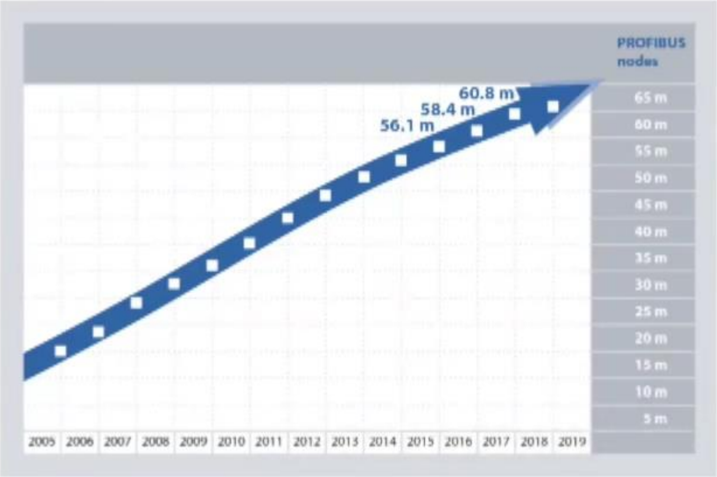
Bus di Campo Seriale

PROFI NET

Protocollo Ethernet Industriale

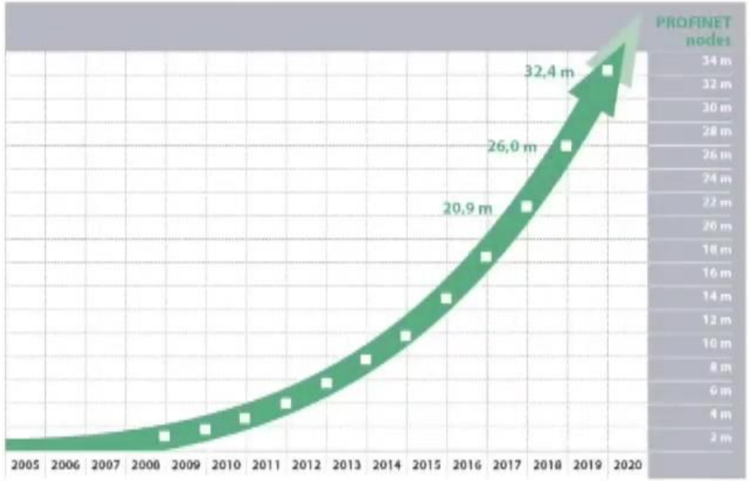
PROFIBUS

1989



PROFINET

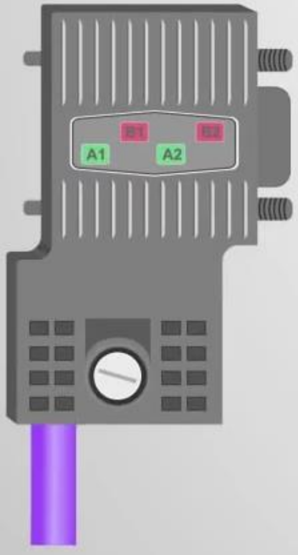
2000s

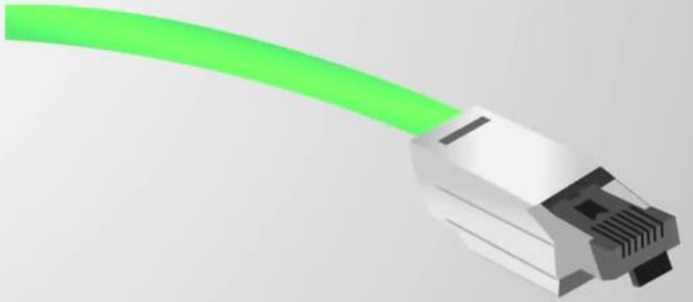


SIEMENS

PROFIBUS

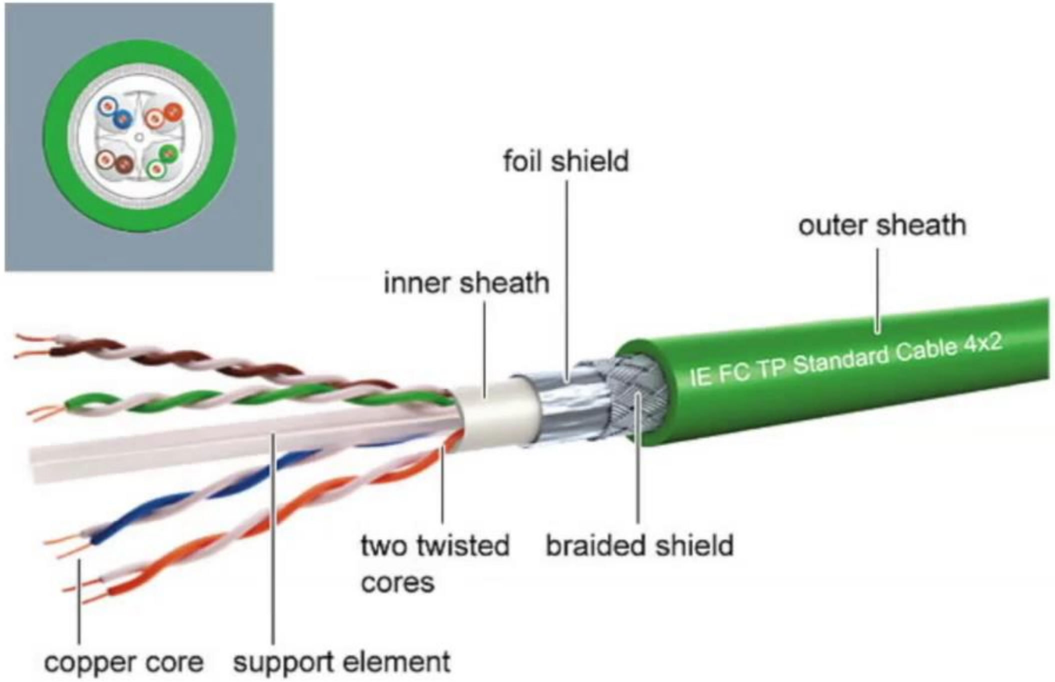
PROFINET





PROFIBUS®

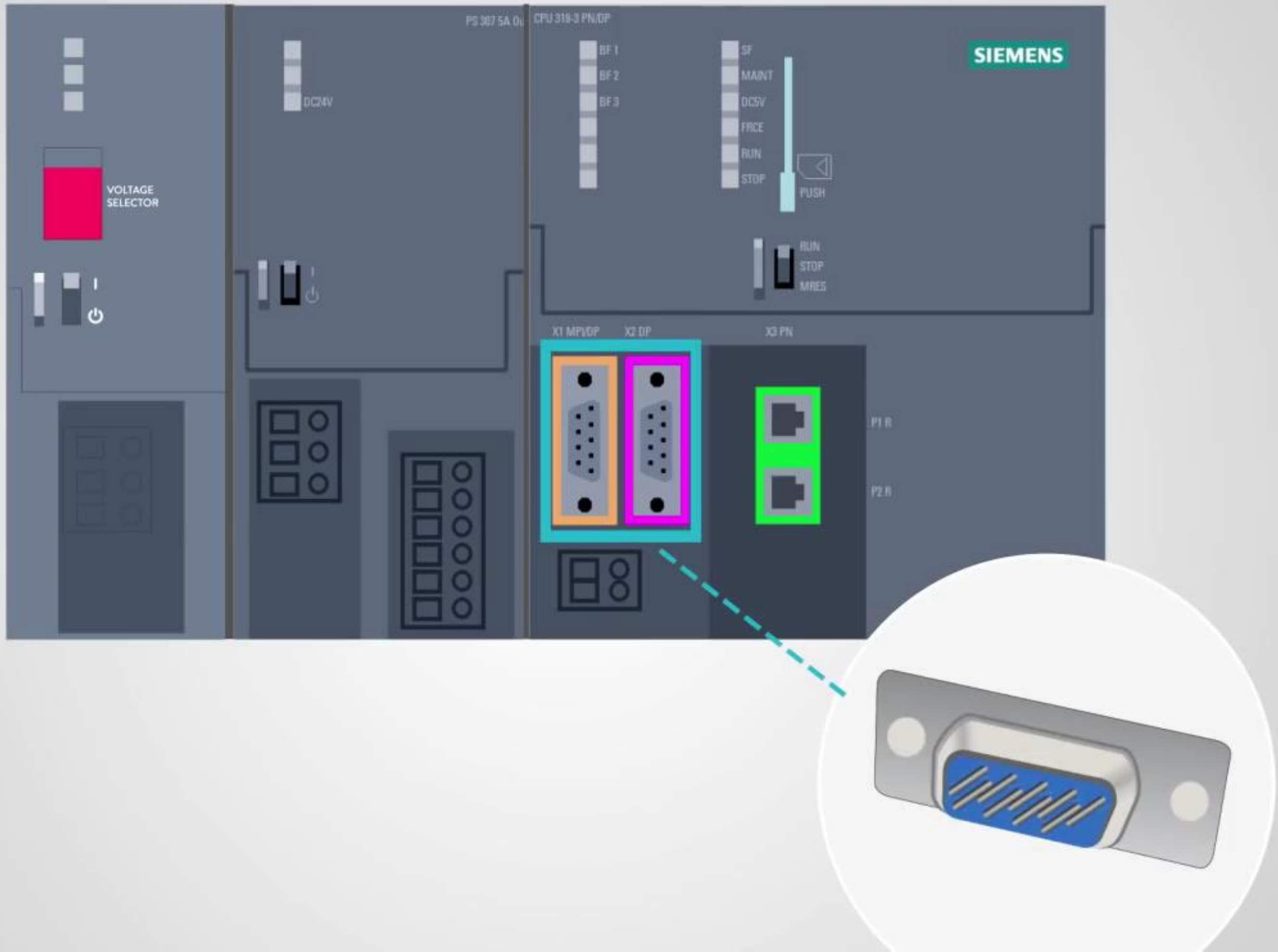
PROFINET®


foil shield
outer sheath
inner sheath
IE FC TP Standard Cable 4x2
two twisted cores
braided shield
copper core
support element

PROFI
BUS

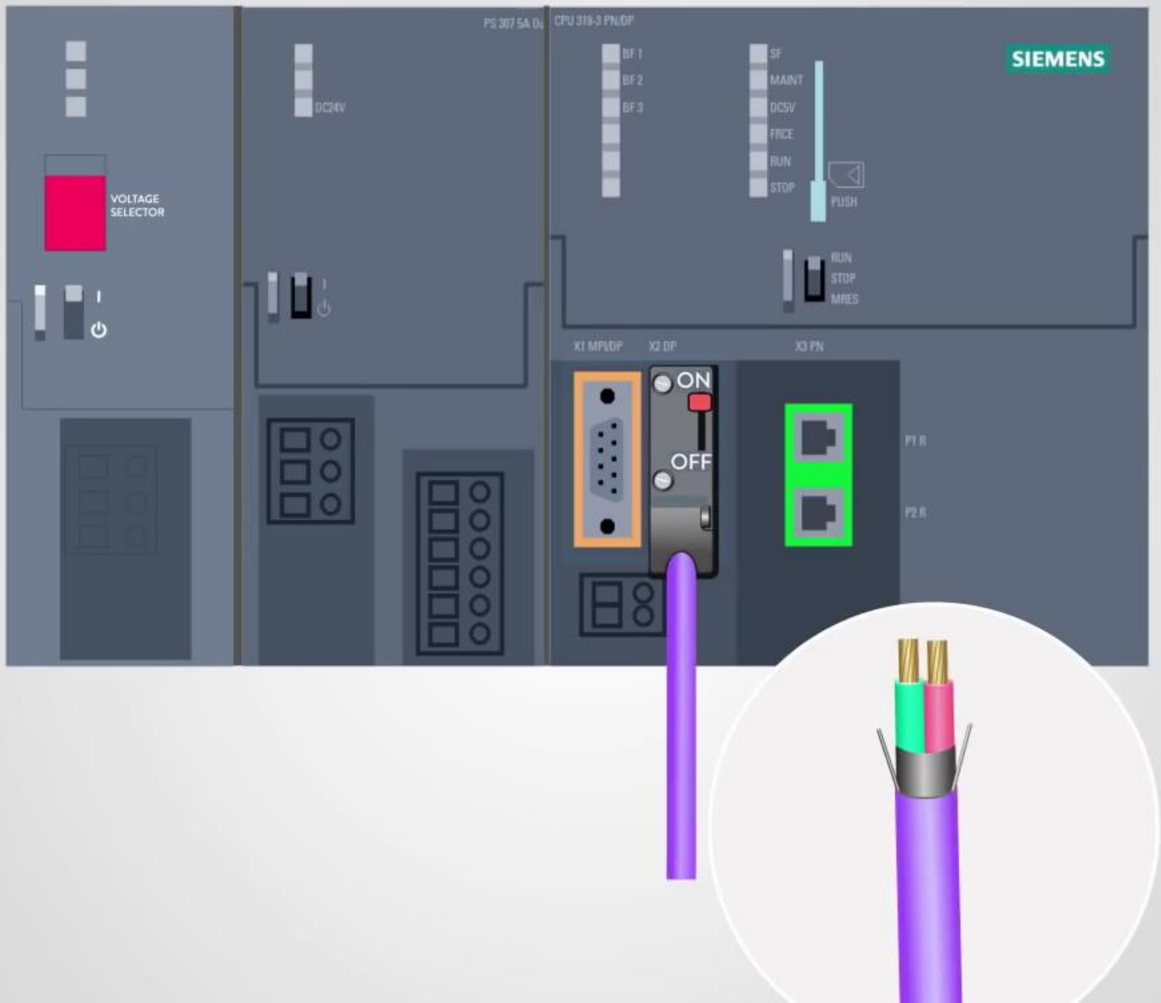
PROcess FIeld BUS

PROFIBUS

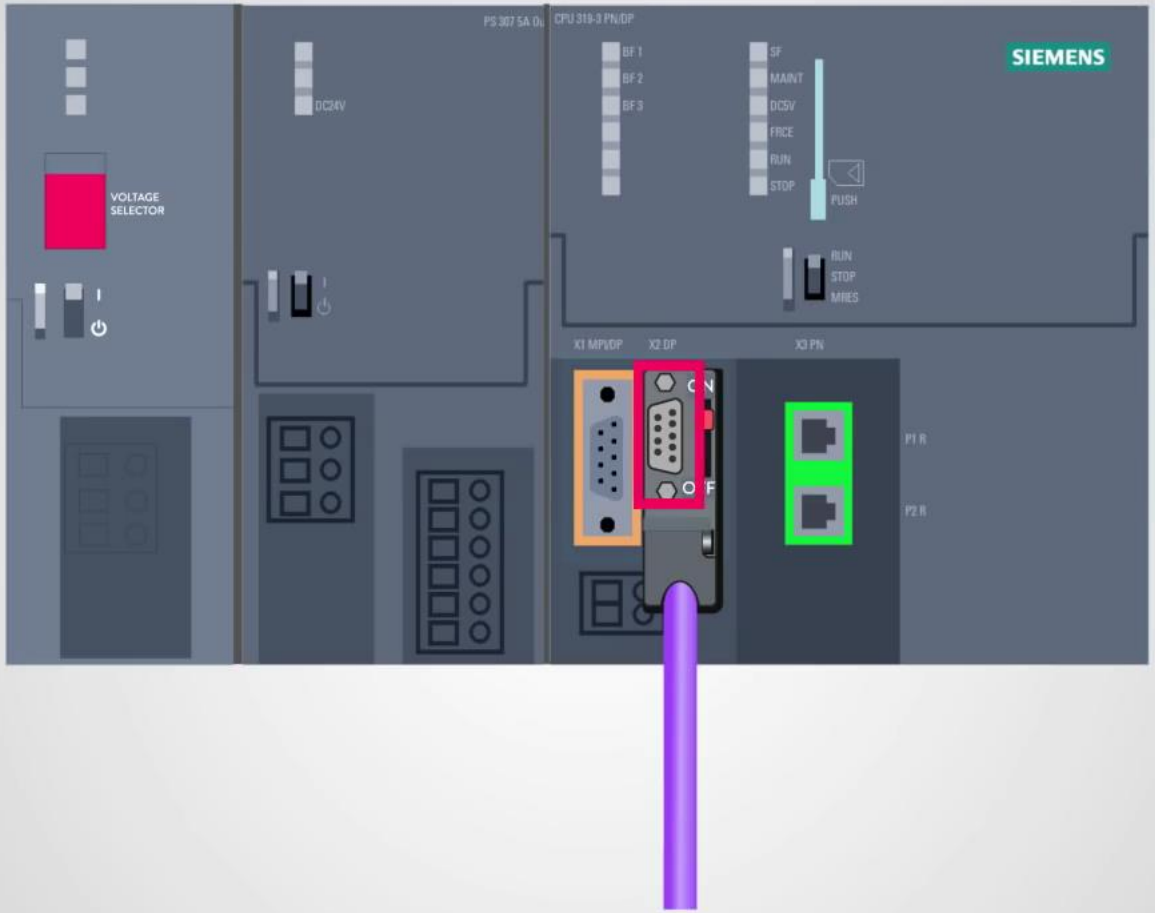

VOLTAGE SELECTOR
DC24V
PS 307 5A
CPU 319-3 PN/DP
SIEMENS
BF 1
BF 2
BF 3
SF
MAINT
DC5V
FRCE
RUN
STOP
PUSH
RUN
STOP
MRES
X1 MPI/DP
X2 DP
X3 PN
P1 R
P2 R

BUS DI CAMPO

PROFI BUS

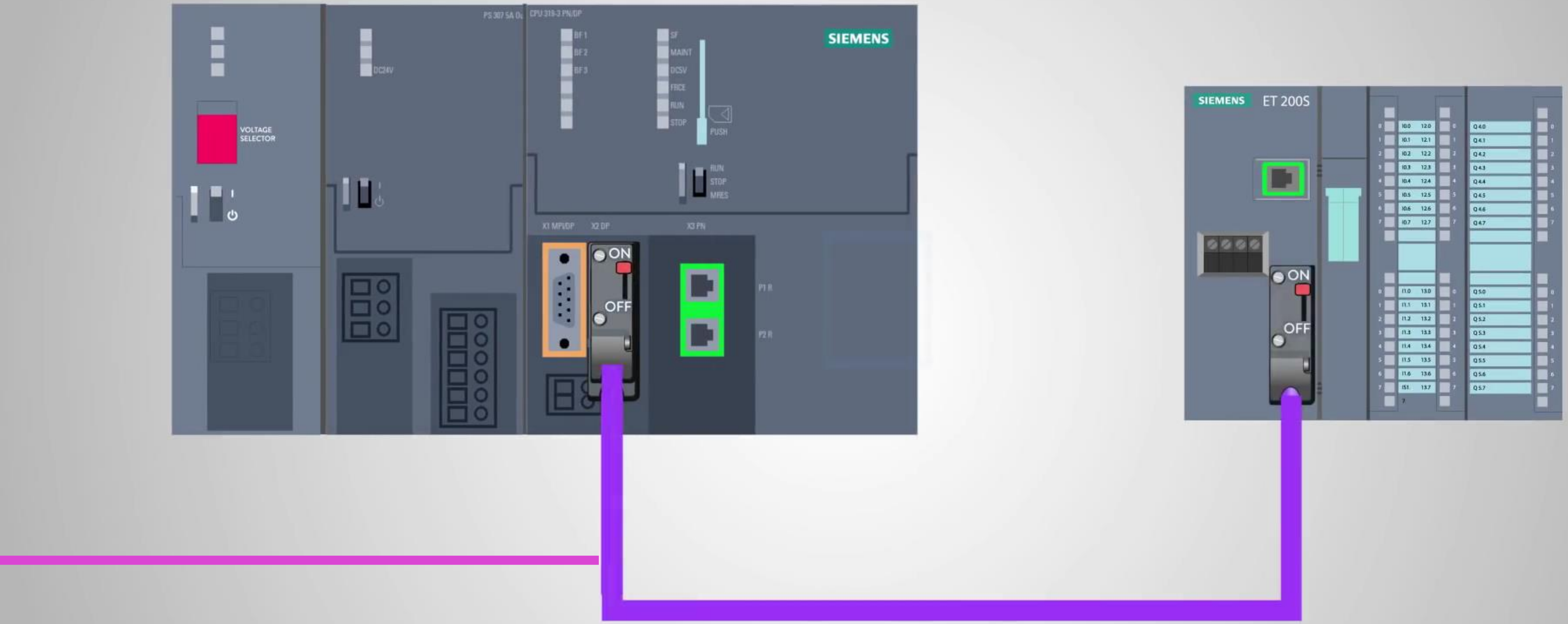

VOLTAGE SELECTOR
DC24V
PS 307 5A
CPU 319-3 PN/DP
BF 1
BF 2
BF 3
SF
MAINT
DC5V
FRCE
RUN
STOP
PUSH
SIEMENS
RUN
STOP
MRES
X1 MPI/DP
X2 DP
X3 PN
ON
OFF
P1 R
P2 R

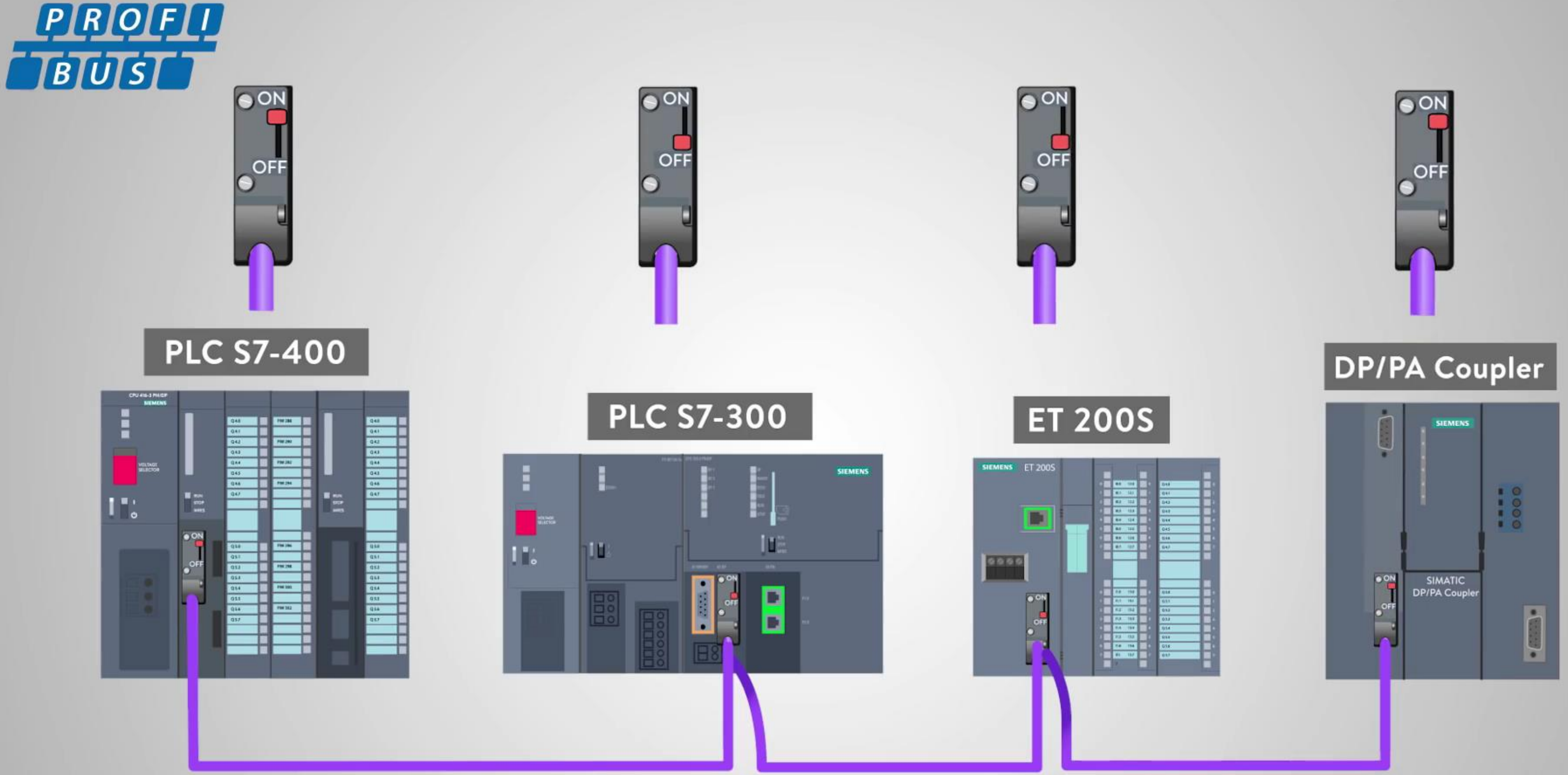
PROFI
BUS


VOLTAGE SELECTOR
DC24V
PS 307 5A
CPU 319-3 PN/DP
BF 1
BF 2
BF 3
SF
MAINT
DC5V
FRCE
RUN
STOP
PUSH
SIEMENS
RUN
STOP
MRES
X1 MPI/DP
X2 DP
X3 PN
ON
OFF
P1 R
P2 R

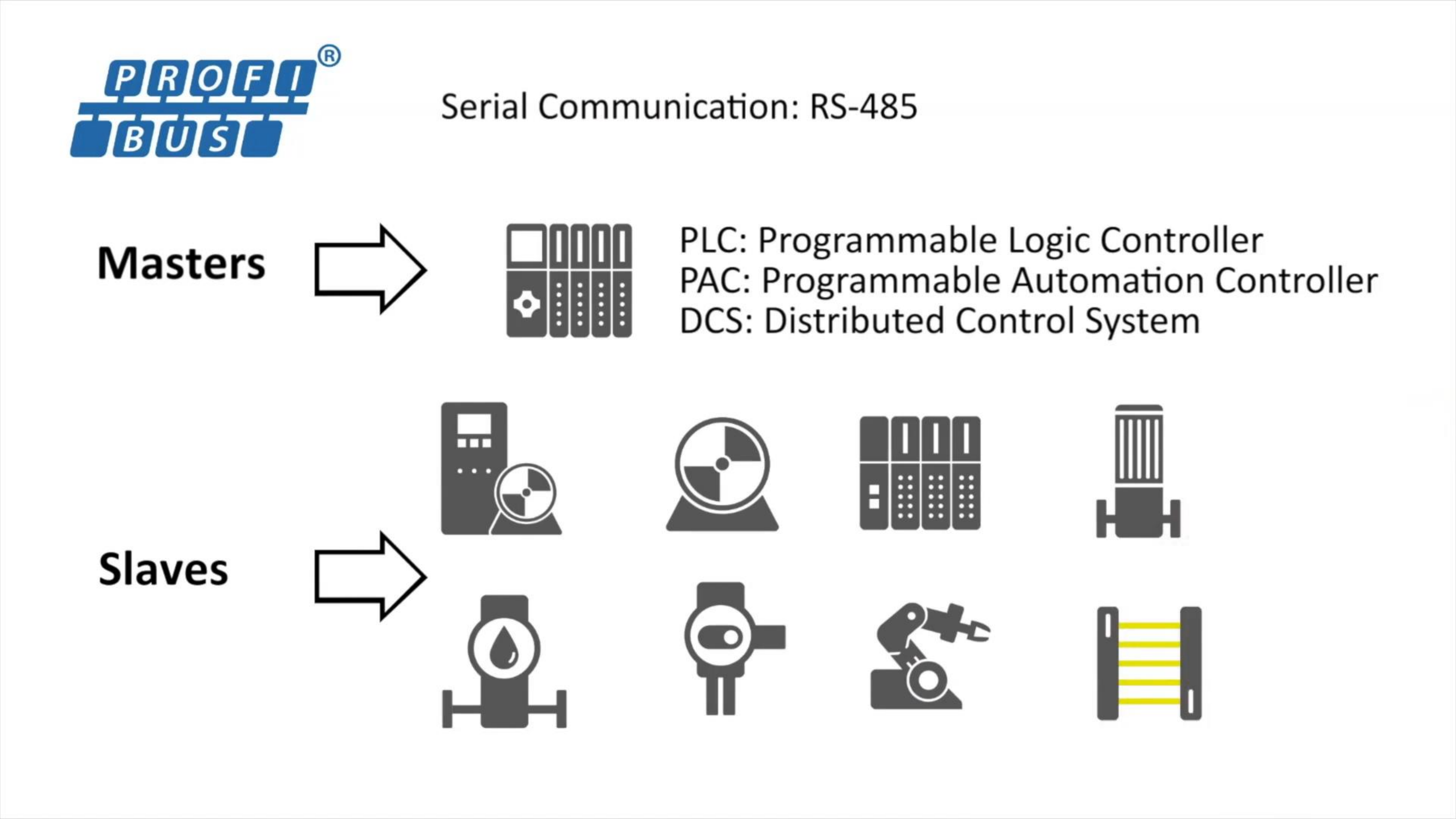
BUS DI CAMPO

PROFIBUS


VOLTAGE SELECTOR
PS 307 5A
CPU 319-3 PN/DP
DC24V
BF 1
BF 2
BF 3
SF
MAINT
DC5V
FRCE
RUN
STOP
PUSH
RUN
STOP
MRES
SIEMENS
X1 MPI/DP
X2 DP
X3 PN
ON
OFF
P1 R
P2 R
SIEMENS
ET 200S
ON
OFF


PROFI BUS
ON
OFF
PLC S7-400
PLC S7-300
ET 200S
DP/PA Coupler
SIEMENS
ET 200S
SIMATIC DP/PA Coupler

BUS DI CAMPO



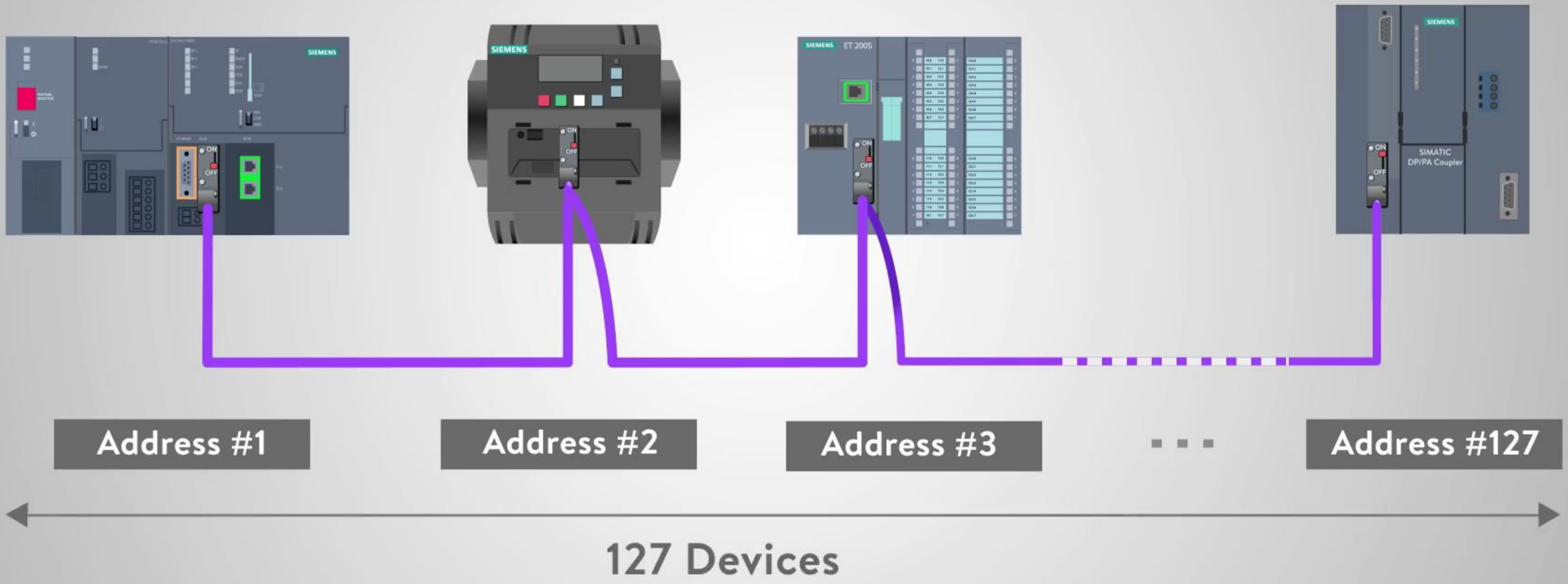
Serial Communication: RS-485

Masters

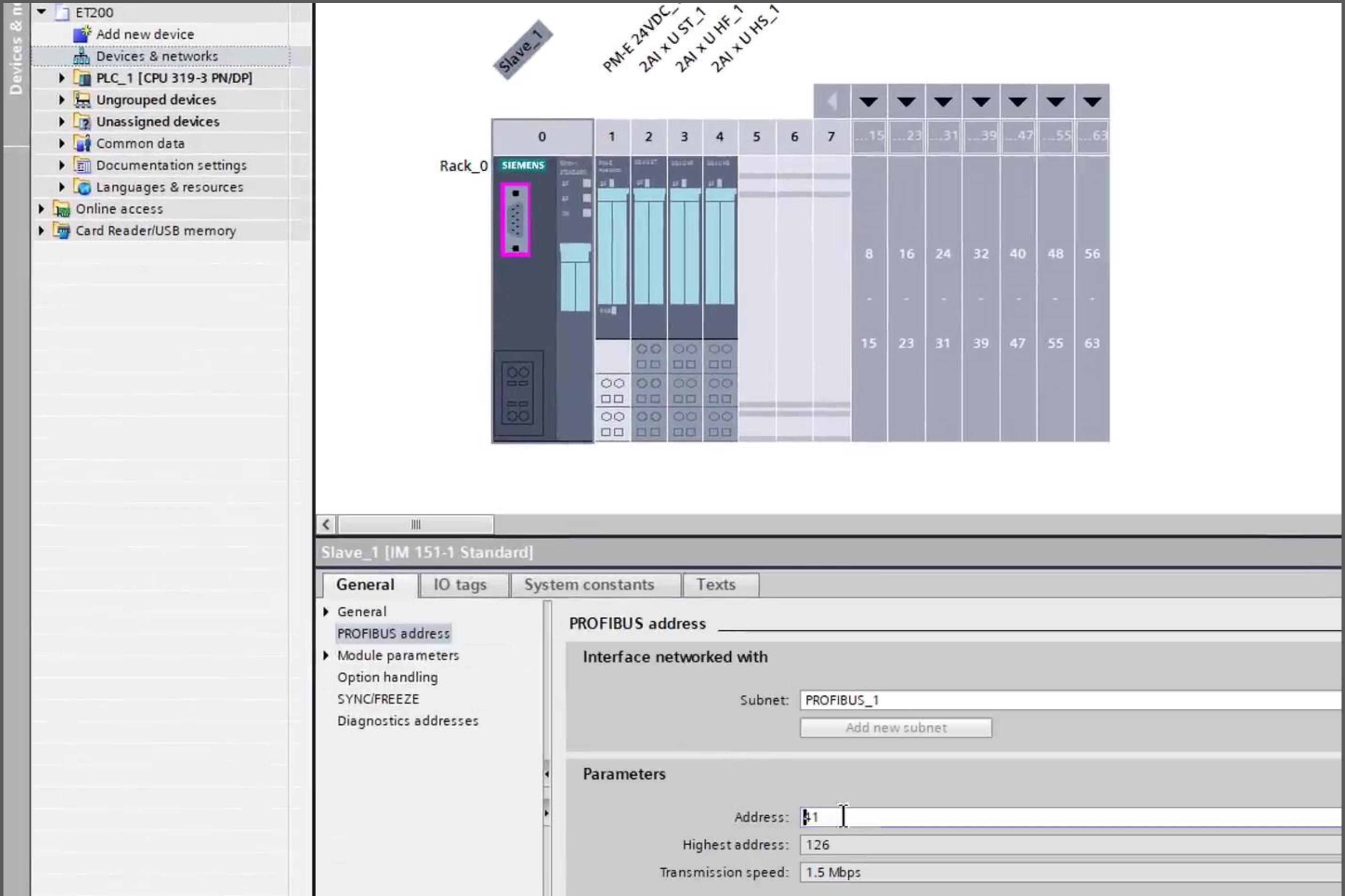
PLC: Programmable Logic Controller
PAC: Programmable Automation Controller
DCS: Distributed Control System

Slaves

PROFIBUS


SIEMENS
ON
OFF
SIEMENS
ON
OFF
SIEMENS ET 200S
ON
OFF
SIEMENS
SIMATIC DP/PA Coupler
ON
OFF
Address #1
Address #2
Address #3
...
Address #127
127 Devices

Bus di Campo


Devices & n
ET200
Add new device
Devices & networks
PLC_1 [CPU 319-3 PN/DP]
Ungrouped devices
Unassigned devices
Common data
Documentation settings
Languages & resources
Online access
Card Reader/USB memory
Slave_1
PM-E 24VDC_
2AI x U ST_1
2AI x U HF_1
2AI x U HS_1
Rack_0
SIEMENS
0
1
2
3
4
5
6
7
...15
...23
...31
...39
...47
...55
...63
8
16
24
32
40
48
56
15
23
31
39
47
55
63
General
IO tags
System constants
Texts
General
PROFIBUS address
Module parameters
Option handling
SYNC/FREEZE
Diagnostics addresses
Add new subnet

Slave_1 [IM 151-1 Standard]

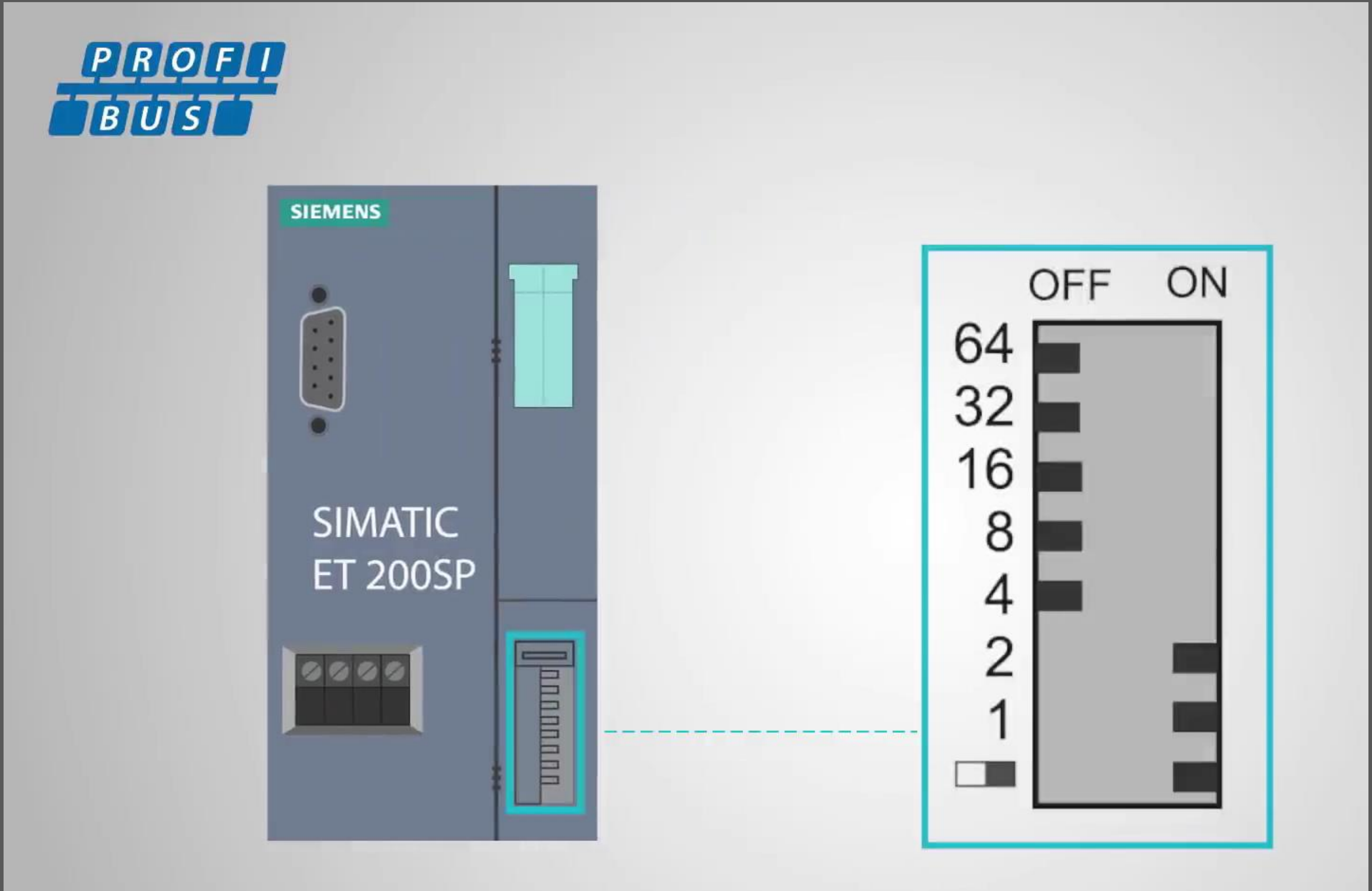
PROFIBUS address

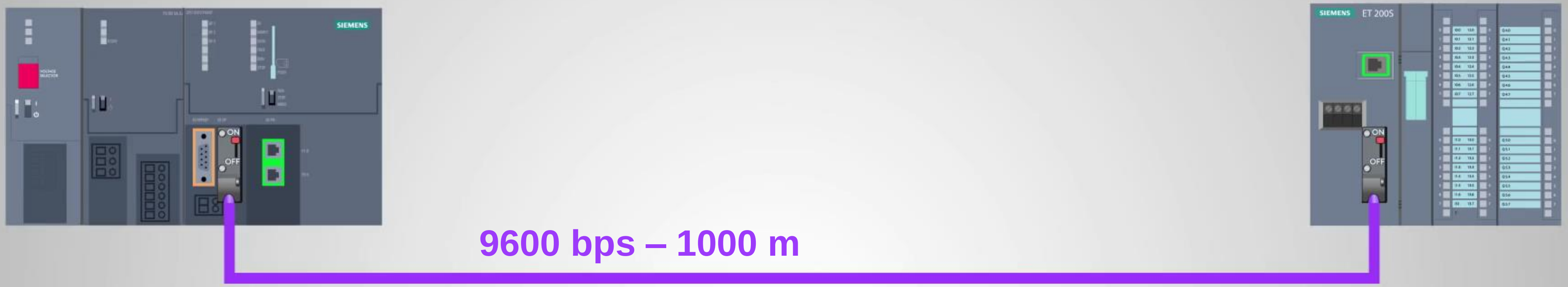
Interface networked with

Subnet: PROFIBUS_1

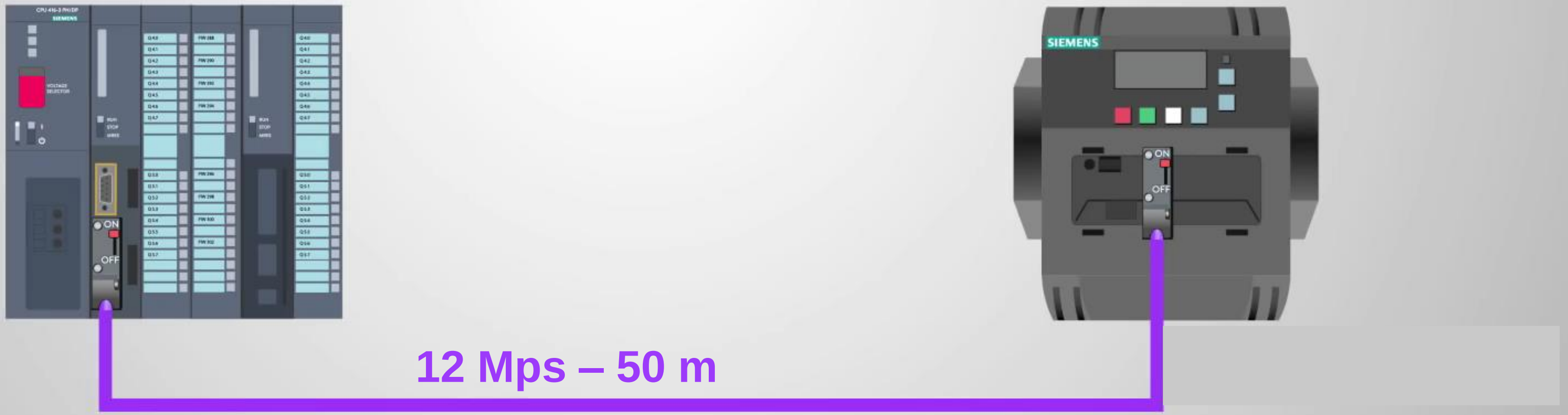
Parameters

Address: 41
Highest address: 126
Transmission speed: 1.5 Mbps

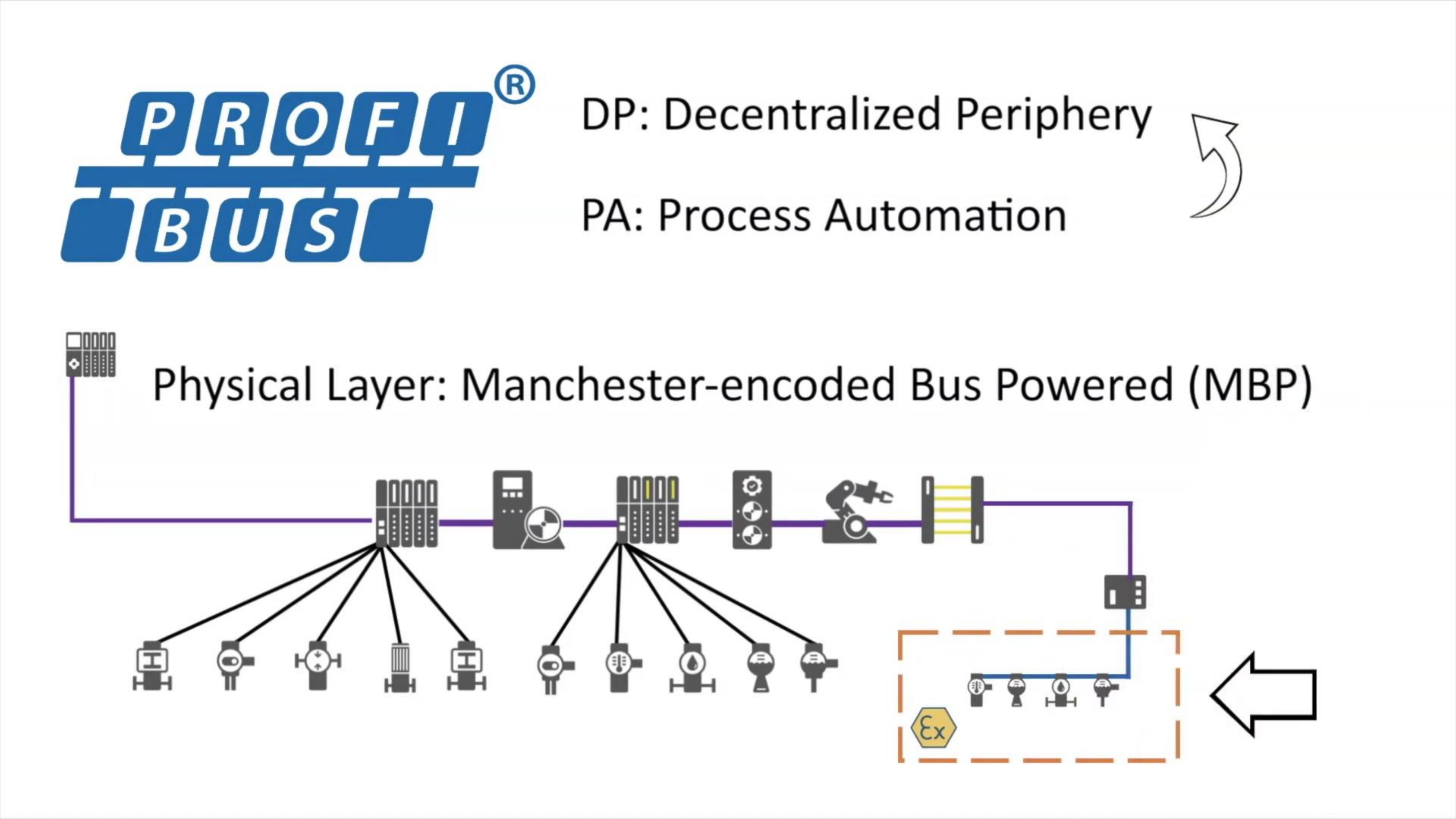

PROFI BUS
SIEMENS
SIMATIC
ET 200SP
OFF
ON
64
32
16
8
4
2
1



9600 bps – 1000 m



12 Mps – 50 m

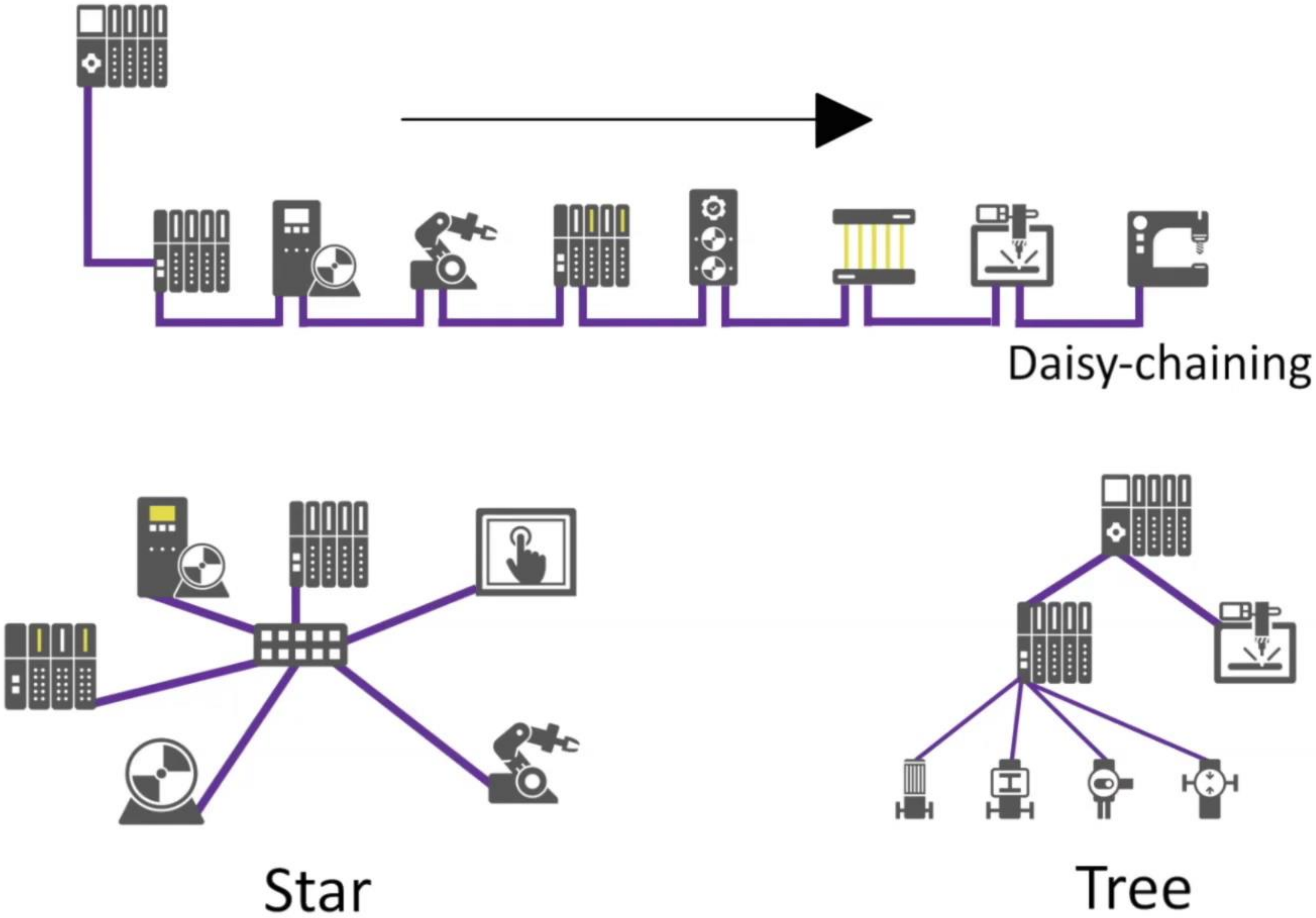


PROFIBUS®

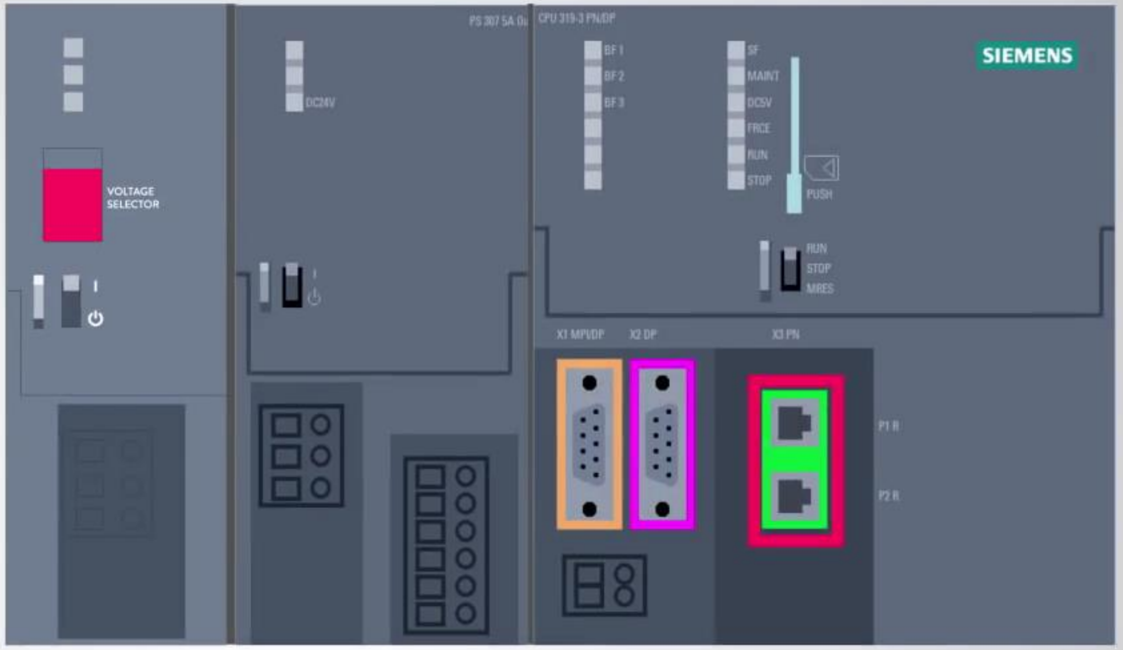
DP: Decentralized Periphery

PA: Process Automation

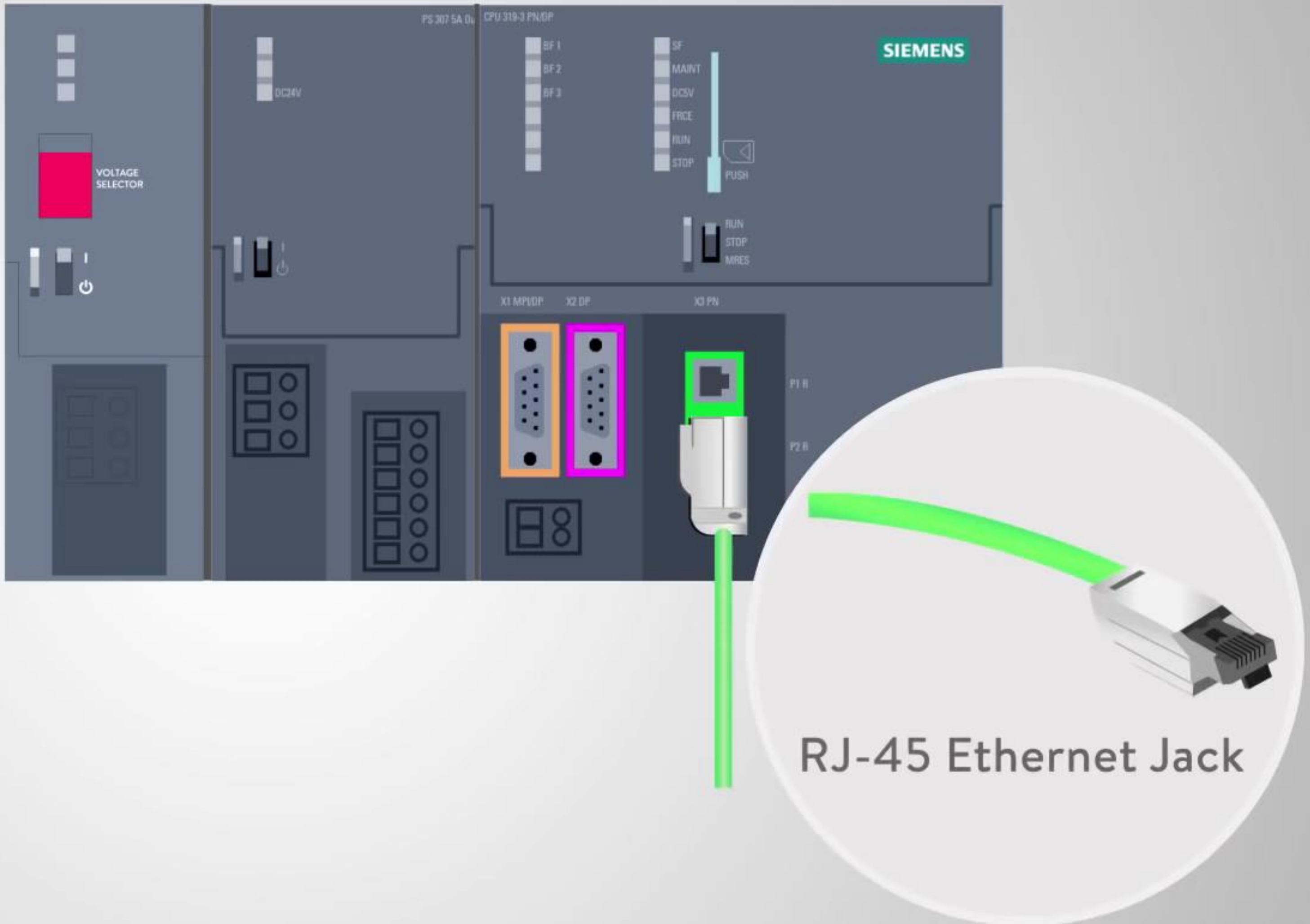
Physical Layer: Manchester-encoded Bus Powered (MBP)

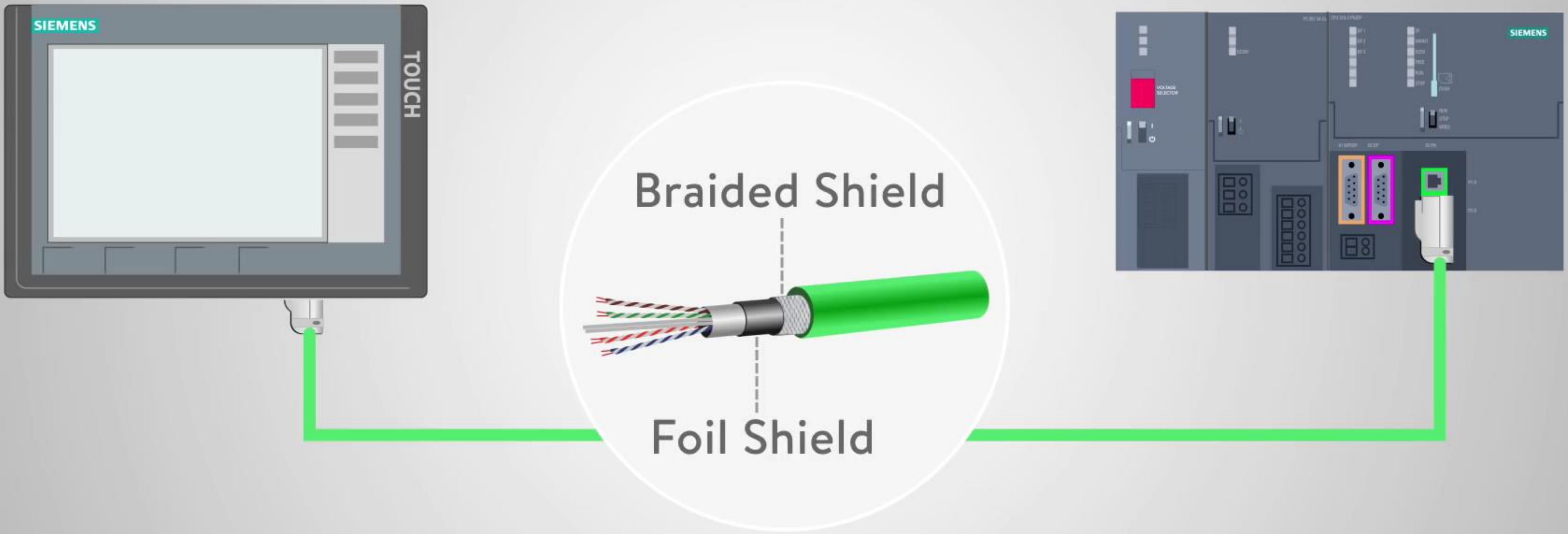

Daisy-chaining
Star
Tree

PROFINET

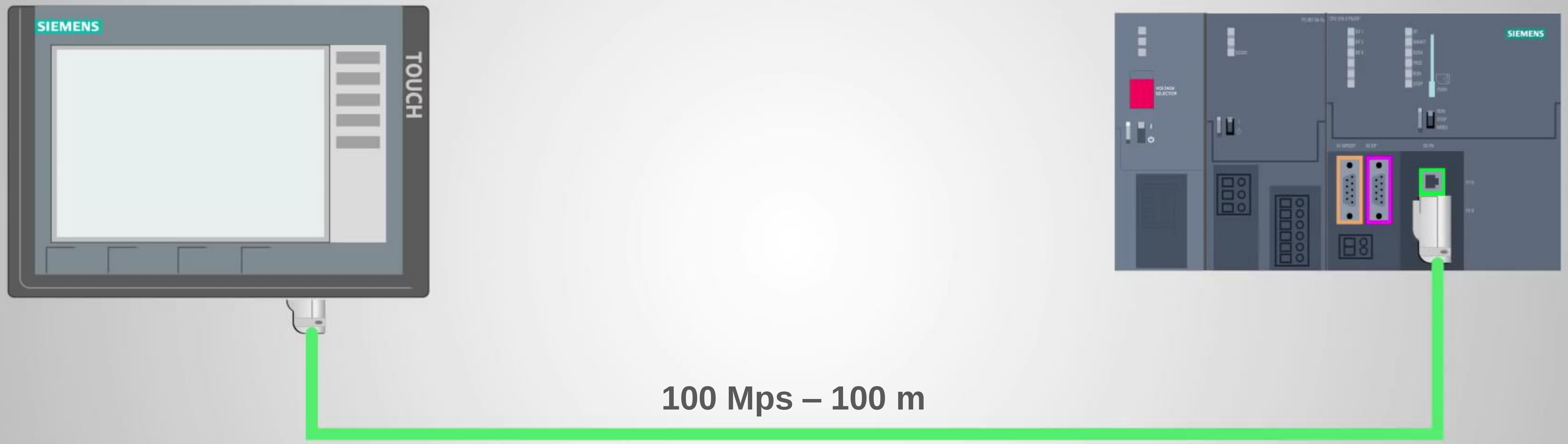

VOLTAGE SELECTOR
PS 307 5A
DC24V
CPU 319-3 PN/DP
BF 1
BF 2
BF 3
SF
MAINT
DC5V
FRCE
RUN
STOP
PUSH
SIEMENS
RUN
STOP
MRES
X1 MPI/DP
X2 DP
X3 PN
P1 R
P2 R

PROFINET


VOLTAGE SELECTOR
DC24V
PS 307 5A
CPU 319-3 PN/DP
SIEMENS
BF 1
BF 2
BF 3
SF
MAINT
DC5V
FRCE
RUN
STOP
PUSH
RUN
STOP
MRES
X1 MPI/DP
X2 DP
X3 PN
P1 R
P2 R
RJ-45 Ethernet Jack

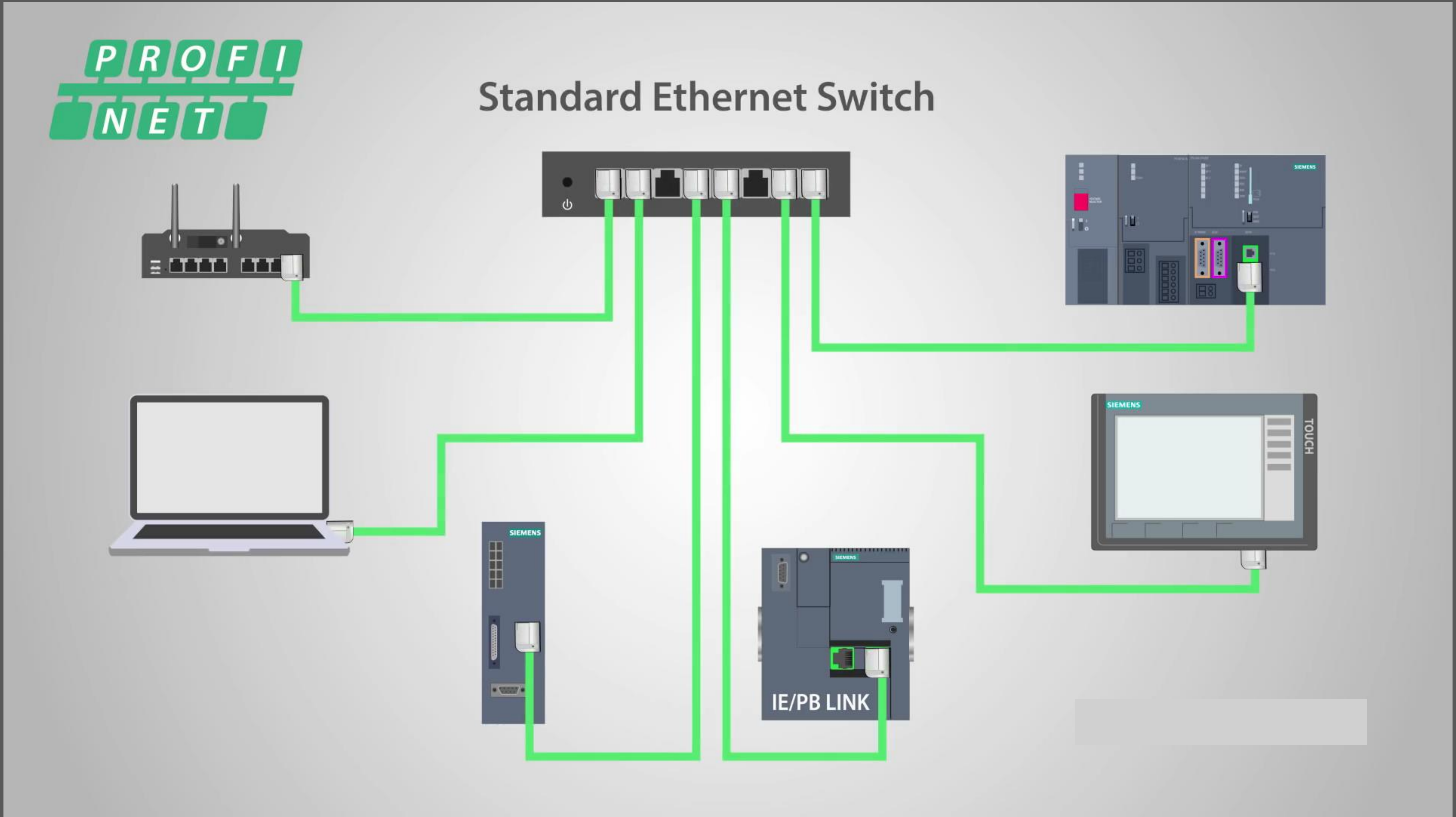

SIEMENS
TOUCH
Braided Shield
Foil Shield
SIEMENS

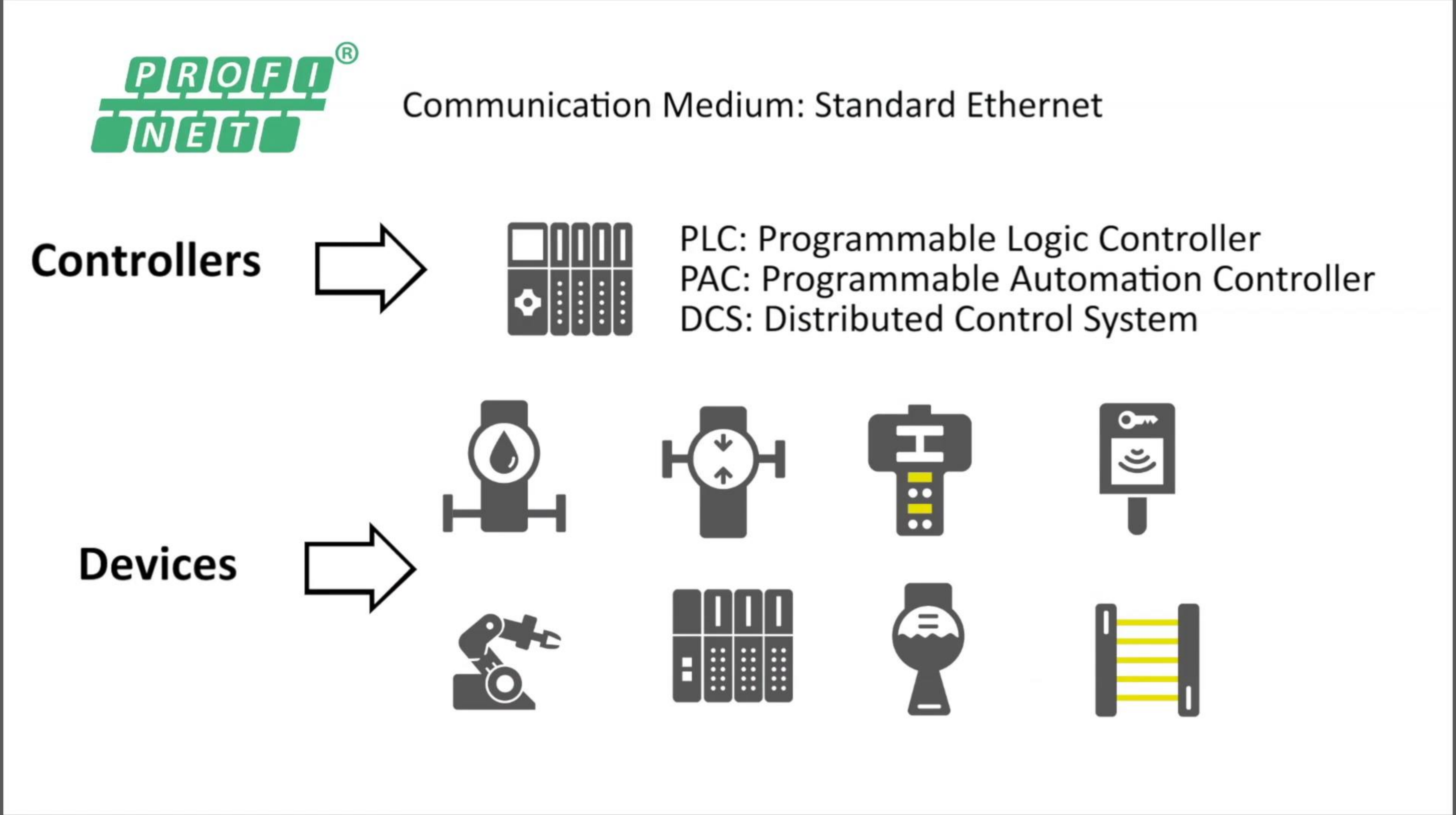
Bus di Campo


SIEMENS
TOUCH
SIEMENS

100 Mps – 100 m

Tempo di Risposta < 1ms


PROFI
NET
Standard Ethernet Switch
SIEMENS
SIEMENS
TOUCH
SIEMENS
SIEMENS
IE/PB LINK



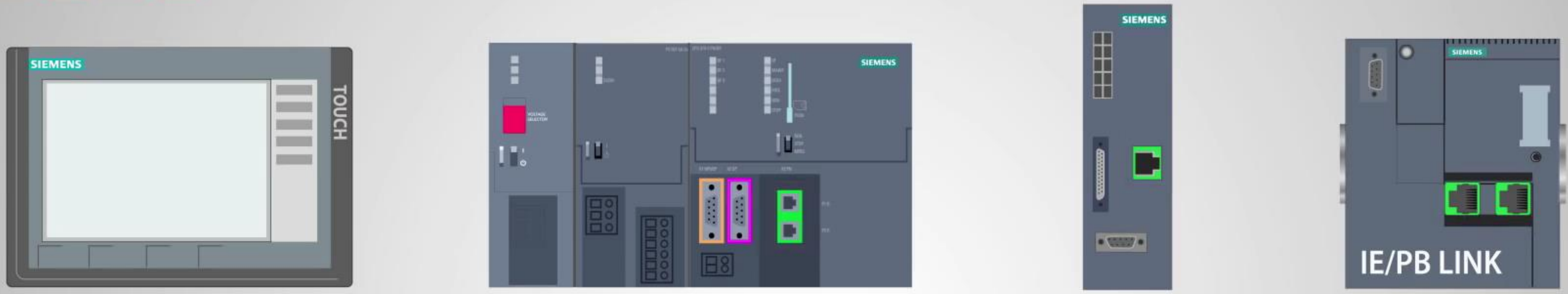
PROFINET®

Communication Medium: Standard Ethernet

Controllers

PLC: Programmable Logic Controller
PAC: Programmable Automation Controller
DCS: Distributed Control System

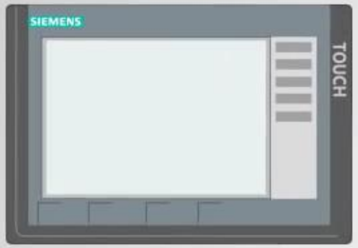
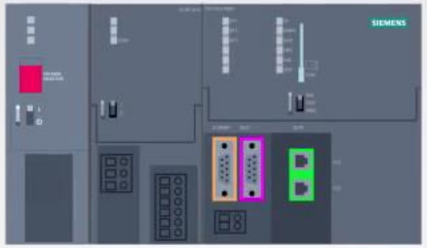
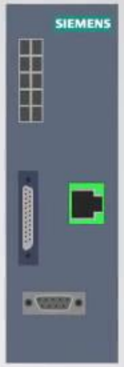
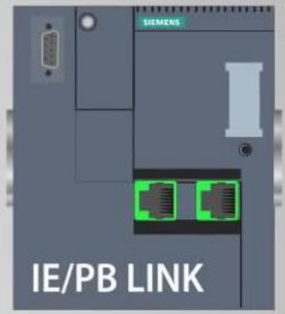
Devices

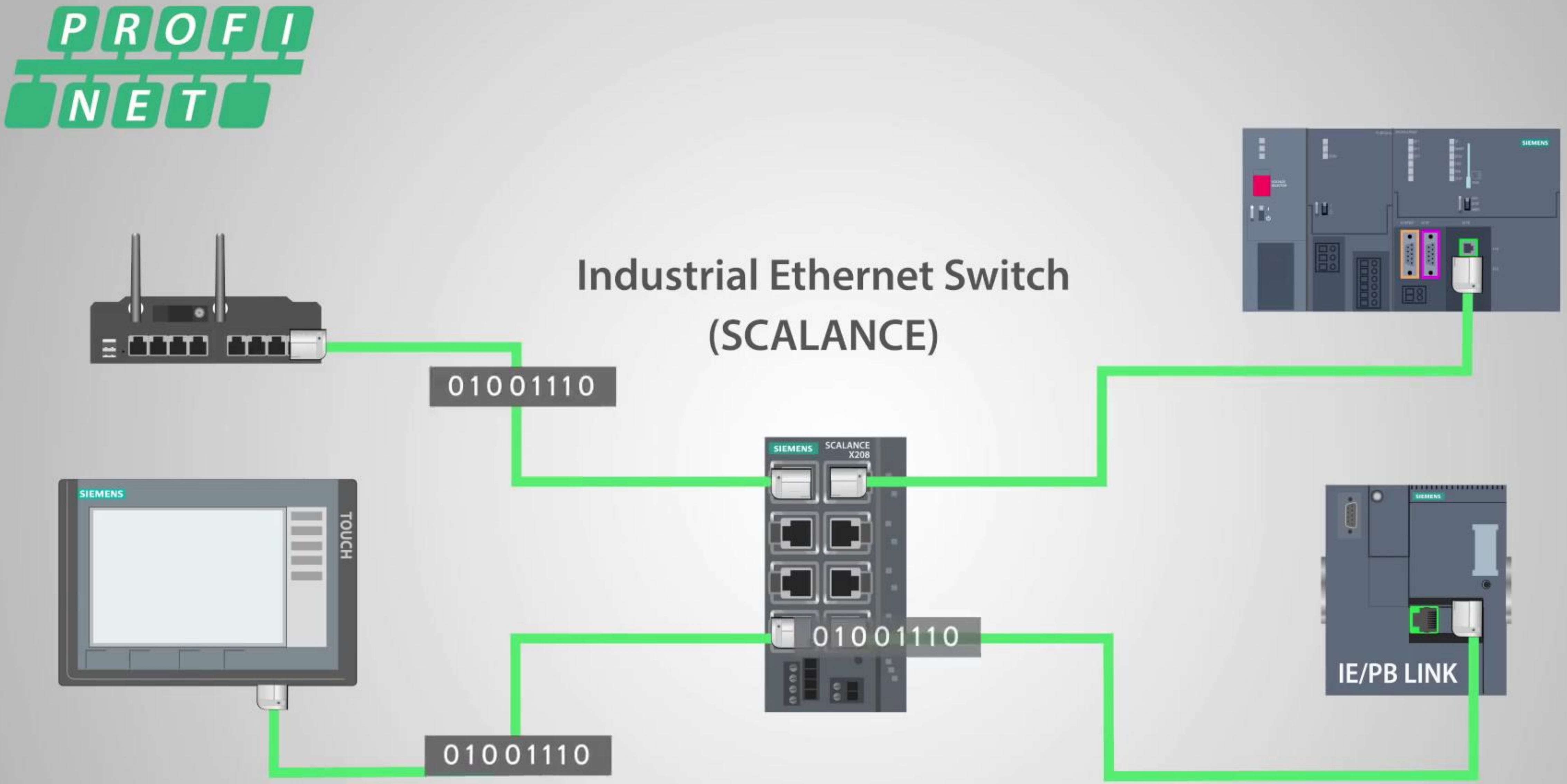

SIEMENS
TOUCH
SIEMENS
SIEMENS
SIEMENS
IE/PB LINK

Types of Addresses in Profinet Devices

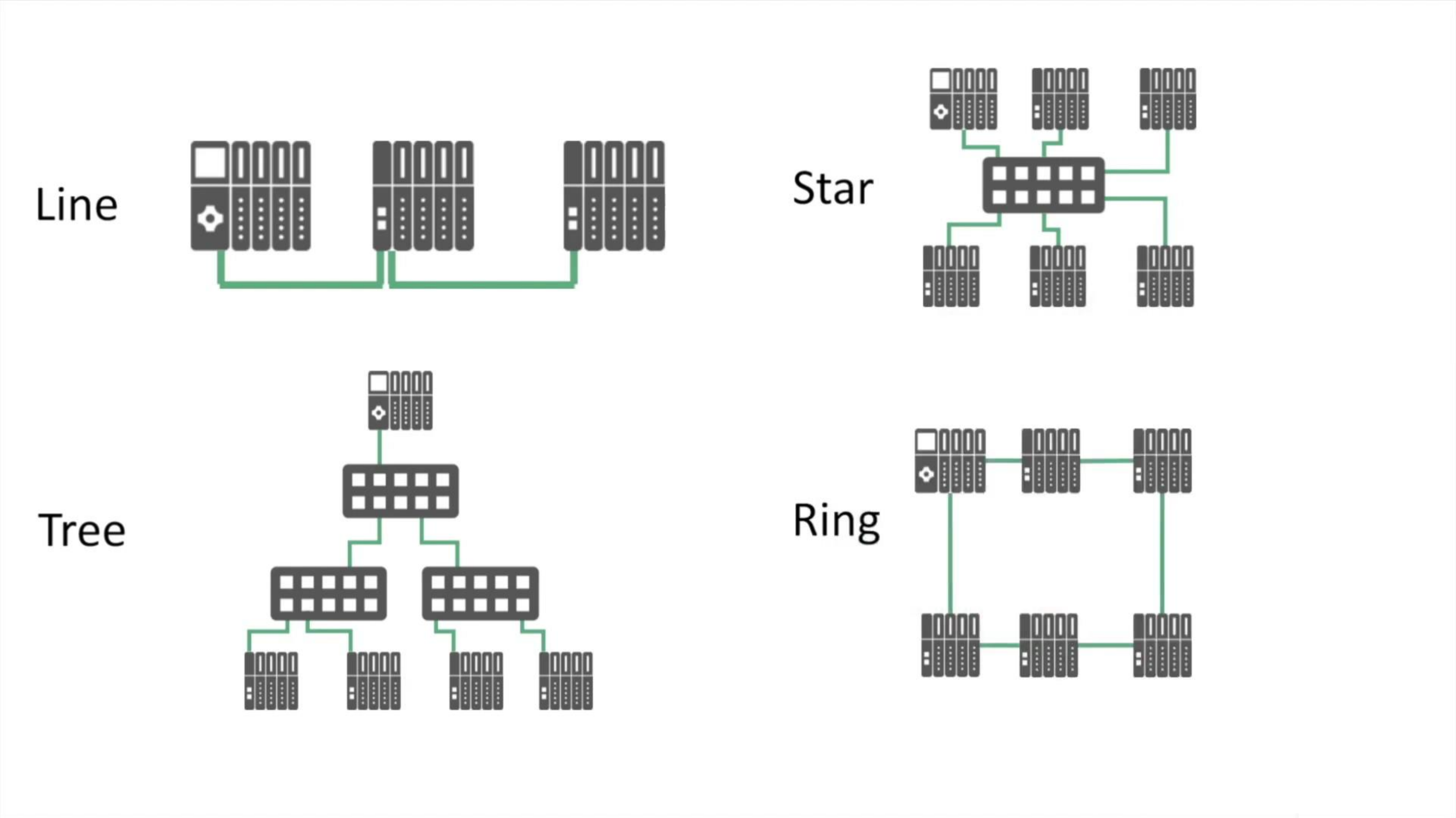
- IP Address
- MAC Address
- Device Name

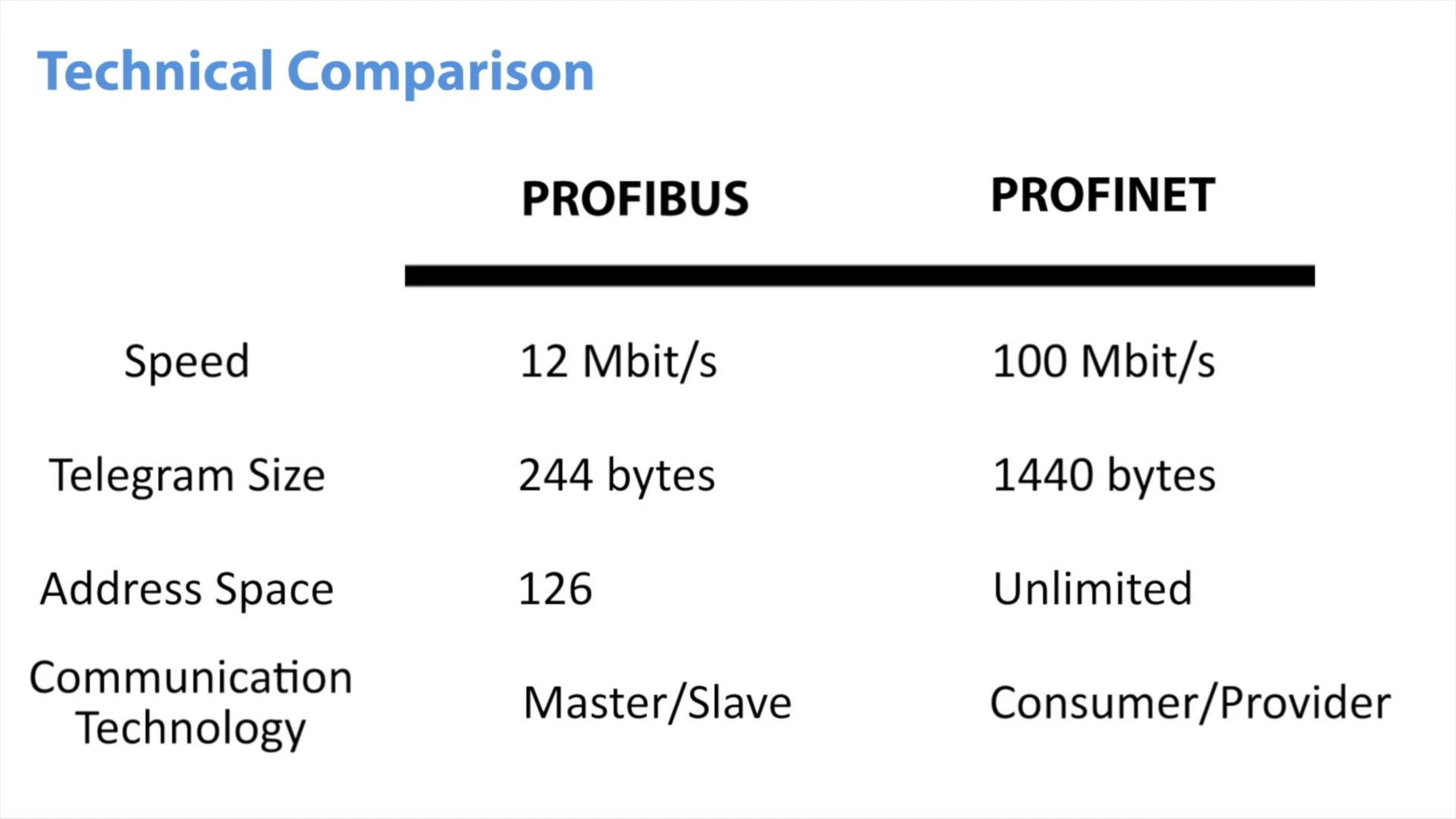
PROFI NET

				
Device Name	HMI_1	PLC_1	Drive_1	IE-PB_1
IP Address	192.168.0.1	192.168.0.2	192.168.0.3	192.168.0.4
MAC Address	28-63-36-0E-F6-E8	00-1C-06-0B-F2-46	00-1F-F8-F4-70-89	00-00-24-1A-35-C8


PROFI NET
Industrial Ethernet Switch
(SCALANCE)
01001110
01001110
01001110
SIEMENS
SCALANCE X208
SIEMENS
TOUCH
SIEMENS
SIEMENS
IE/PB LINK

BUS DI CAMPO

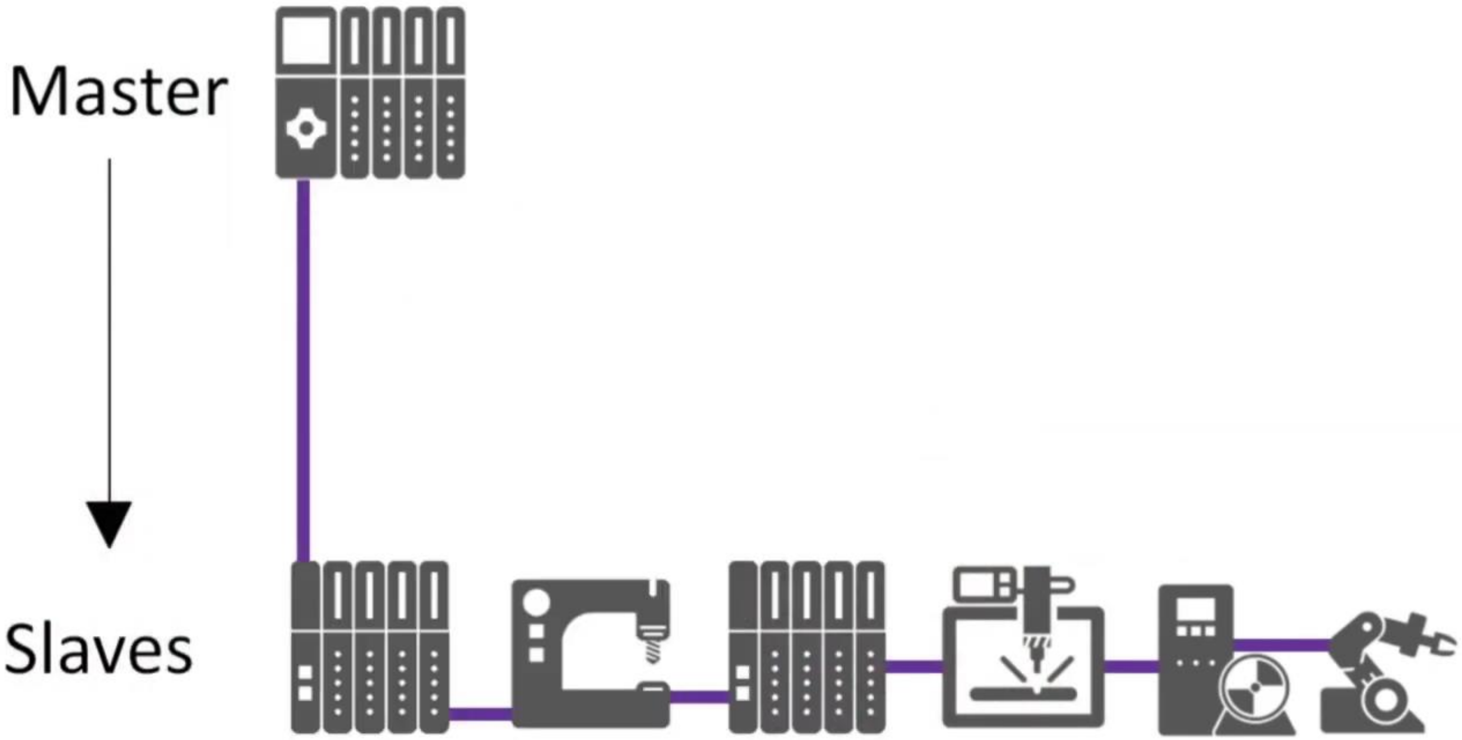

Line
Star
Tree
Ring



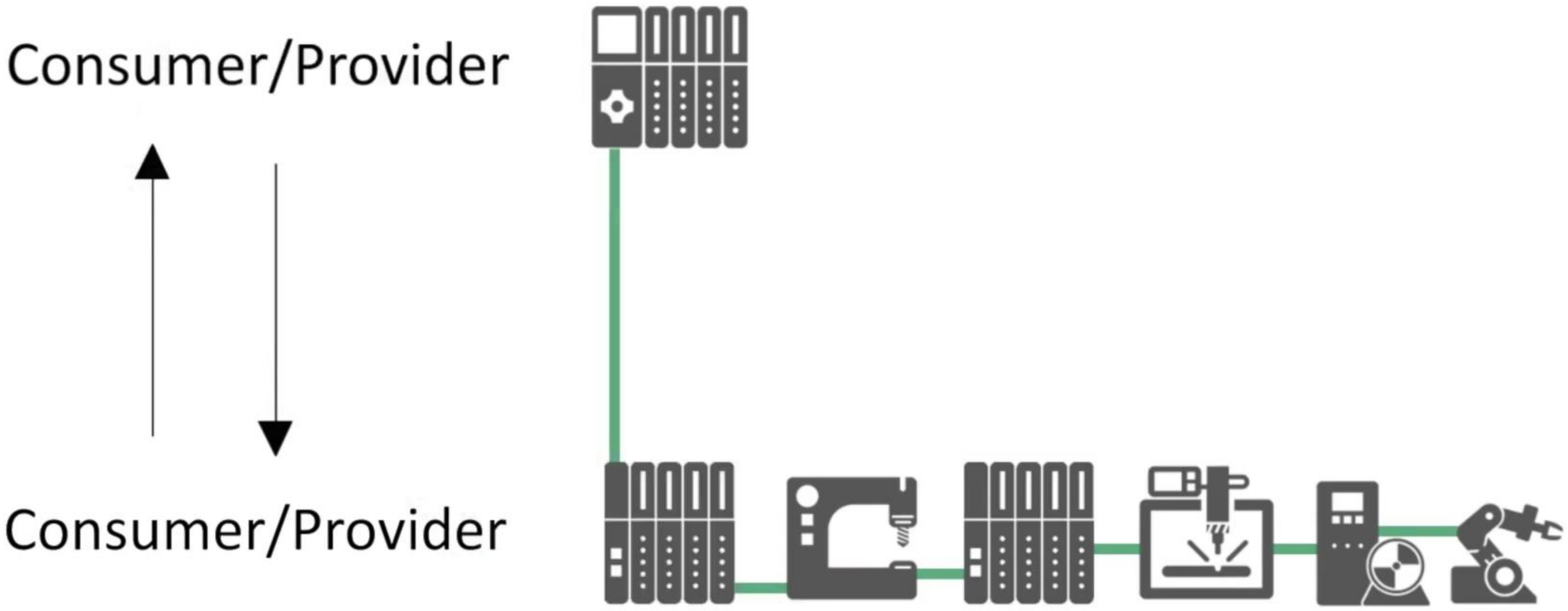
Technical Comparison

	PROFIBUS	PROFINET
Speed	12 Mbit/s	100 Mbit/s
Telegram Size	244 bytes	1440 bytes
Address Space	126	Unlimited
Communication Technology	Master/Slave	Consumer/Provider

Master-Slave Interaction


Master
Slaves

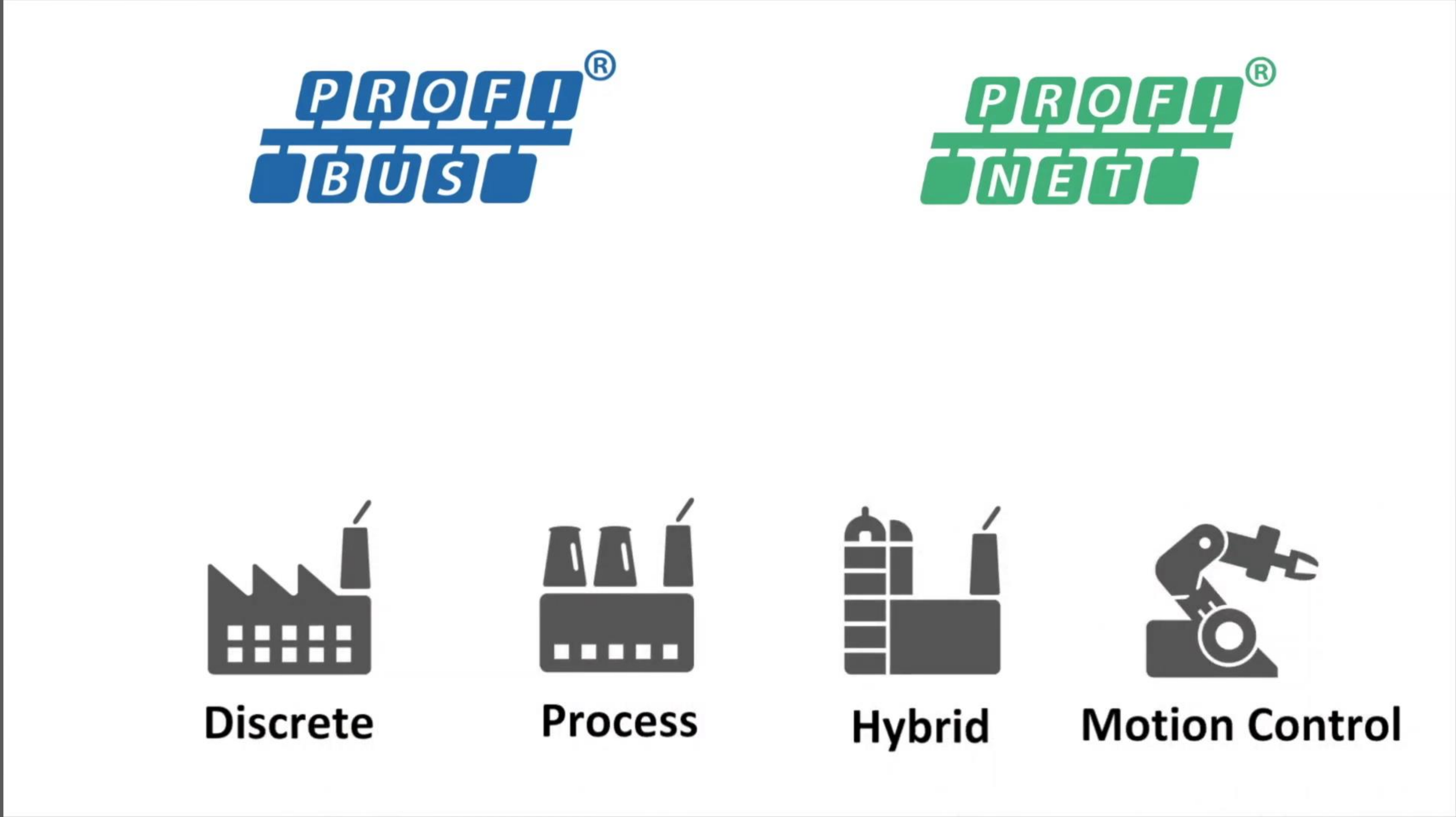
Consumer-Provider Model



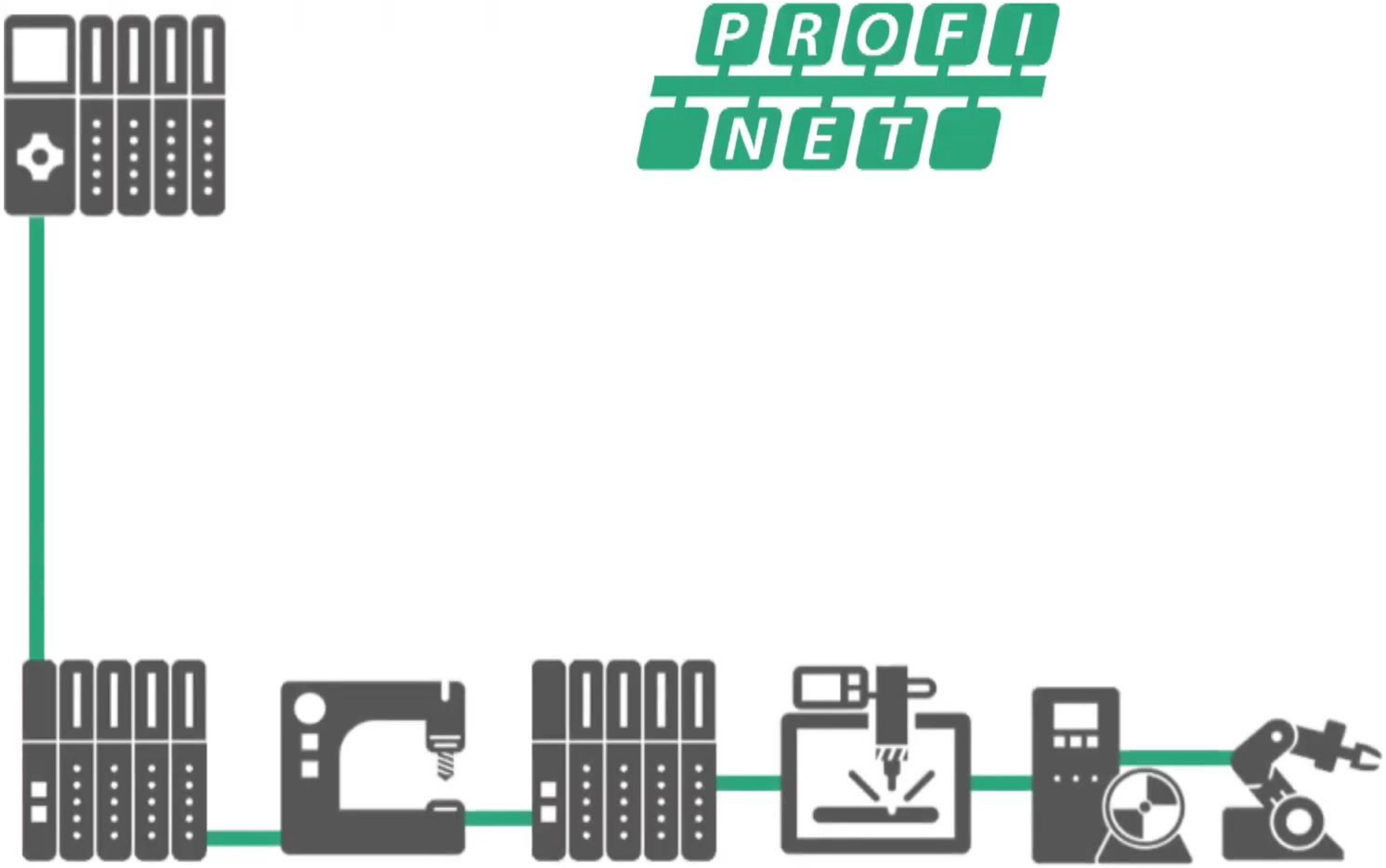
Consumer/Provider

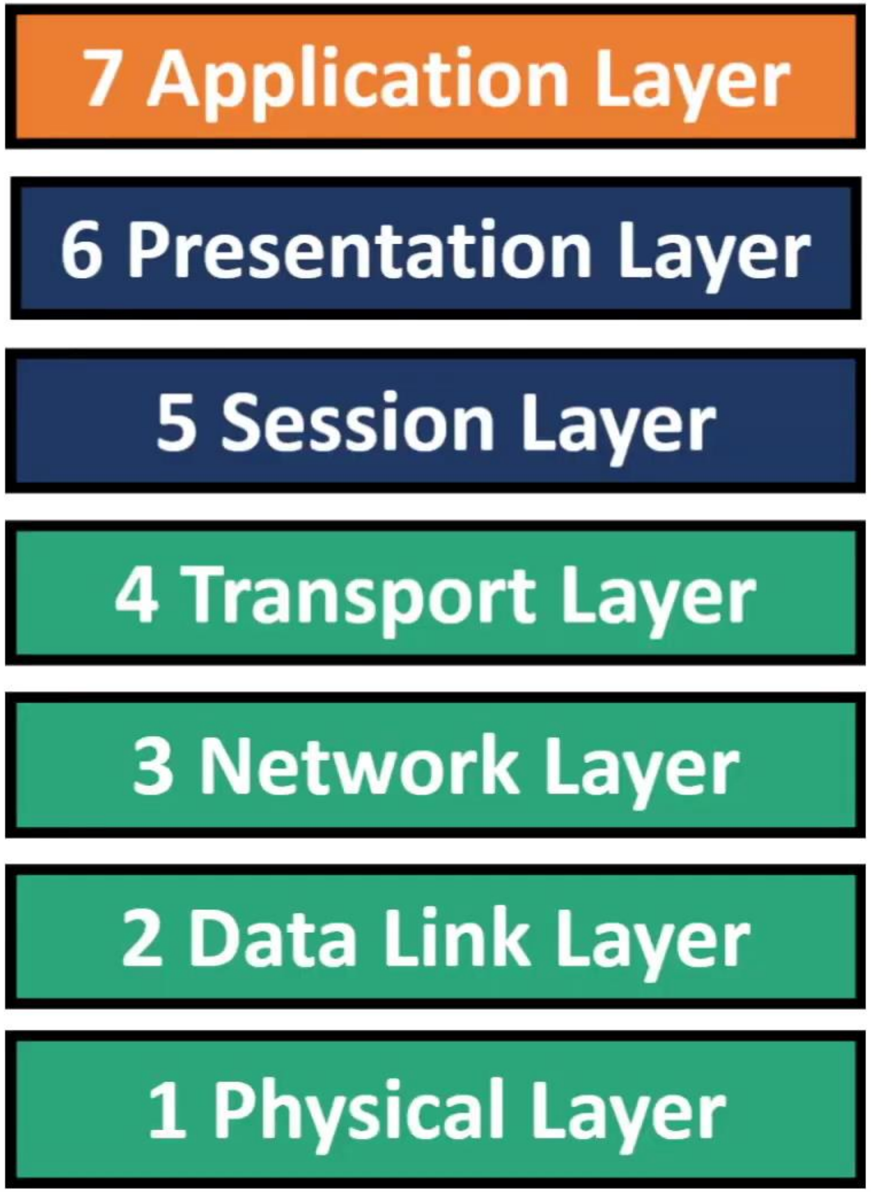
Consumer/Provider

Bus di Campo


PROFIBUS
PROFINET
Discrete
Process
Hybrid
Motion Control

FUNZIONAMENTO DI PROFINET


PROFINET



7 Application Layer

6 Presentation Layer

5 Session Layer

4 Transport Layer

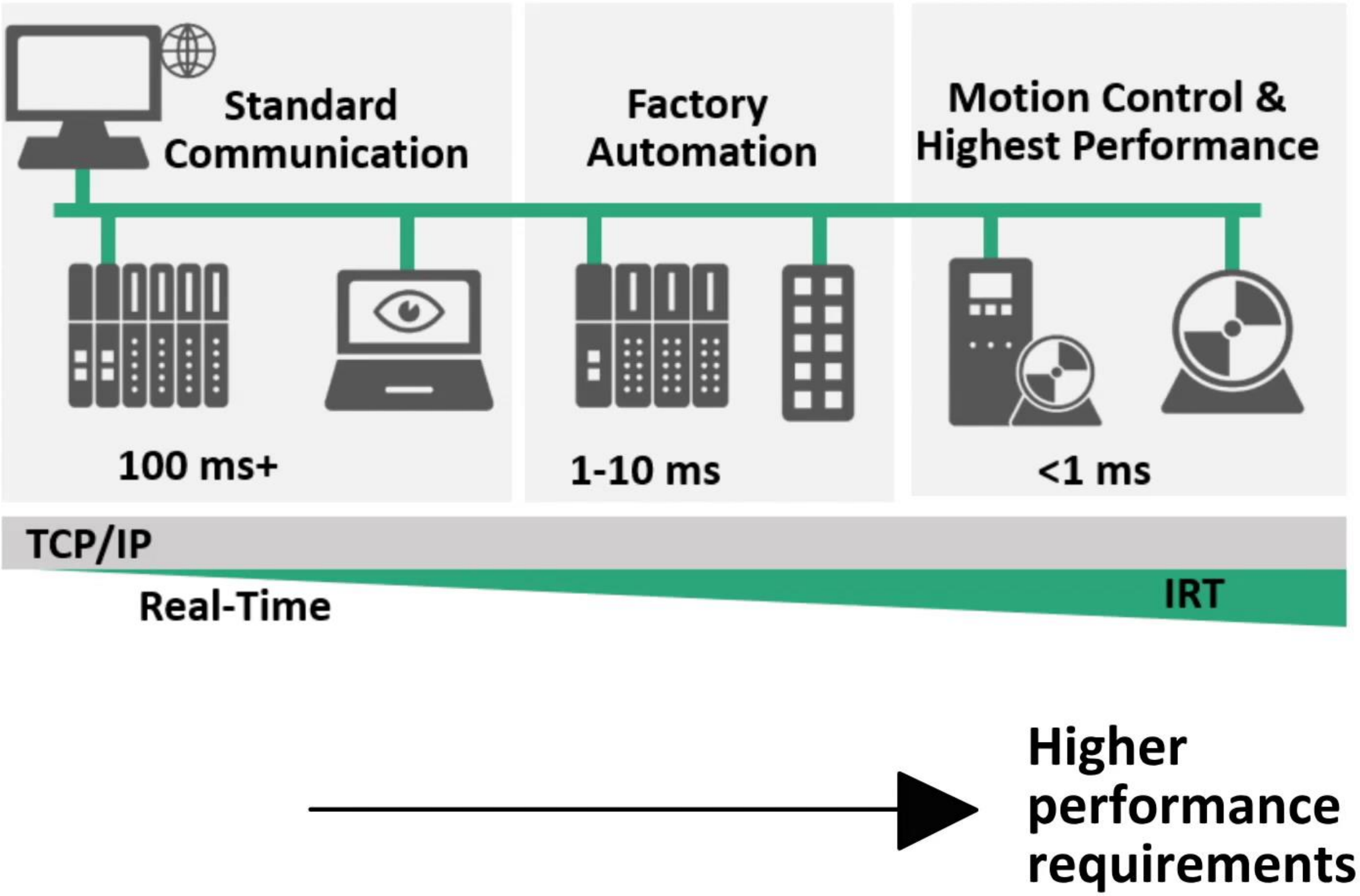
3 Network Layer

2 Data Link Layer

1 Physical Layer

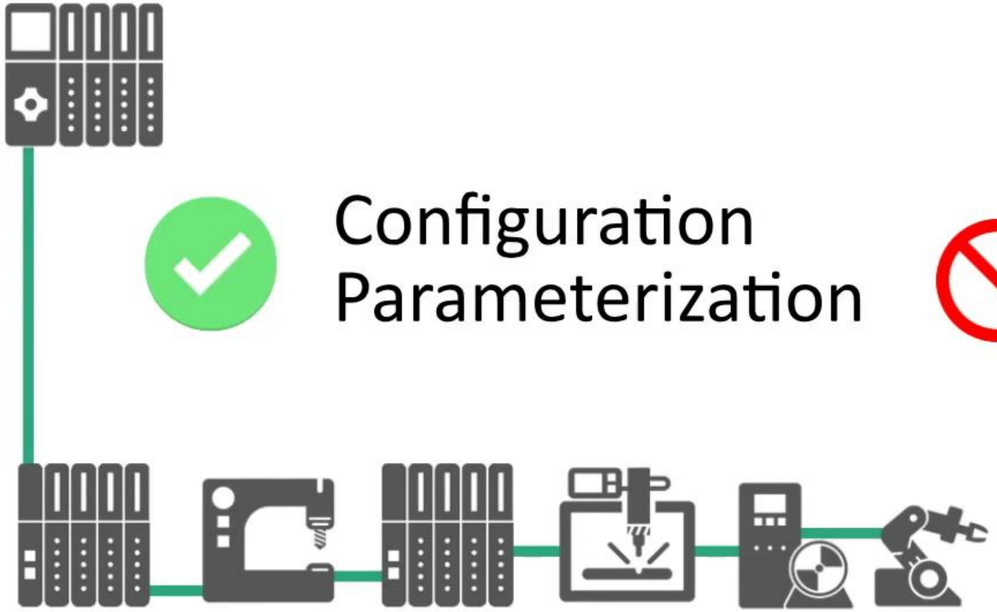
Modello Iso/Osi

BUS DI CAMPO


Standard Communication
Factory Automation
Motion Control & Highest Performance
100 ms+
1-10 ms
<1 ms
TCP/IP
Real-Time
IRT
Higher performance requirements

TCP/IP

UDP/IP

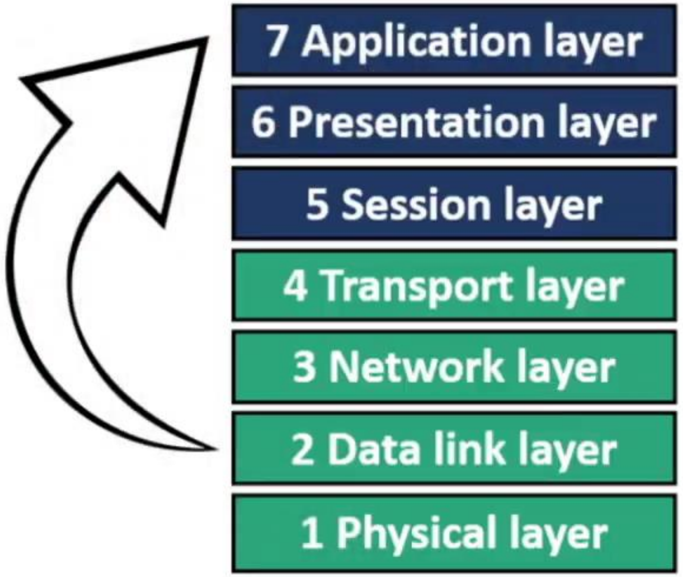


✓ Configuration
Parameterization

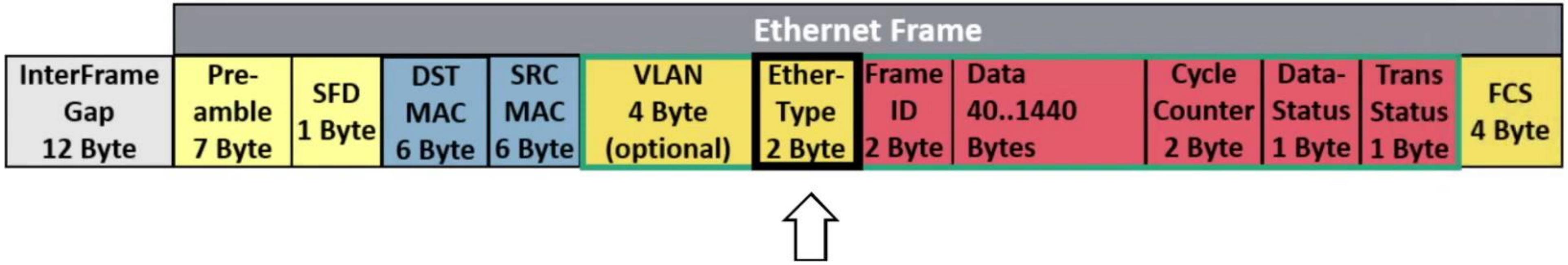
🚫 Time-critical
tasks

PROFI NET

RT= Real Time

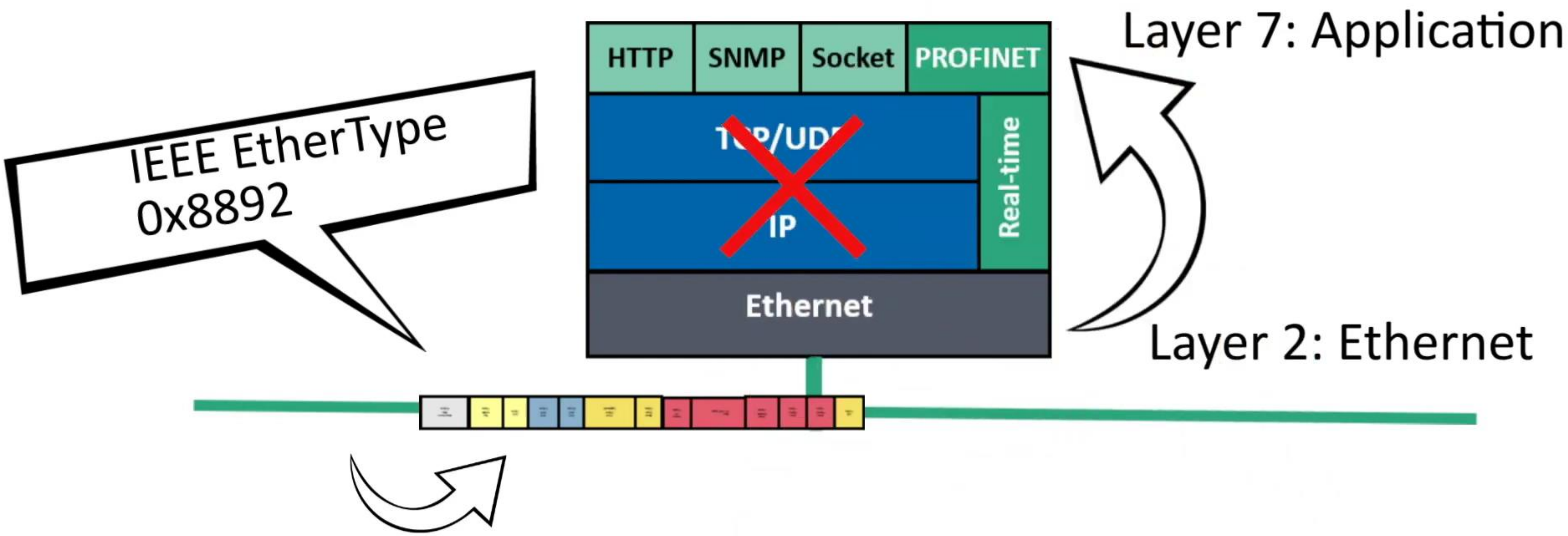


- 7 Application layer
- 6 Presentation layer
- 5 Session layer
- 4 Transport layer
- 3 Network layer
- 2 Data link layer
- 1 Physical layer



	Ethernet Frame											
InterFrame Gap 12 Byte	Pre-amble 7 Byte	SFD 1 Byte	DST MAC 6 Byte	SRC MAC 6 Byte	VLAN 4 Byte (optional)	Ether-Type 2 Byte	Frame ID 2 Byte	Data 40..1440 Bytes	Cycle Counter 2 Byte	Data-Status 1 Byte	Trans Status 1 Byte	FCS 4 Byte

PROFINET RT EtherType: 0x8892



IEEE EtherType
0x8892

HTTP
SNMP
Socket
PROFINET

~~TCP/UDP~~

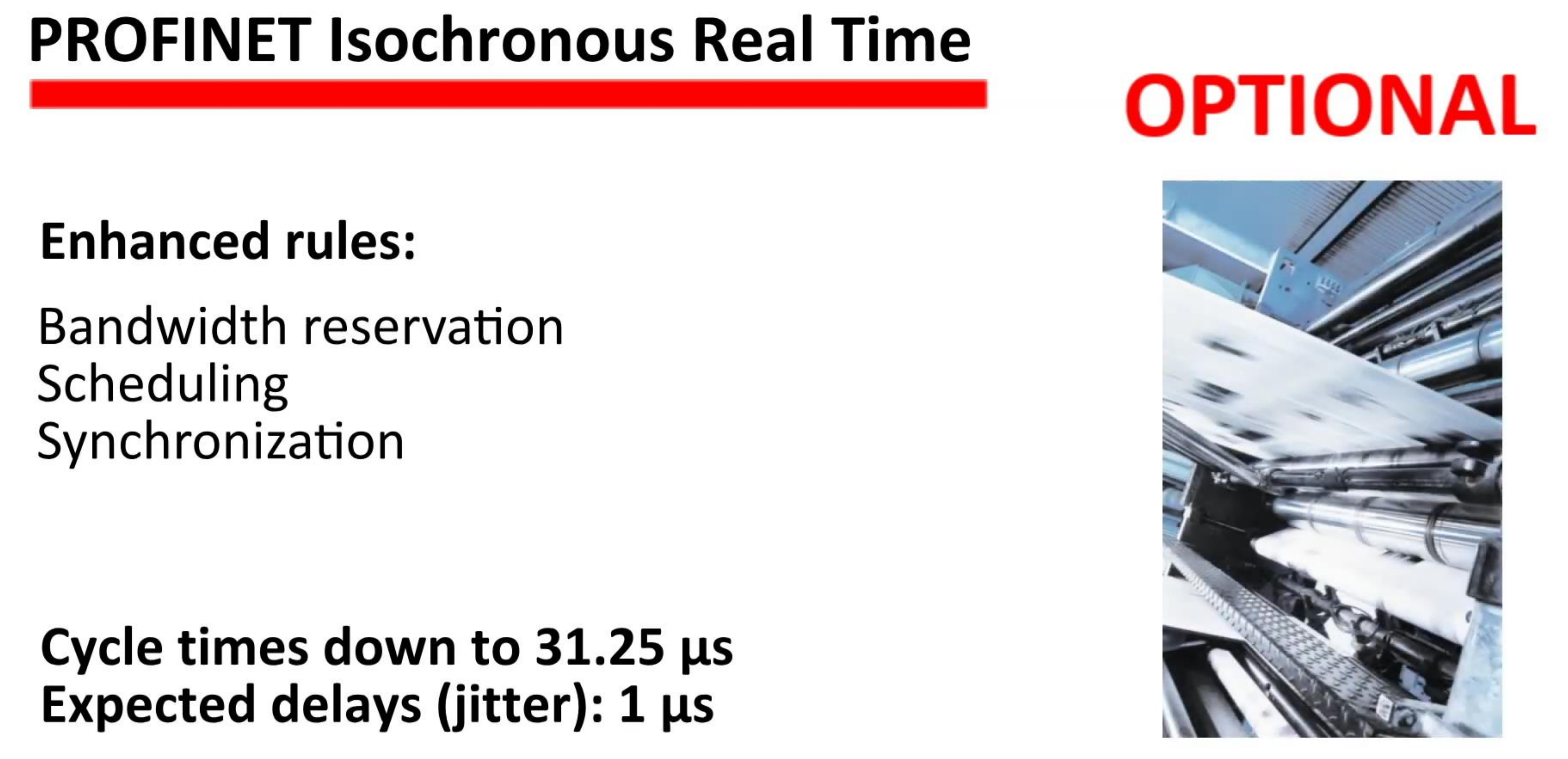
~~IP~~

Real-time

Ethernet

Layer 7: Application

Layer 2: Ethernet



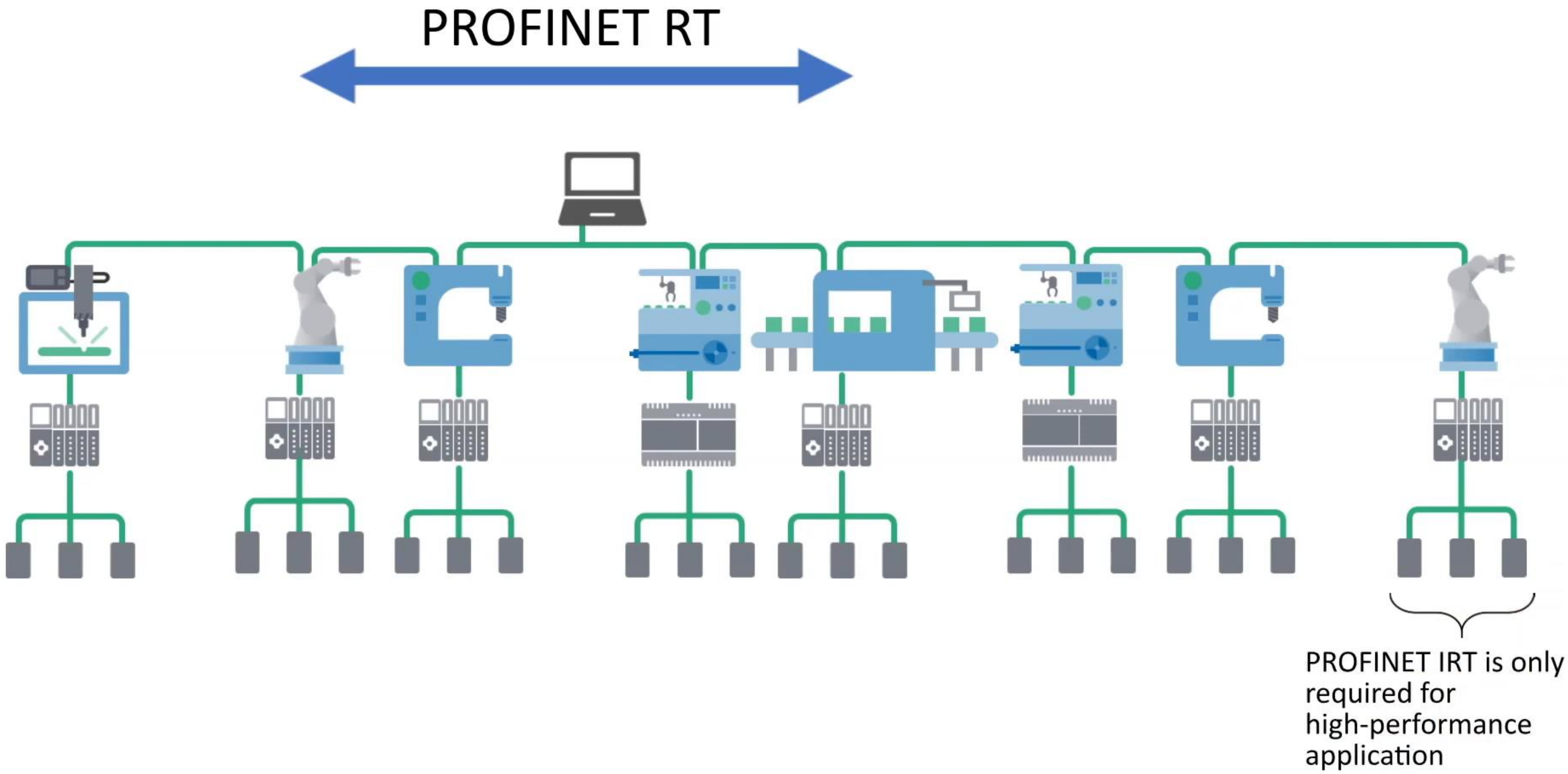
PROFINET Isochronous Real Time

OPTIONAL

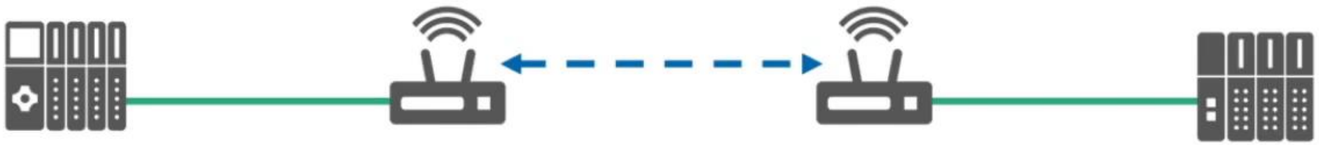
Enhanced rules:

Bandwidth reservation
Scheduling
Synchronization

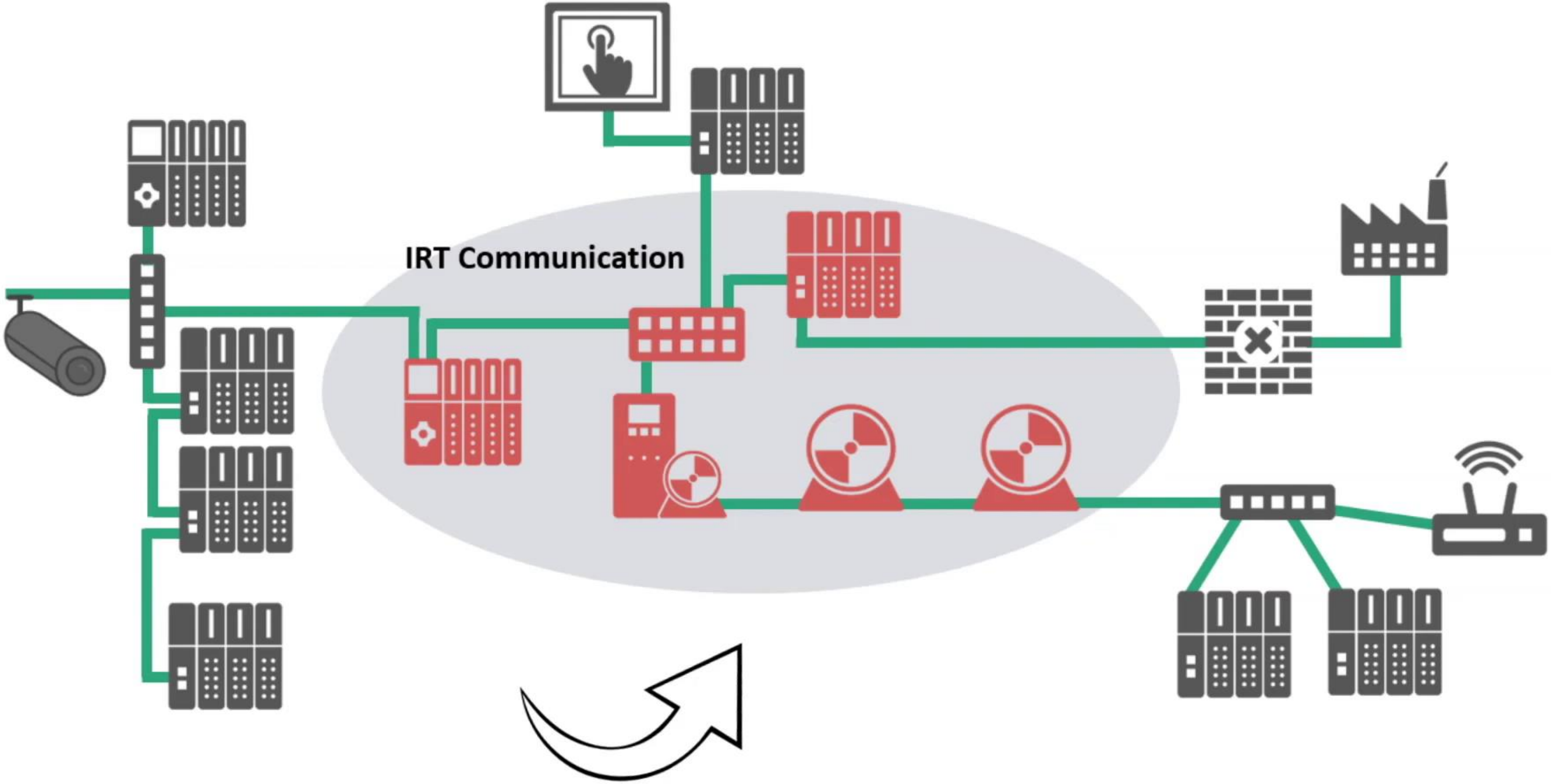
Cycle times down to 31.25 µs
Expected delays (jitter): 1 µs

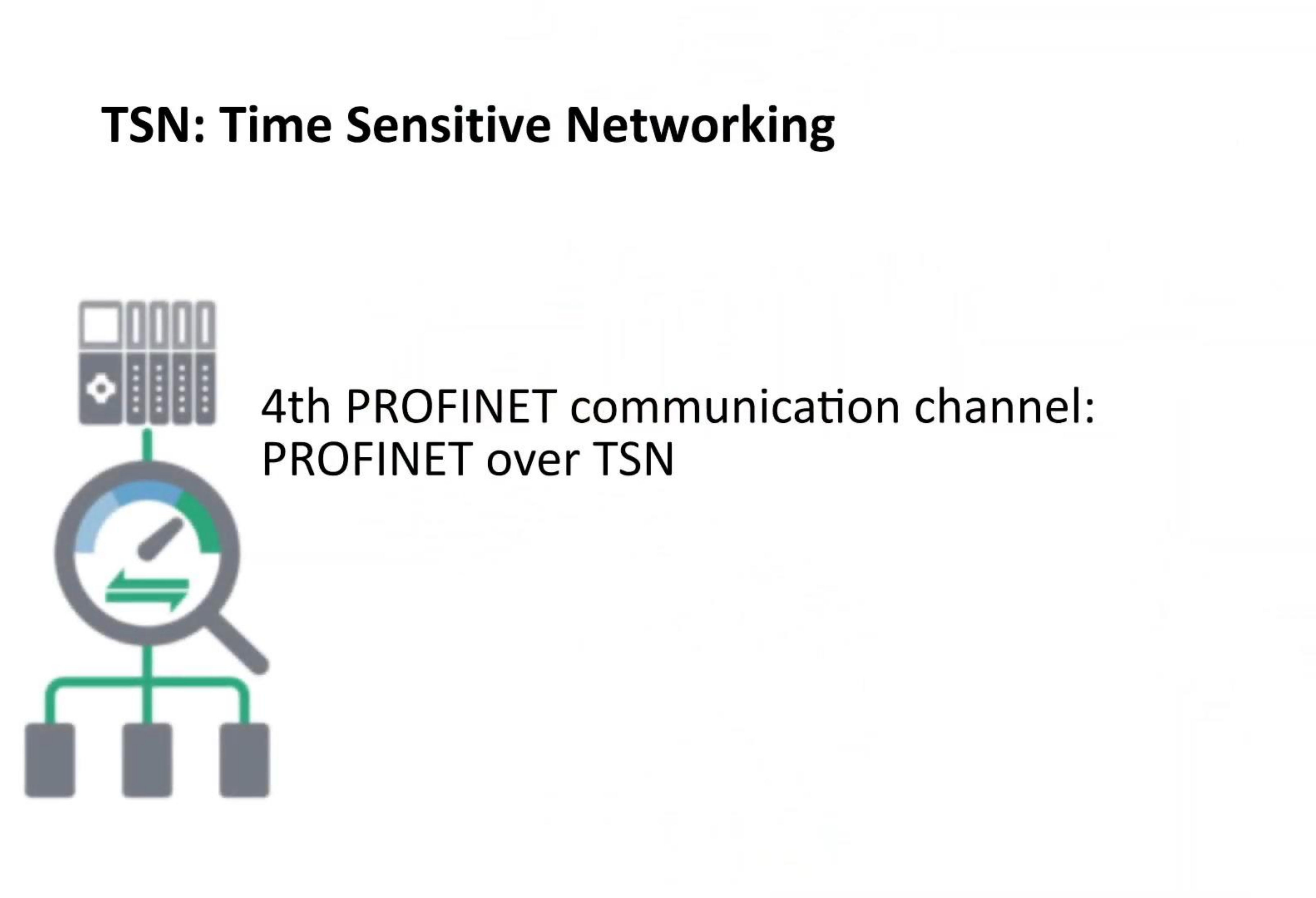

PROFINET RT
PROFINET IRT is only required for high-performance application

✓ PROFINET RT



BUS DI CAMPO

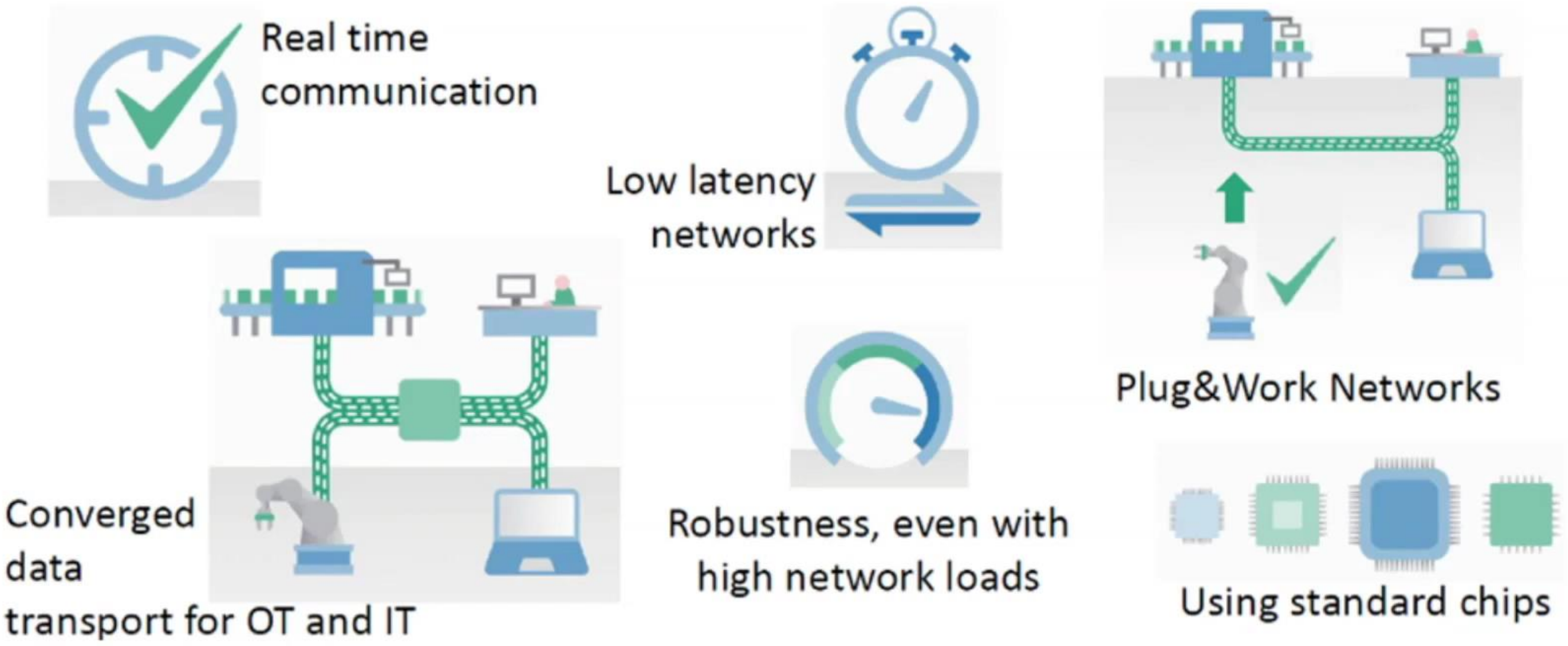

IRT Communication



TSN: Time Sensitive Networking

4th PROFINET communication channel:
PROFINET over TSN

BUS DI CAMPO



Real time communication

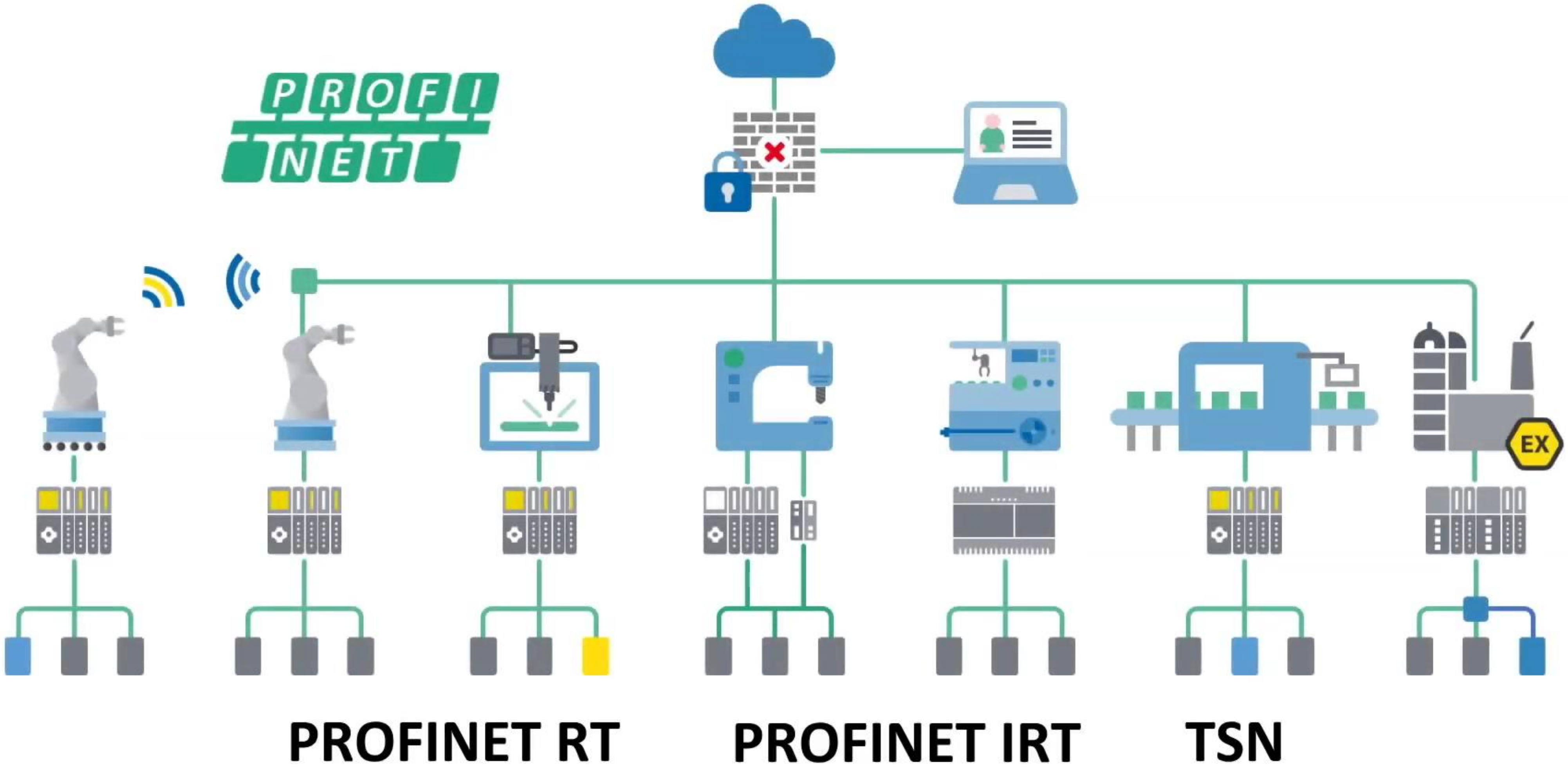
Low latency networks

Plug&Work Networks

Converged data transport for OT and IT

Robustness, even with high network loads

Using standard chips


PROFI
NET
EX
PROFINET RT
PROFINET IRT
TSN

ETHERCAT

EtherCAT
Ethernet for Control Automation Technology

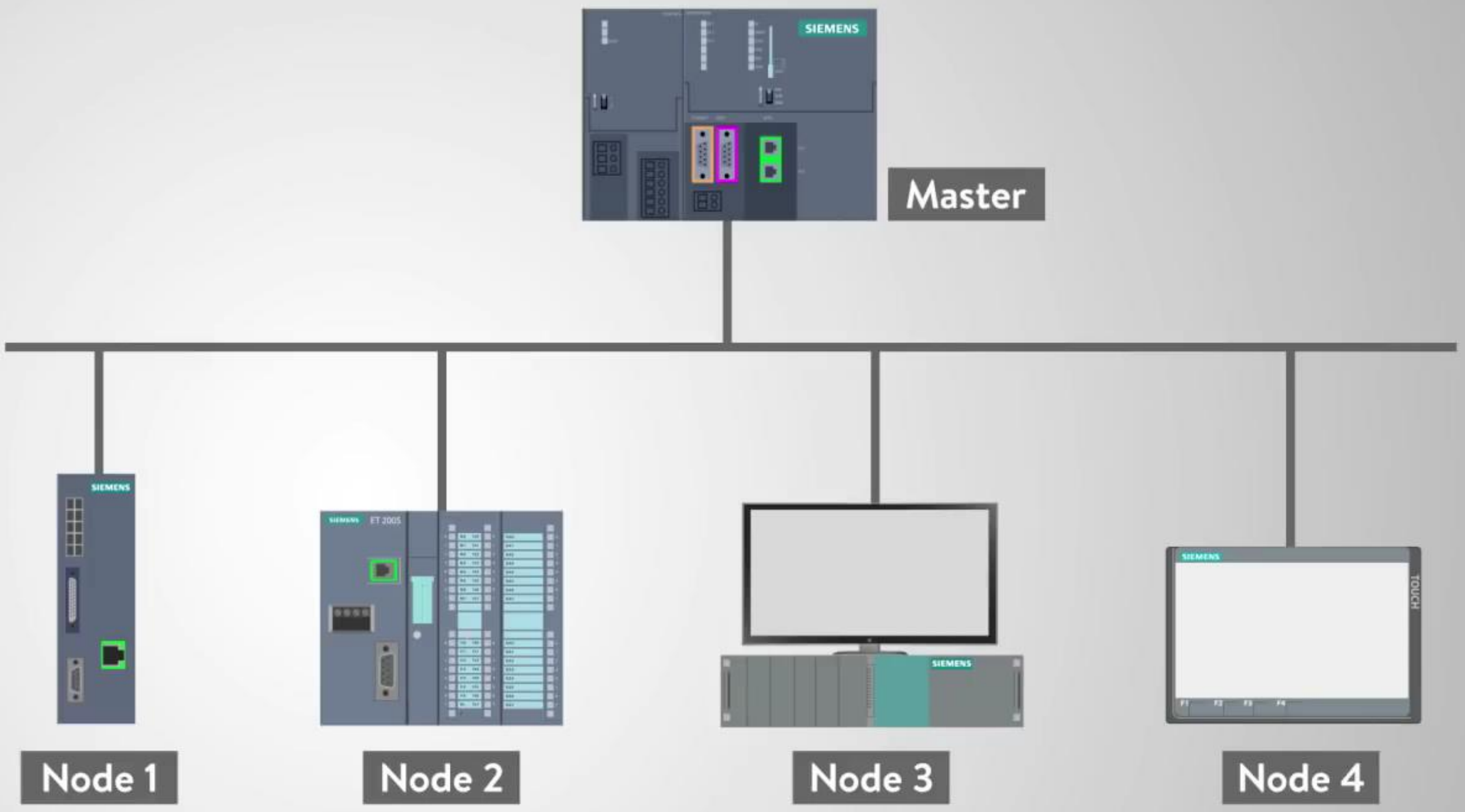
EtherCAT

Data Frame

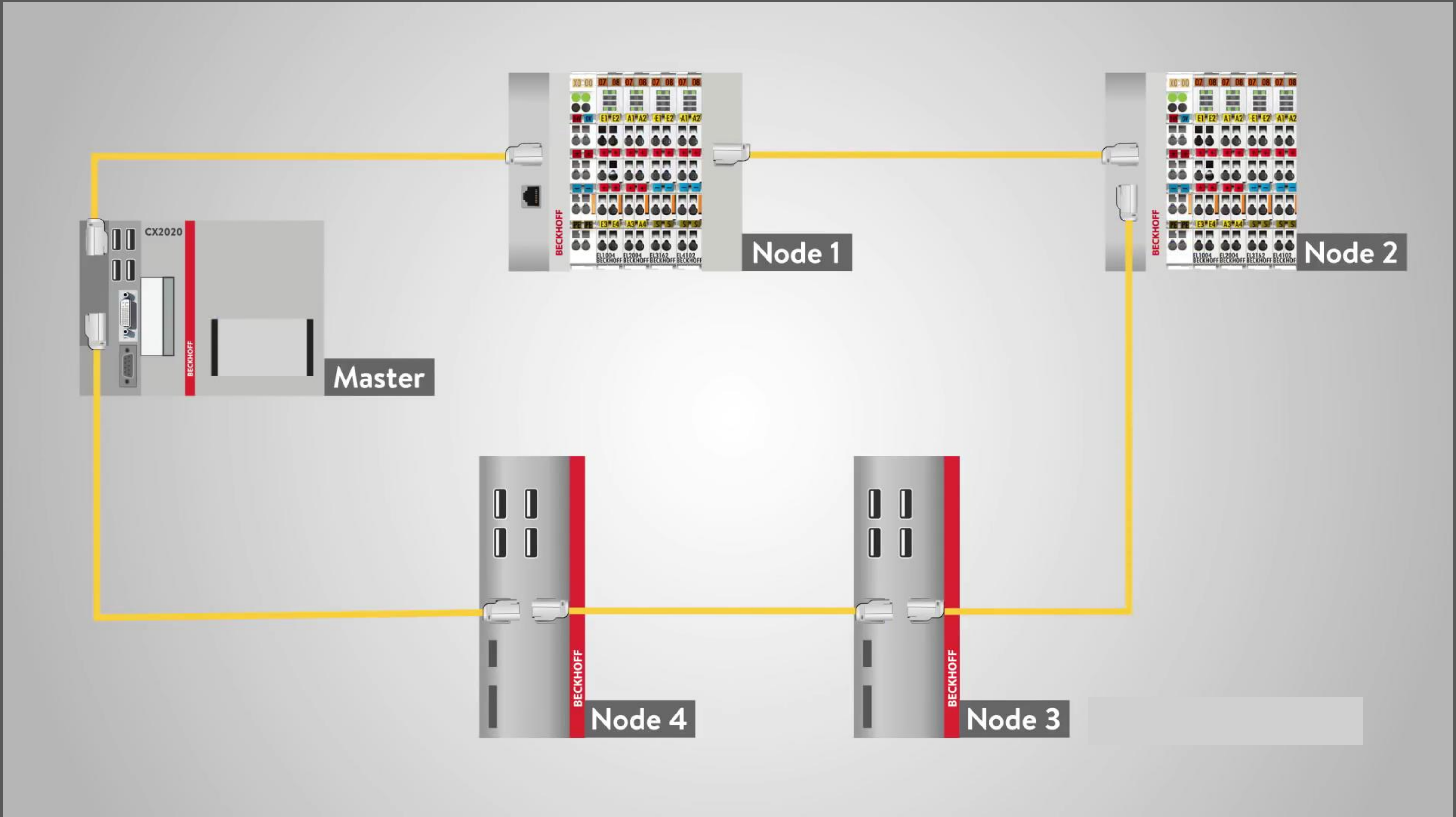
- Tempi di Risposta Rapidi
- Requisiti Minimi per Dispositivi
- Costi di Implementazione

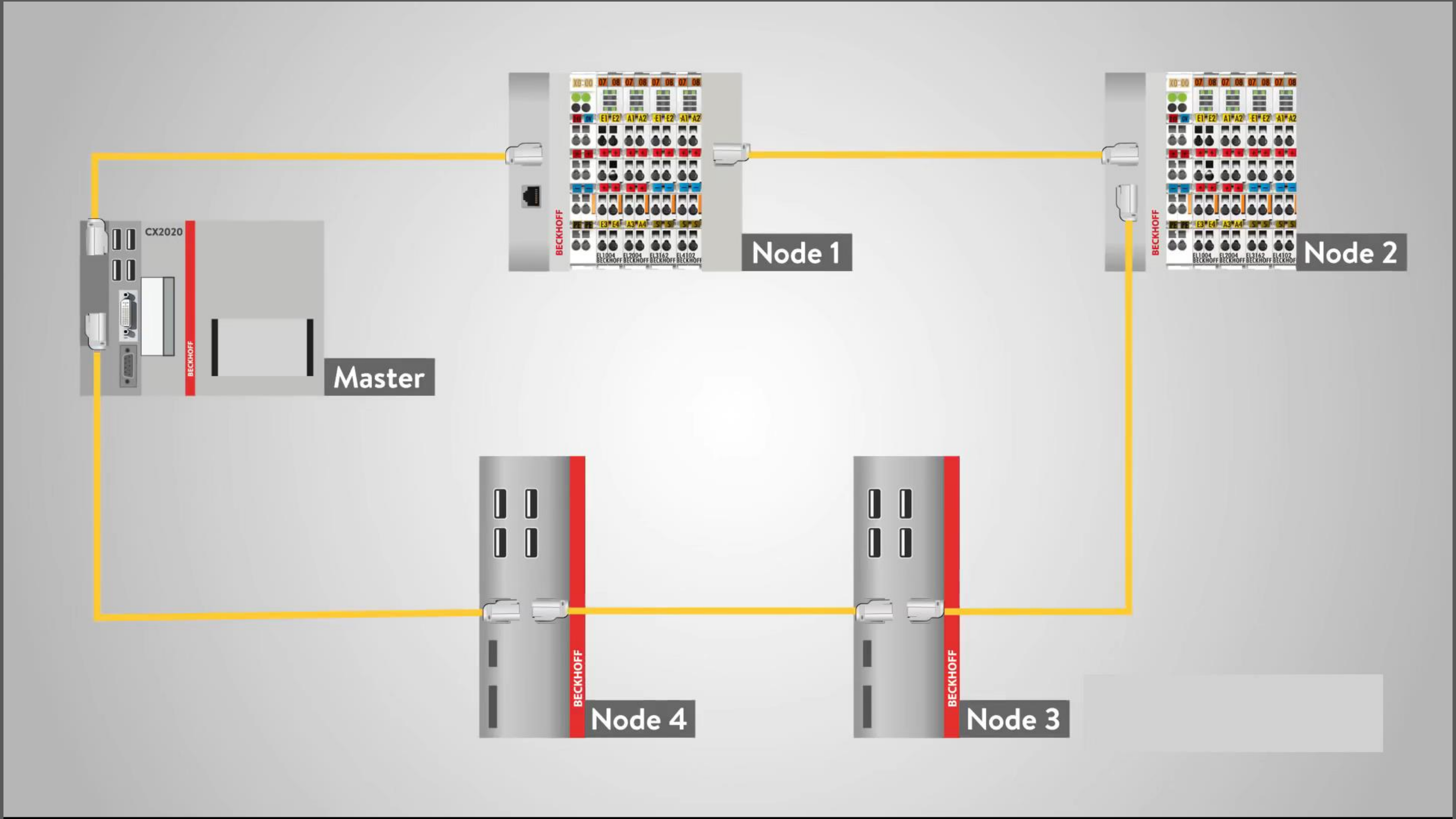
OSI Model

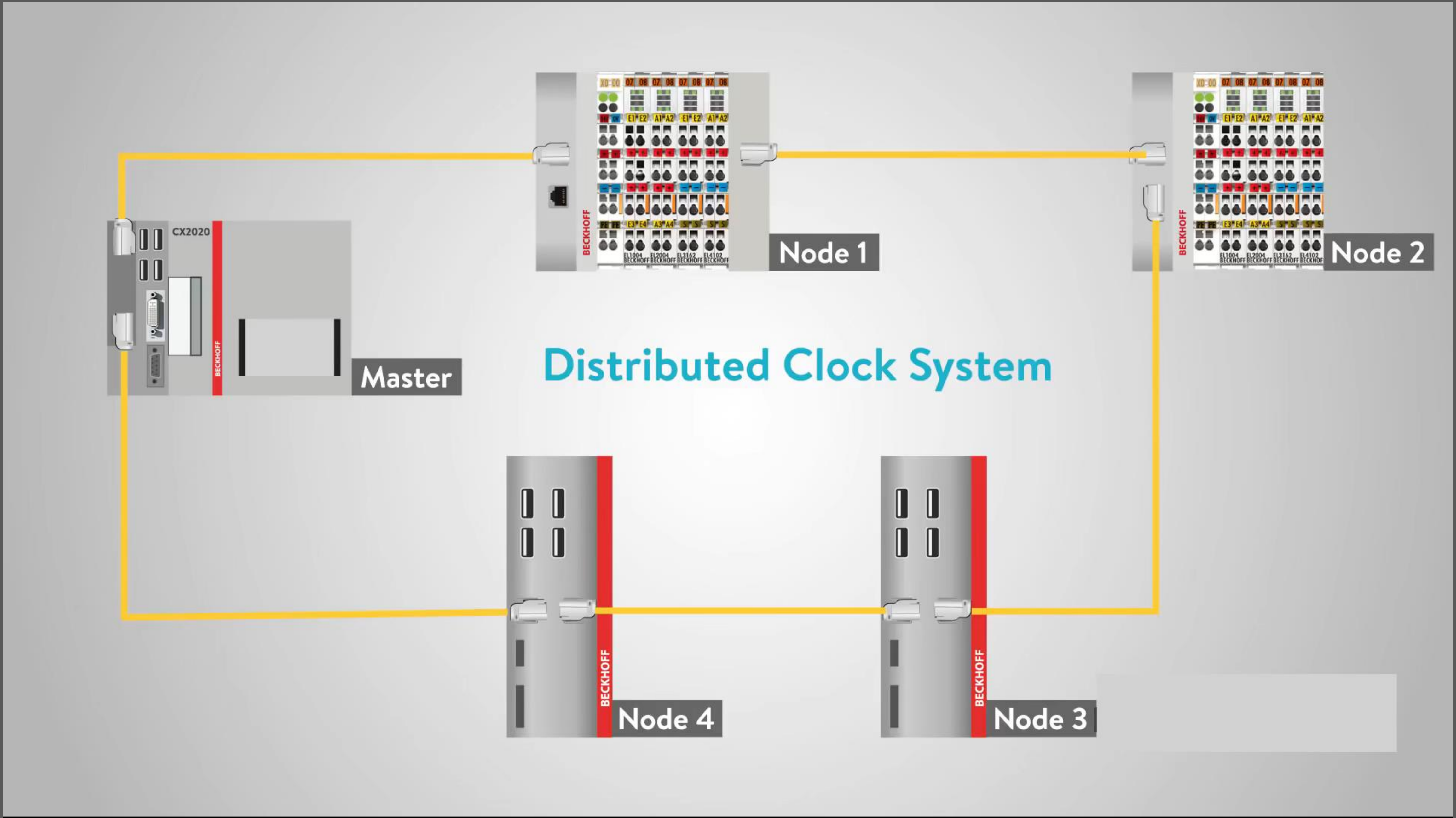
7	Application
6	Presentation
5	Session
4	Transport
3	Network
2	Data Link
1	Physical

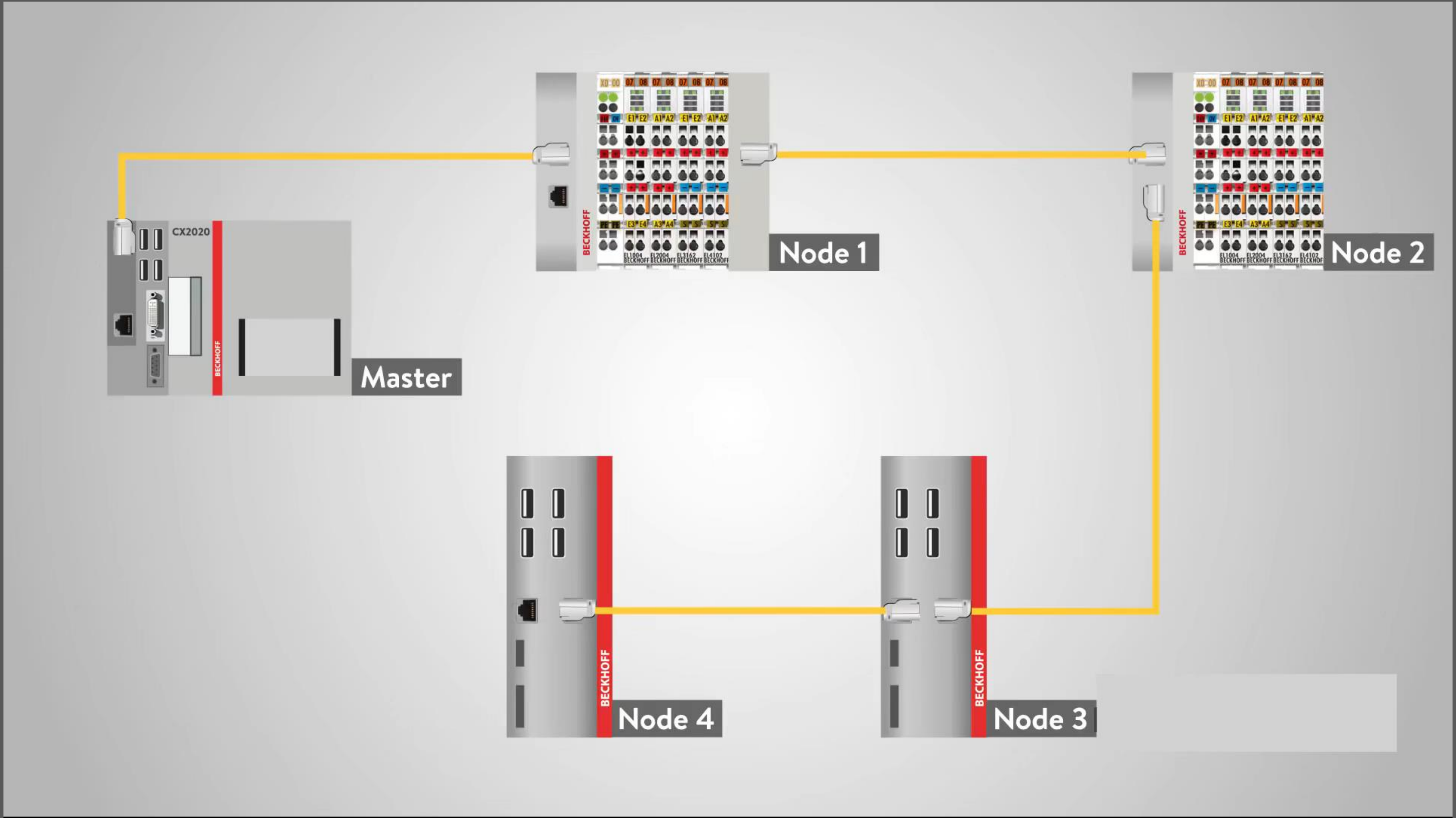

SIEMENS
Master
Node 1
Node 2
Node 3
Node 4

Ethernet **EtherCAT**

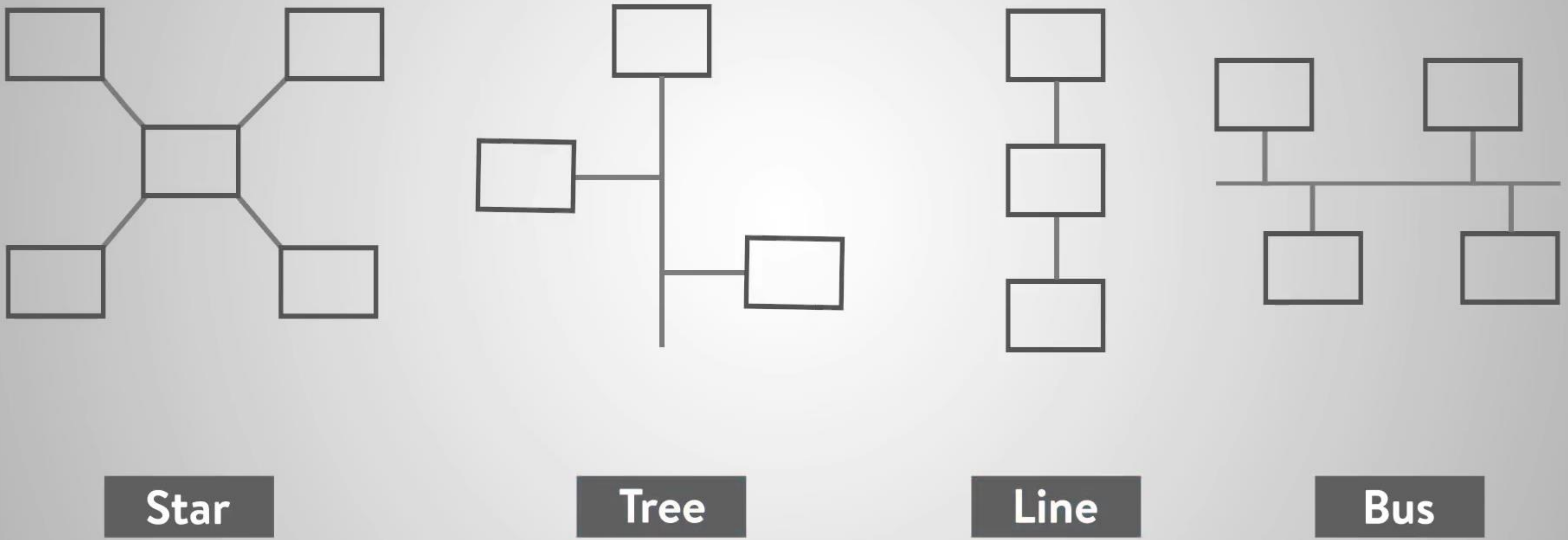

CX2020
BECKHOFF
Master
Node 1
Node 2
Node 3
Node 4

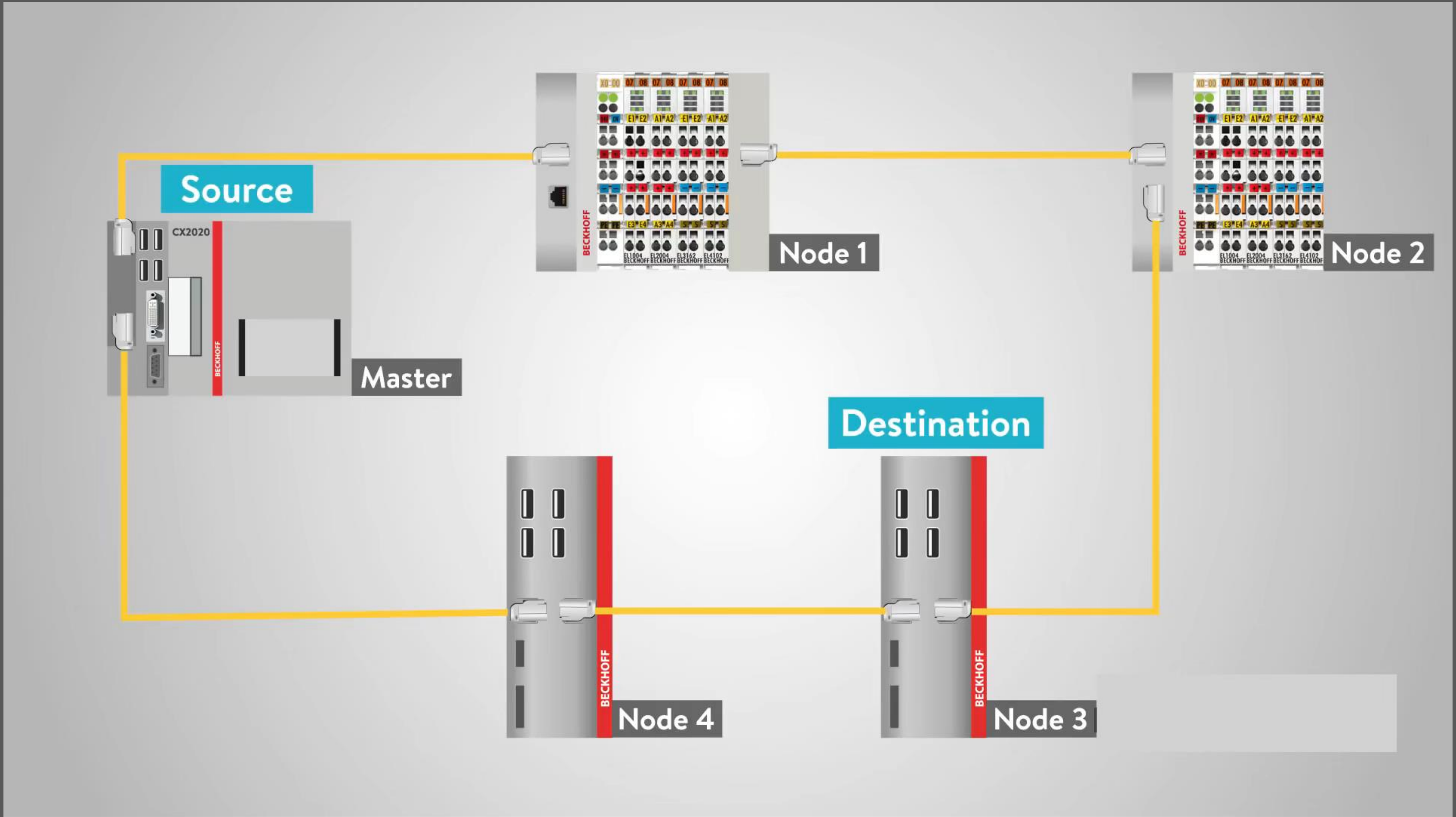

CX2020
BECKHOFF
Master
Node 1
Node 2
Node 3
Node 4


CX2020
BECKHOFF
Master
Node 1
Node 2
Node 3
Node 4
Distributed Clock System

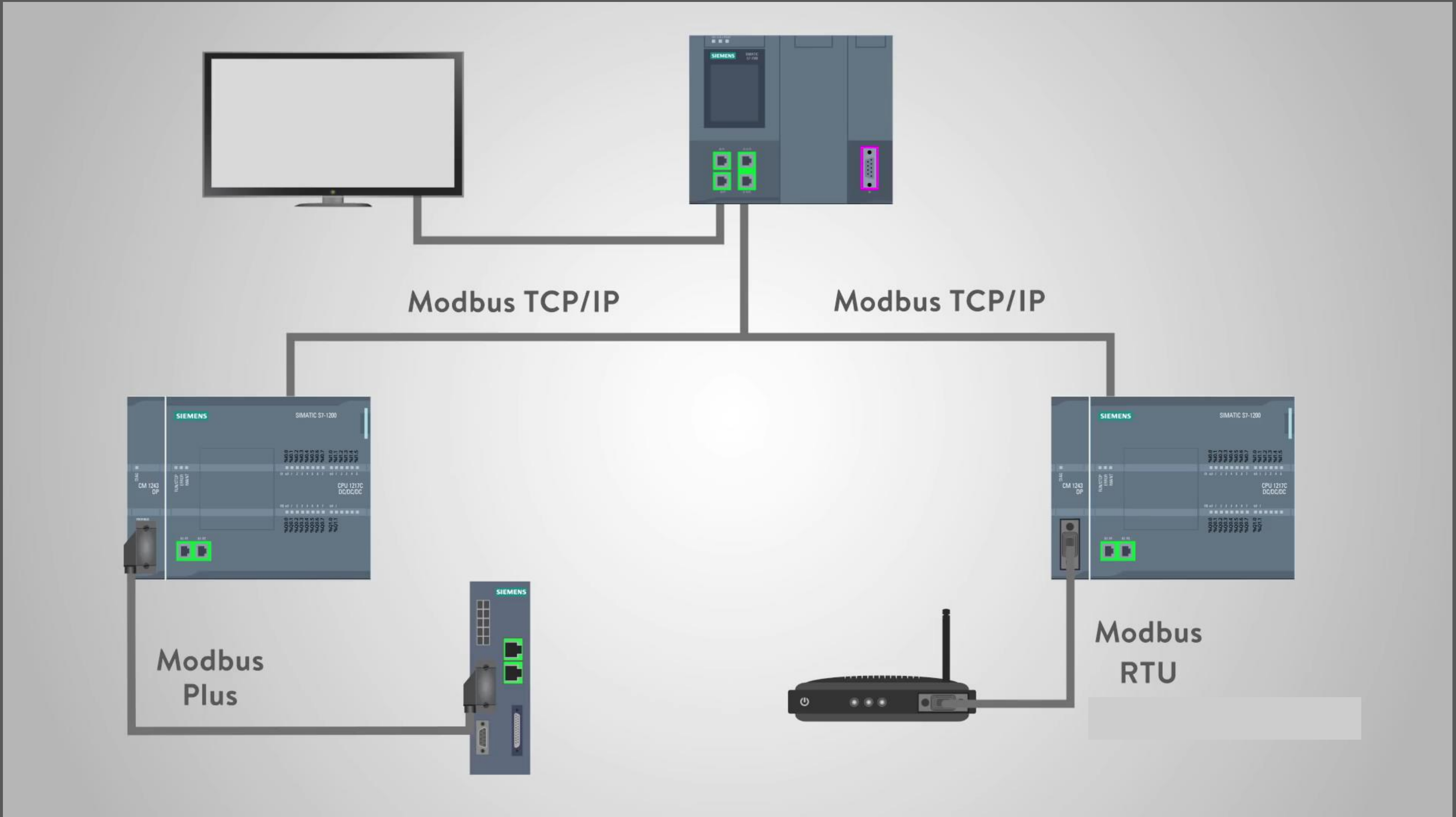

CX2020
BECKHOFF
Master
Node 1
Node 2
Node 3
Node 4

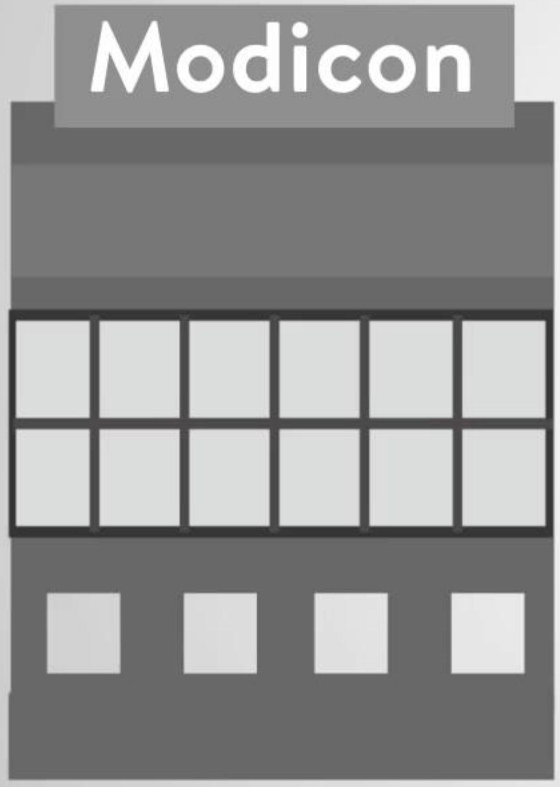
ETHERCAT – TOPOLOGIA DI RETE

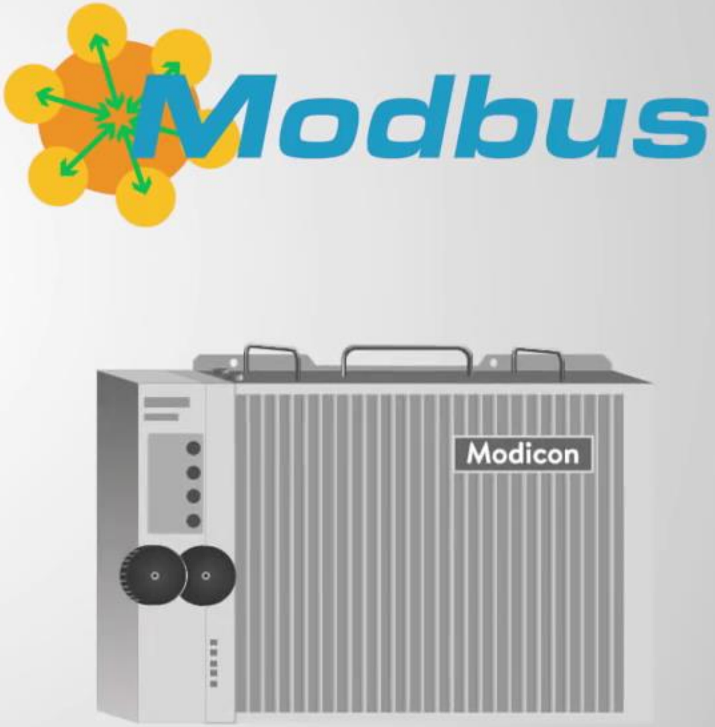

Star
Tree
Line
Bus


Source
CX2020
Master
Node 1
Node 2
Destination
Node 4
Node 3
BECKHOFF

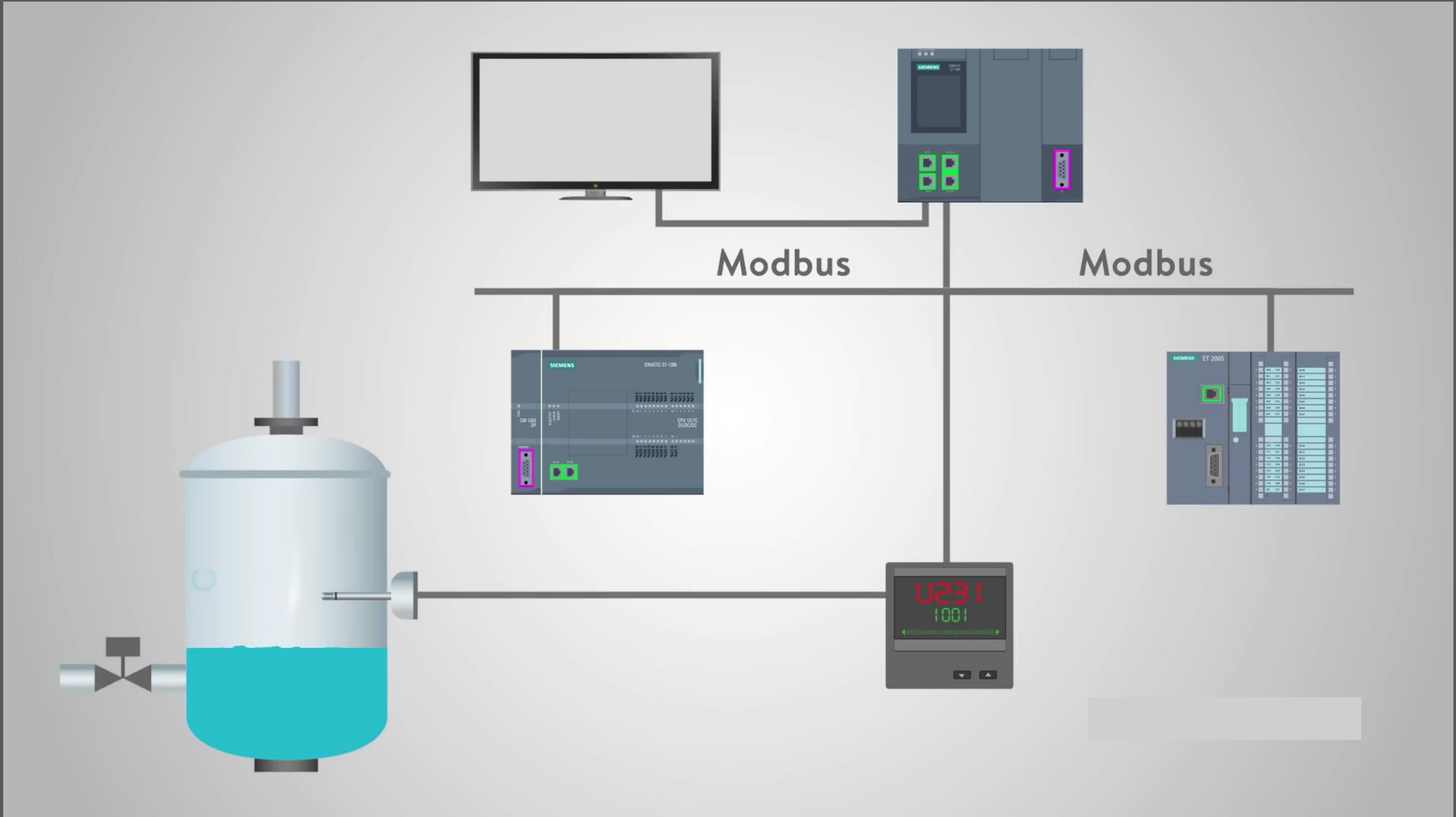
Modbus

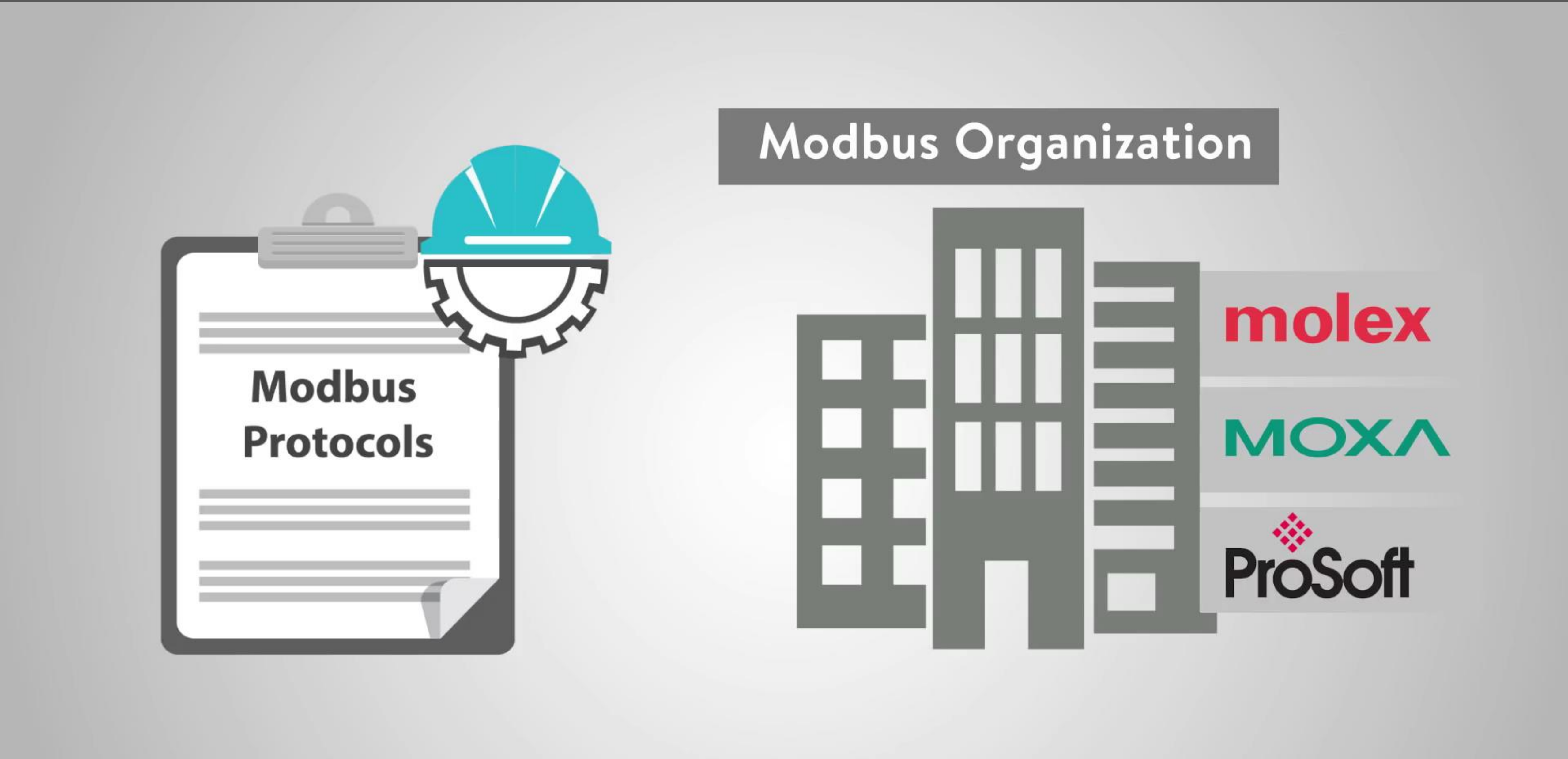

Modbus TCP/IP
Modbus TCP/IP
SIEMENS
SIMATIC S7-1200
CM 1243 DP
CPU 1217C DC/DC/DC
SIEMENS
SIMATIC S7-1200
CM 1243 DP
CPU 1217C DC/DC/DC
SIEMENS
Modbus Plus
Modbus RTU

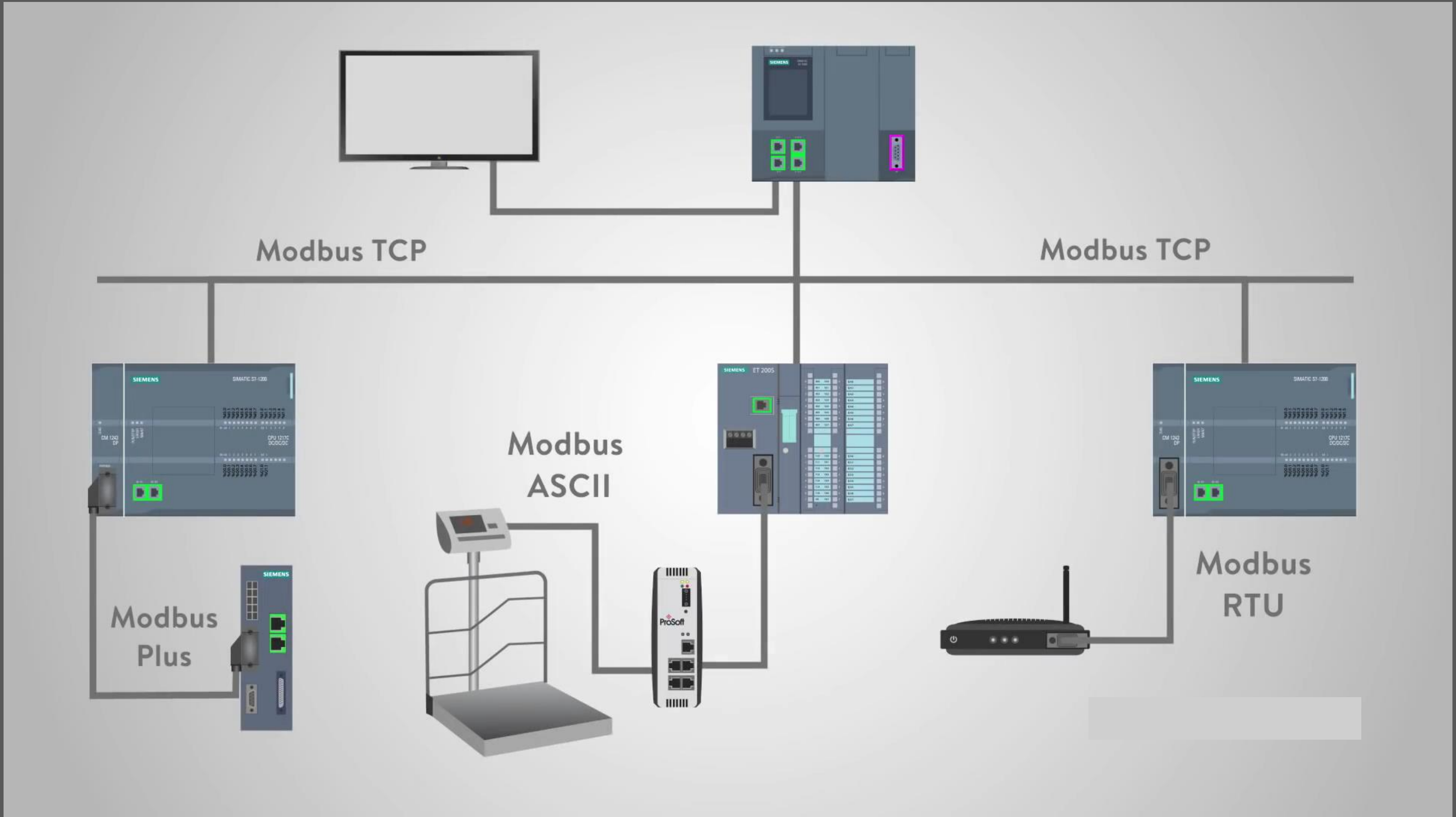

Modicon

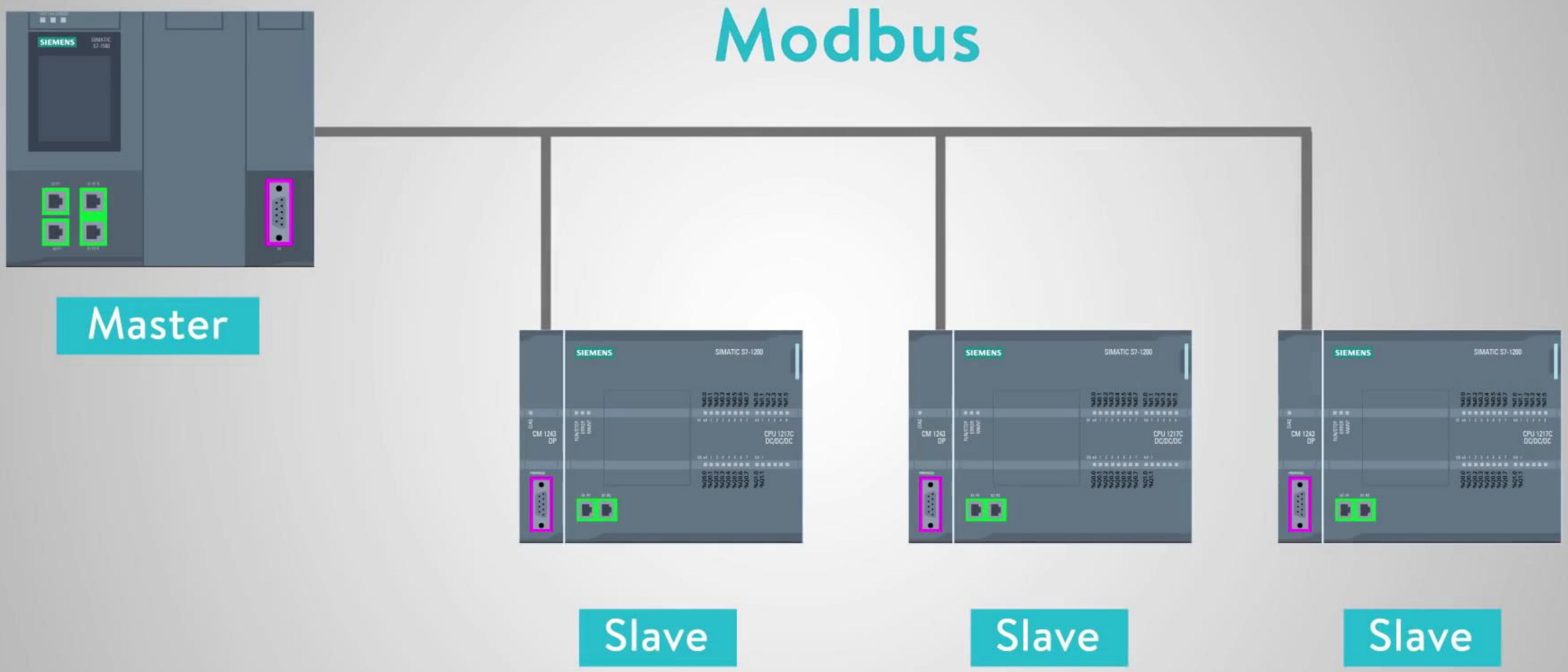

Modbus
Modicon

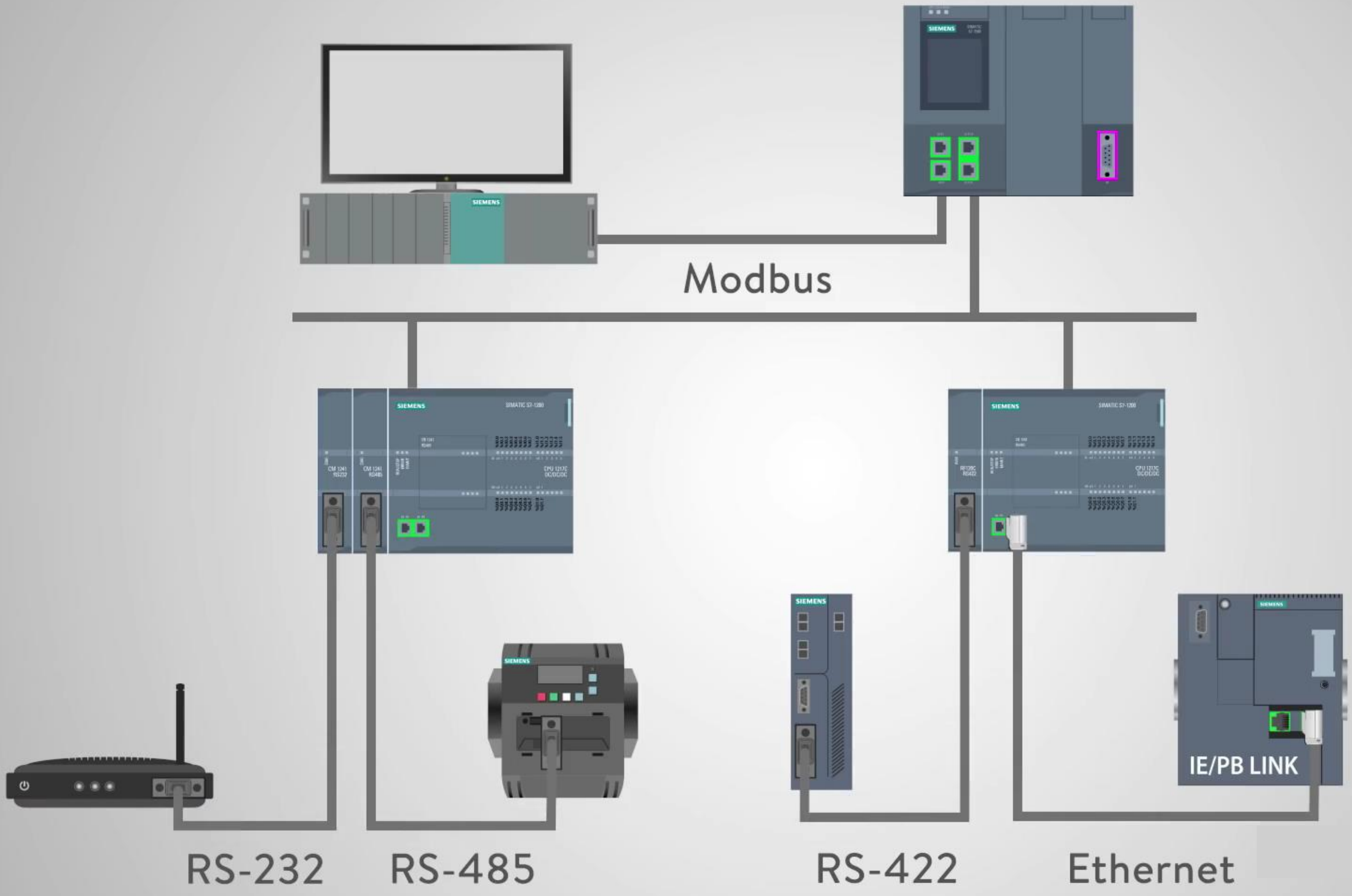
Schneider Electric
Modicon

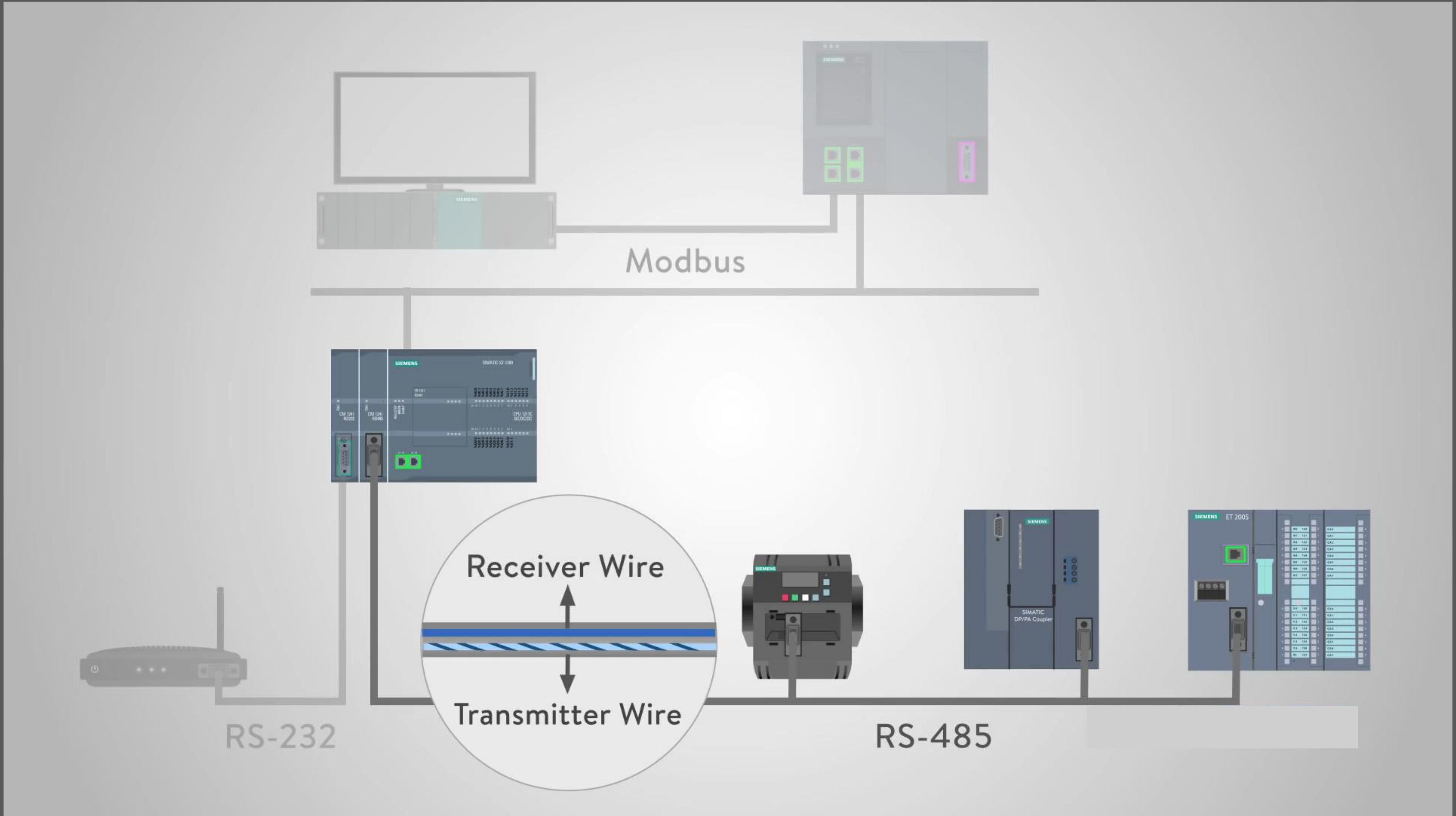

Modbus
Modbus
SIEMENS
SIMATIC S7-1200
SIEMENS
ET 200S
U231
1001

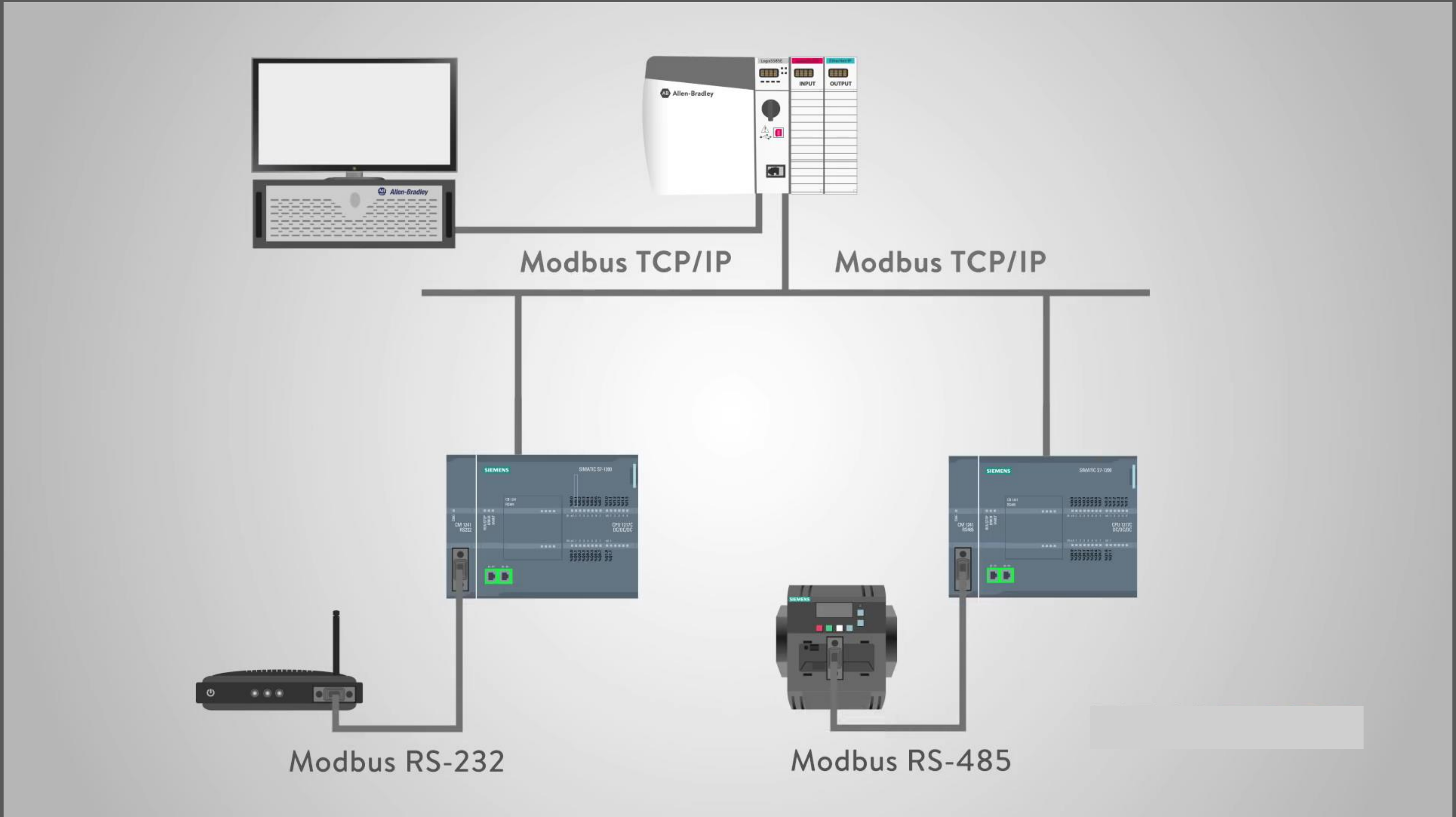

Modbus Protocols
Modbus Organization
molex
MOXA
ProSoft


Modbus TCP
Modbus TCP
SIEMENS
SIMATIC S7-1200
Modbus ASCII
ET 200S
SIEMENS
SIMATIC S7-1200
Modbus Plus
ProSoft
Modbus RTU

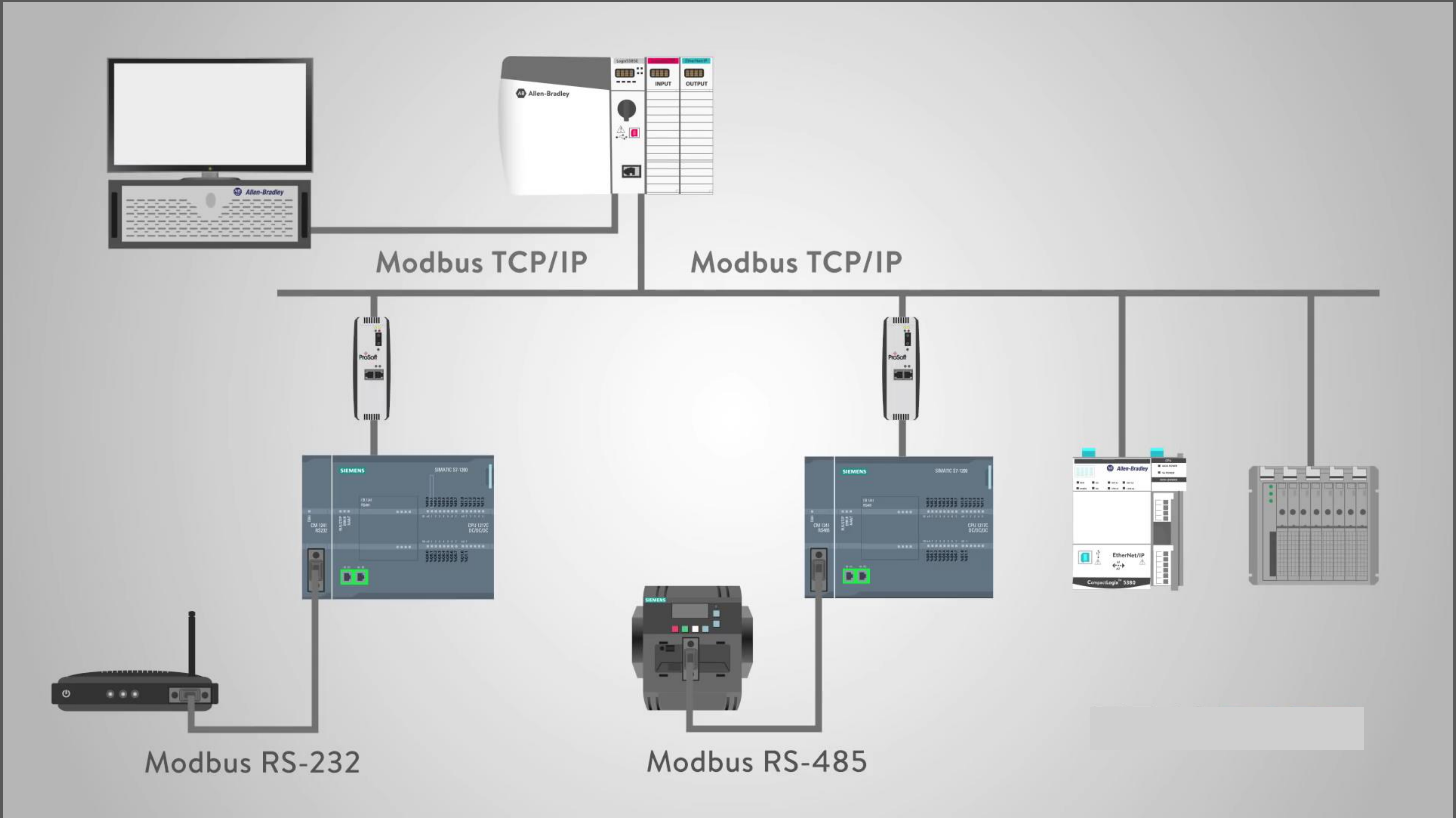

Modbus
Master
Slave
Slave
Slave
SIEMENS
SIMATIC S7-1200
CM 1243 DP
CPU 1217C DC/DC/DC


Modbus
IE/PB LINK
RS-232
RS-485
RS-422
Ethernet

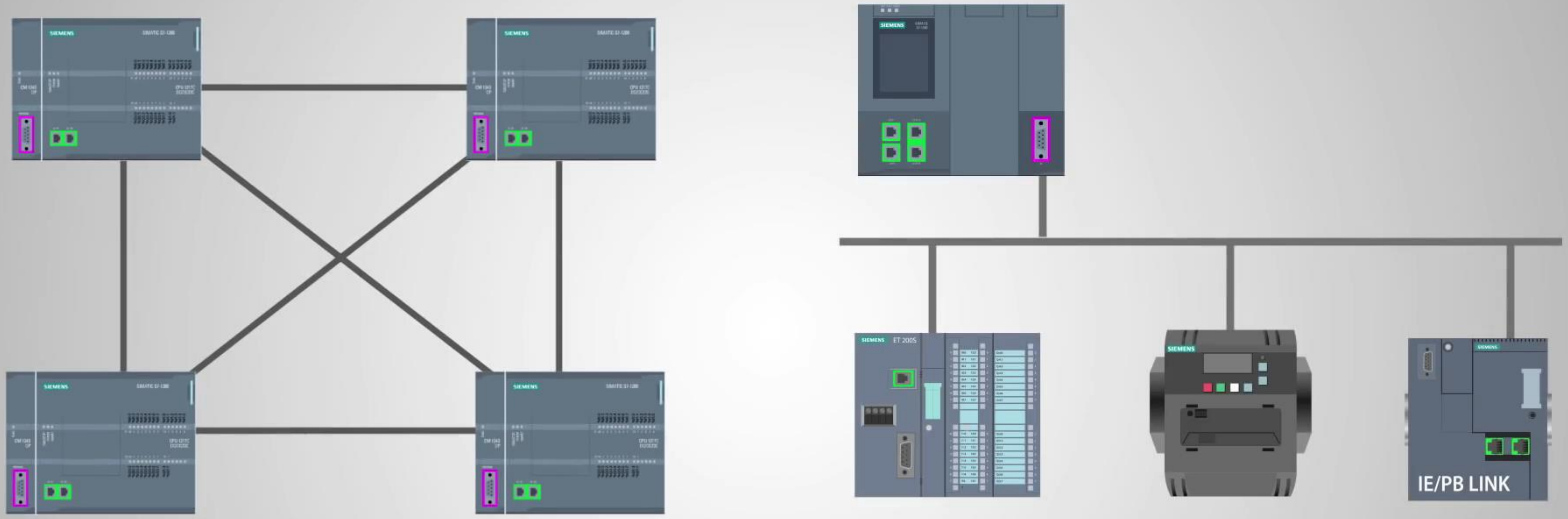

Modbus
Receiver Wire
Transmitter Wire
RS-232
RS-485

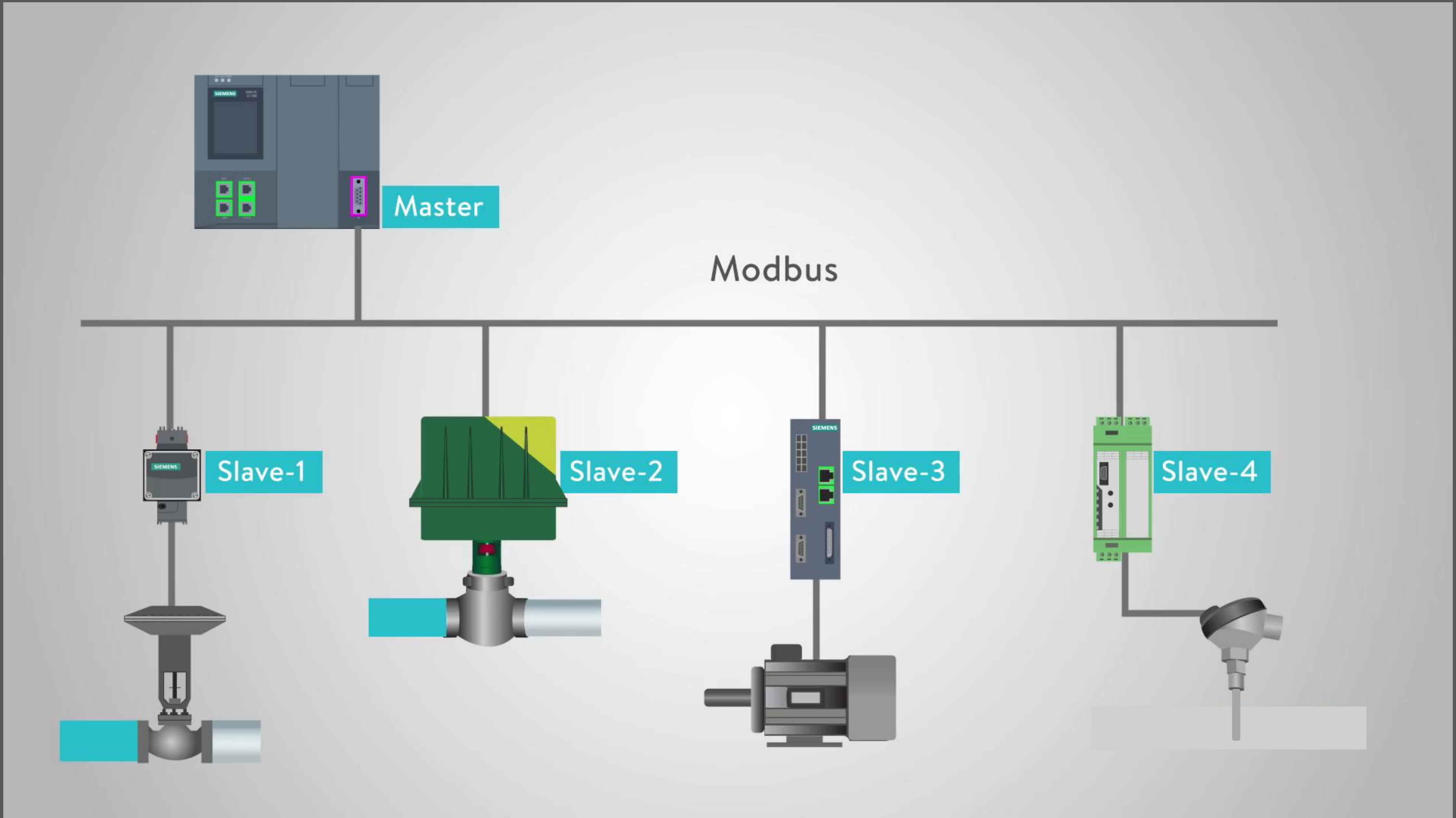

Allen-Bradley
INPUT
OUTPUT
Allen-Bradley
Modbus TCP/IP
Modbus TCP/IP
SIEMENS
SIMATIC S7-1200
SIEMENS
SIMATIC S7-1200
SIEMENS
Modbus RS-232
Modbus RS-485

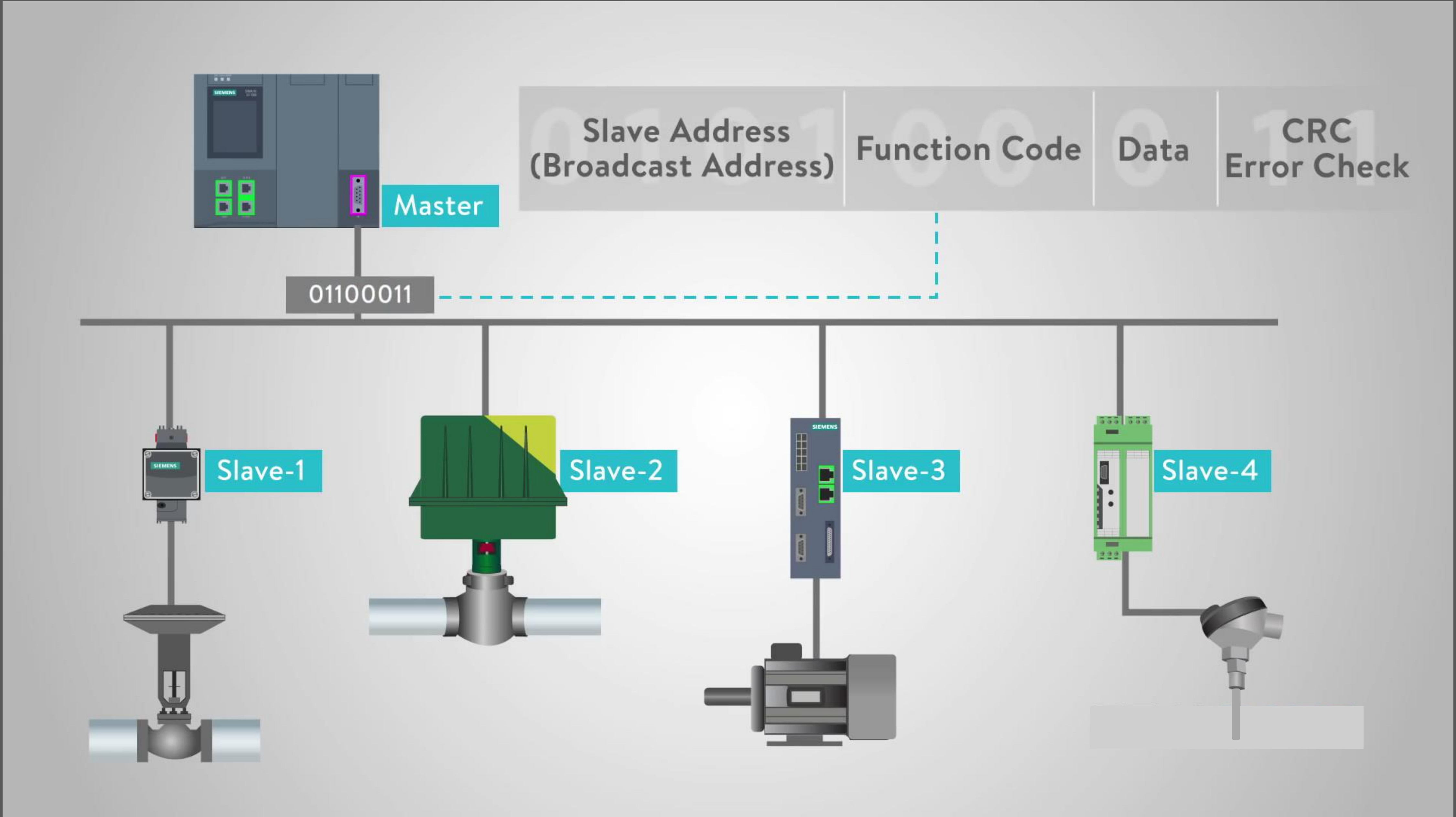
BUS DI CAMPO


Allen-Bradley
Allen-Bradley
INPUT
OUTPUT
Modbus TCP/IP
Modbus TCP/IP
ProSoft
ProSoft
SIEMENS
SIMATIC S7-1200
SIEMENS
SIMATIC S7-1200
Allen-Bradley
EtherNet/IP
CompactLogix 5380
SIEMENS
Modbus RS-232
Modbus RS-485

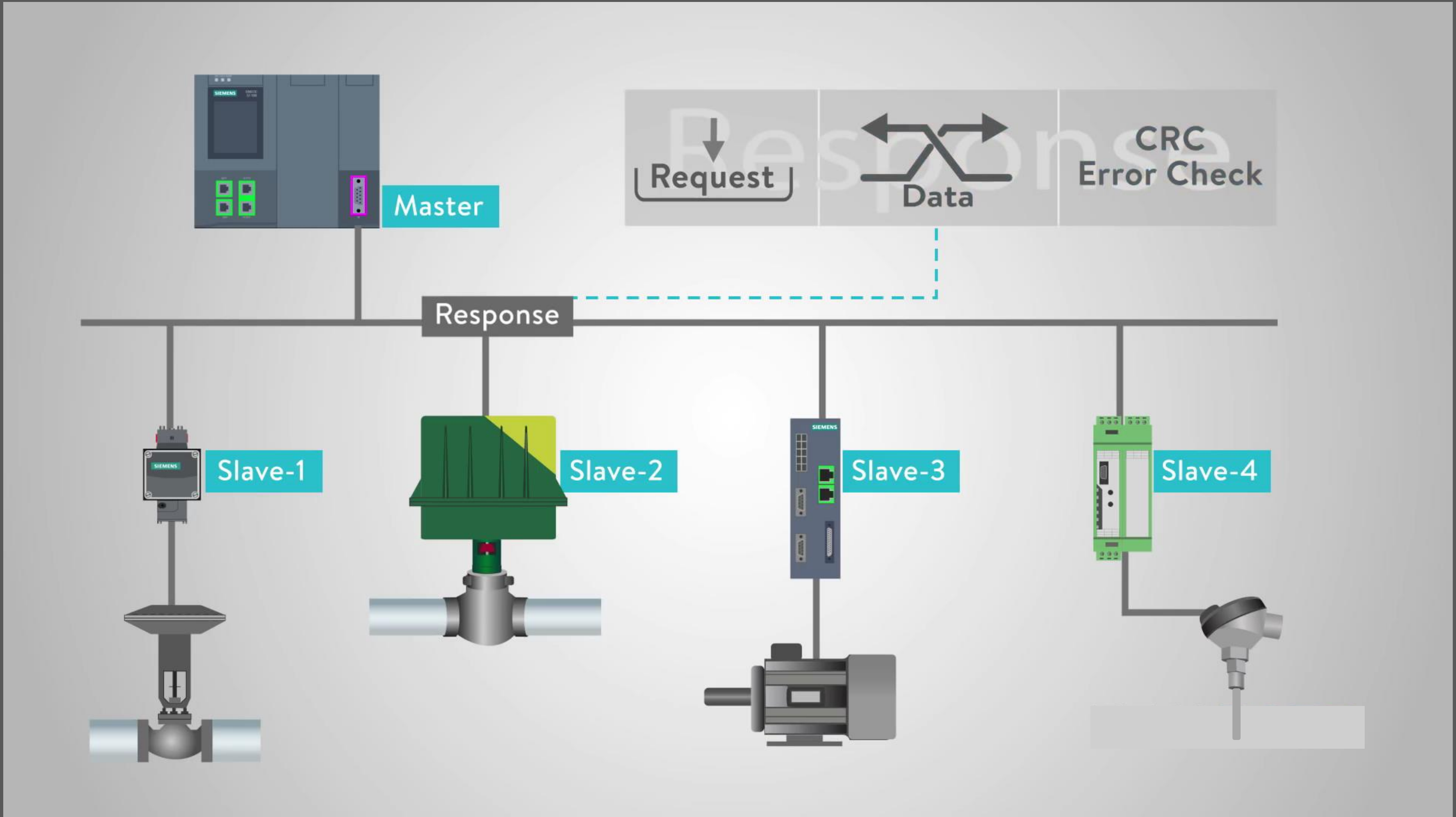
BUS DI CAMPO


SIEMENS
ET 200S
IE/PB LINK

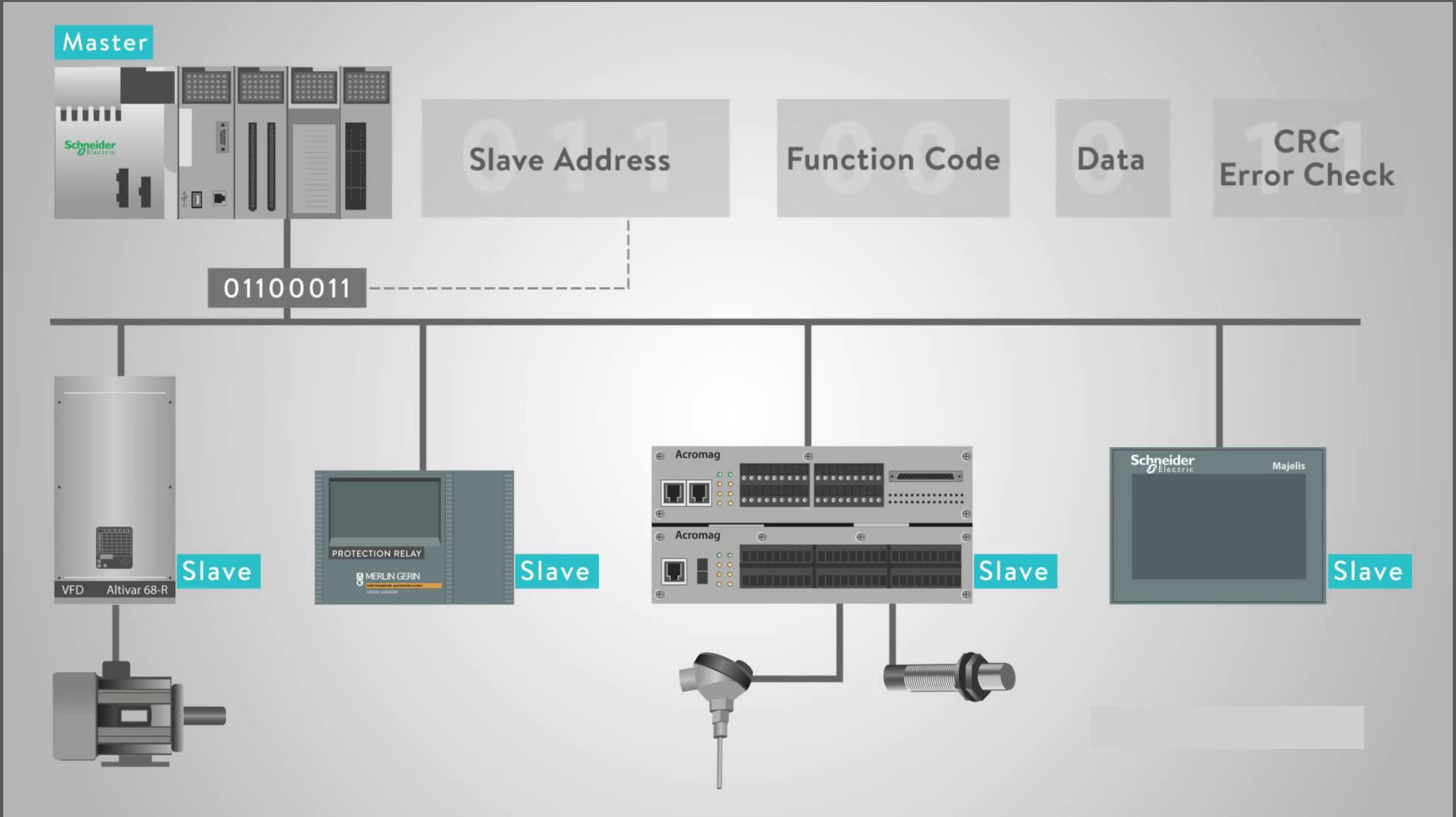

Master
Modbus
Slave-1
Slave-2
Slave-3
Slave-4


Slave Address
(Broadcast Address)
Function Code
Data
CRC
Error Check
Master
01100011
Slave-1
Slave-2
Slave-3
Slave-4

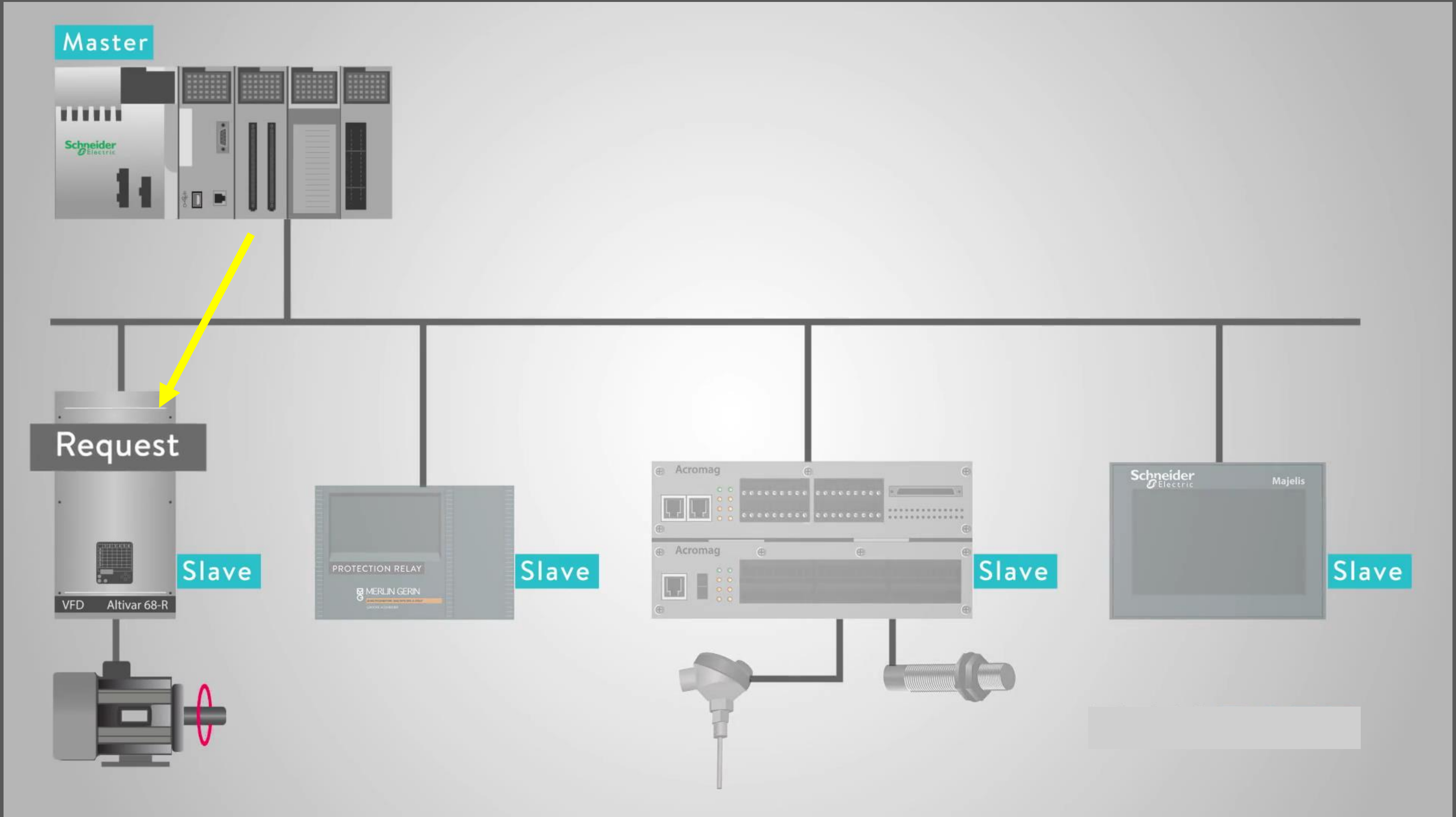
BUS DI CAMPO

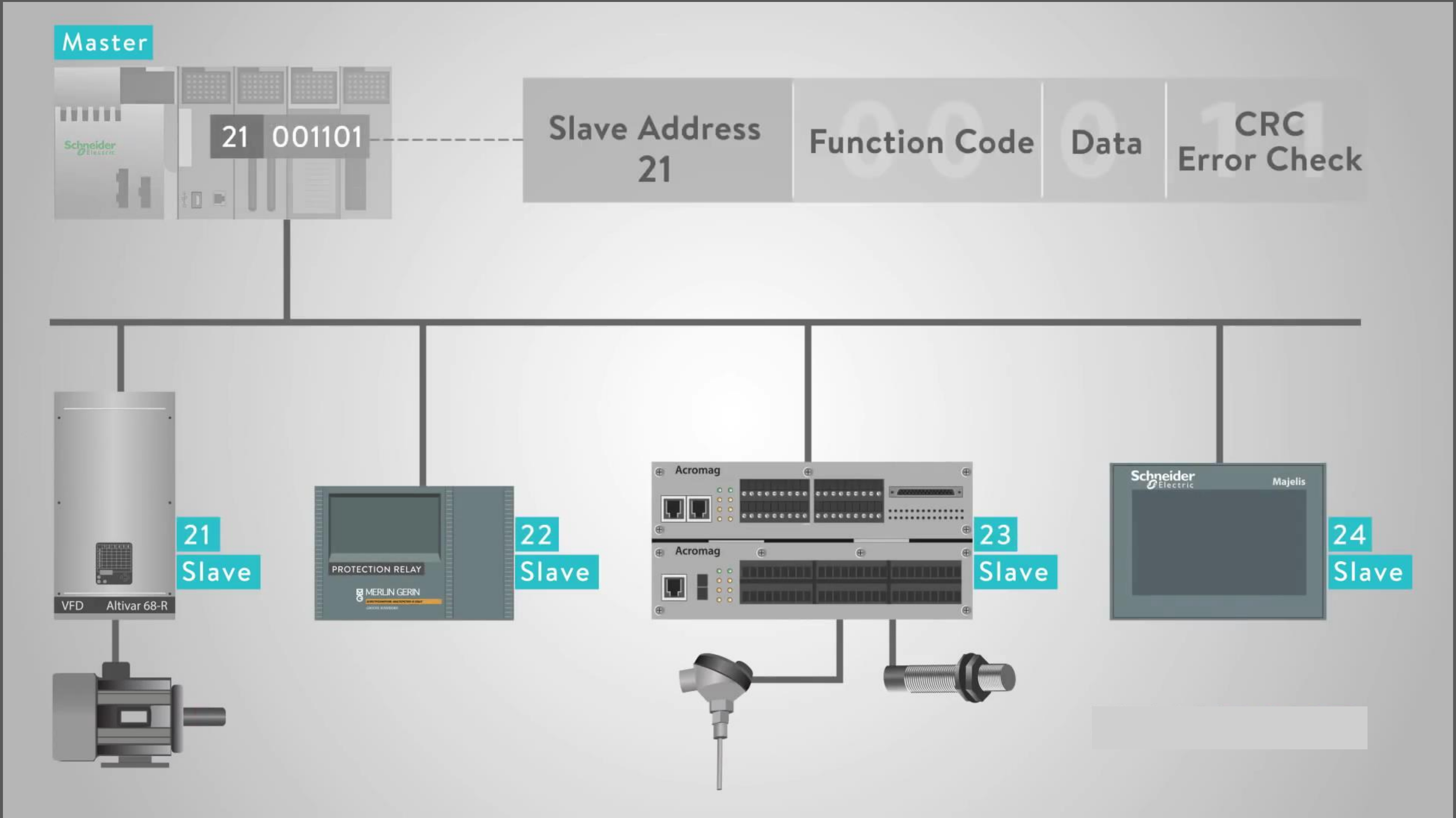

Master
Request
Data
CRC
Error Check
Response
Slave-1
Slave-2
Slave-3
Slave-4
SIEMENS

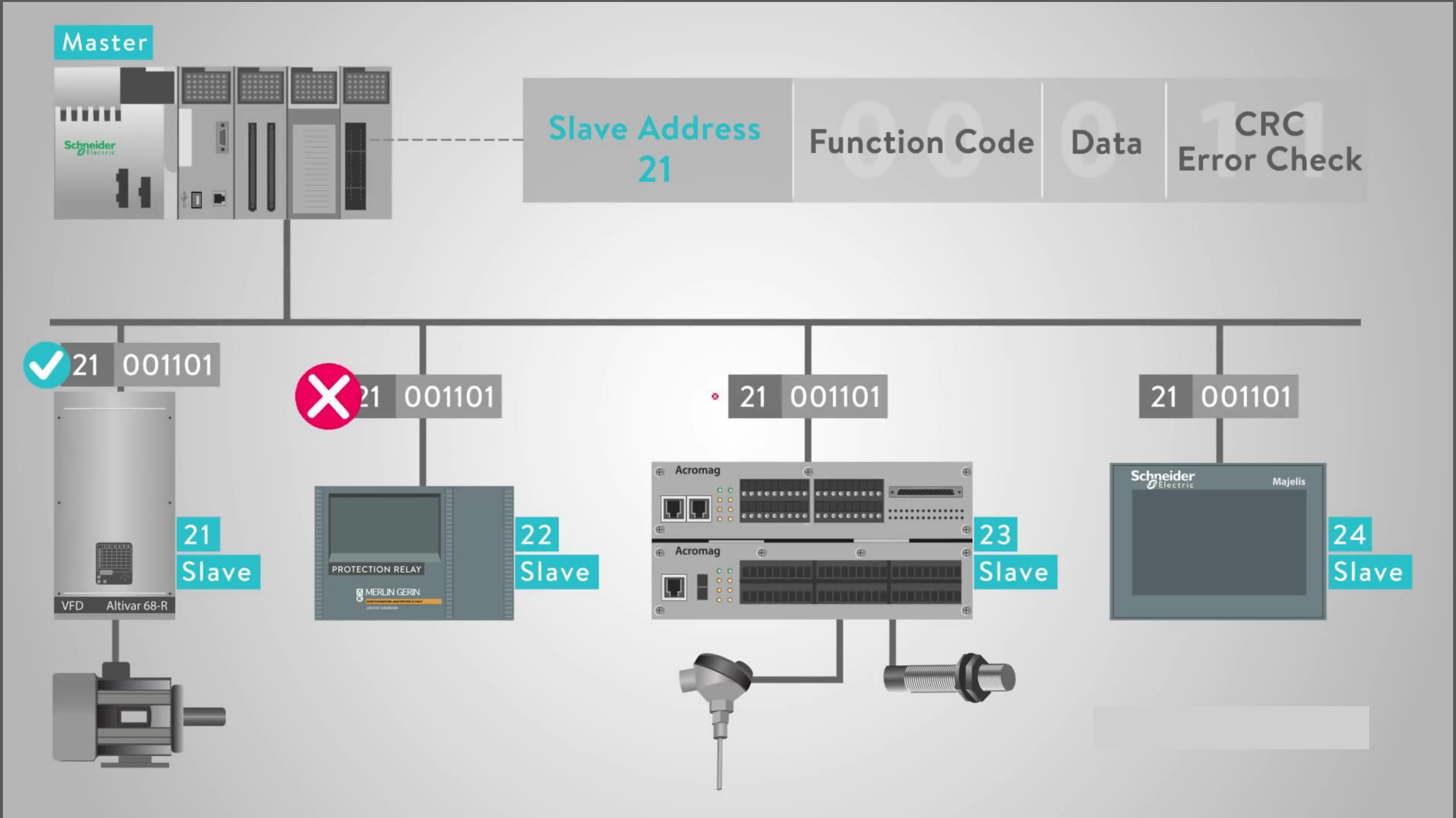
BUS DI CAMPO

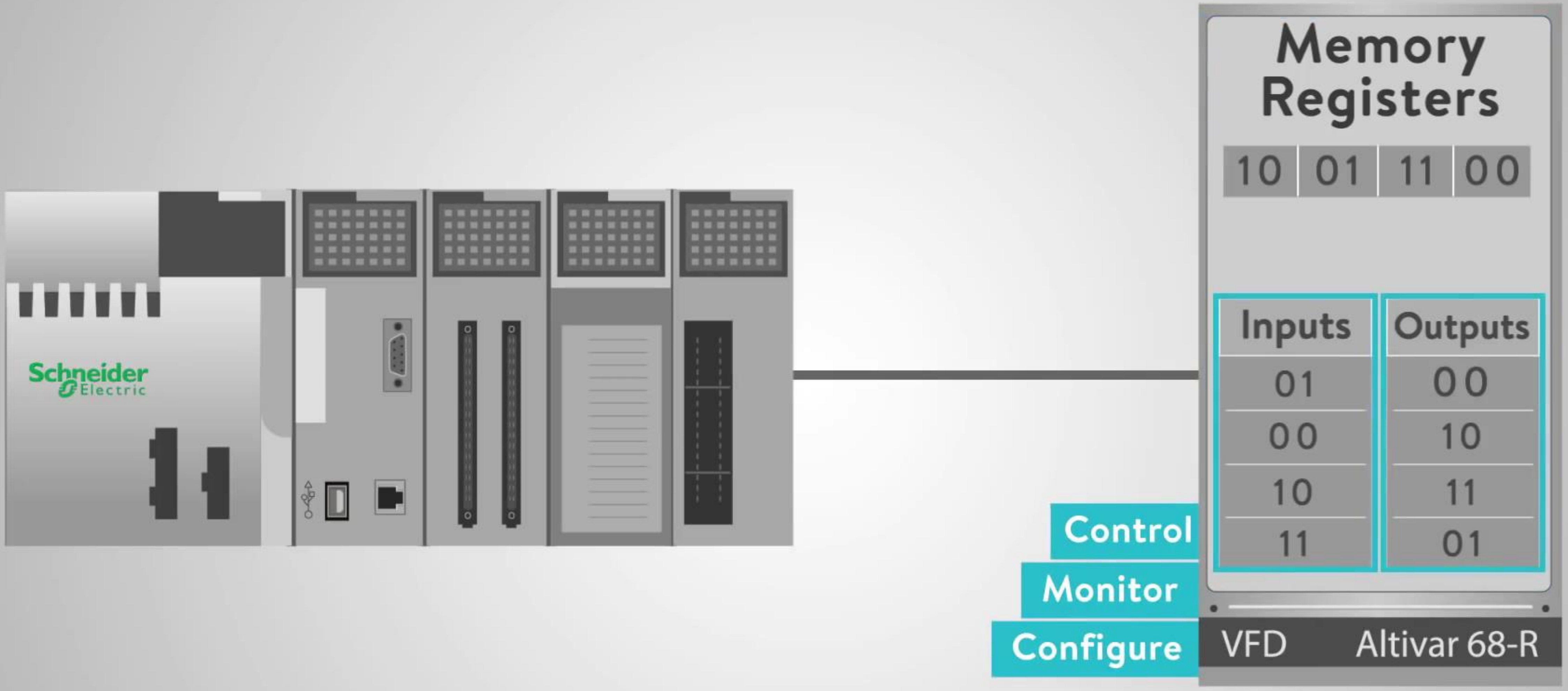

Master
Schneider Electric
Slave Address
Function Code
Data
CRC
Error Check
01100011
VFD
Altivar 68-R
Slave
PROTECTION RELAY
MERLIN GERIN
Slave
Acromag
Acromag
Slave
Schneider Electric
Majelis
Slave

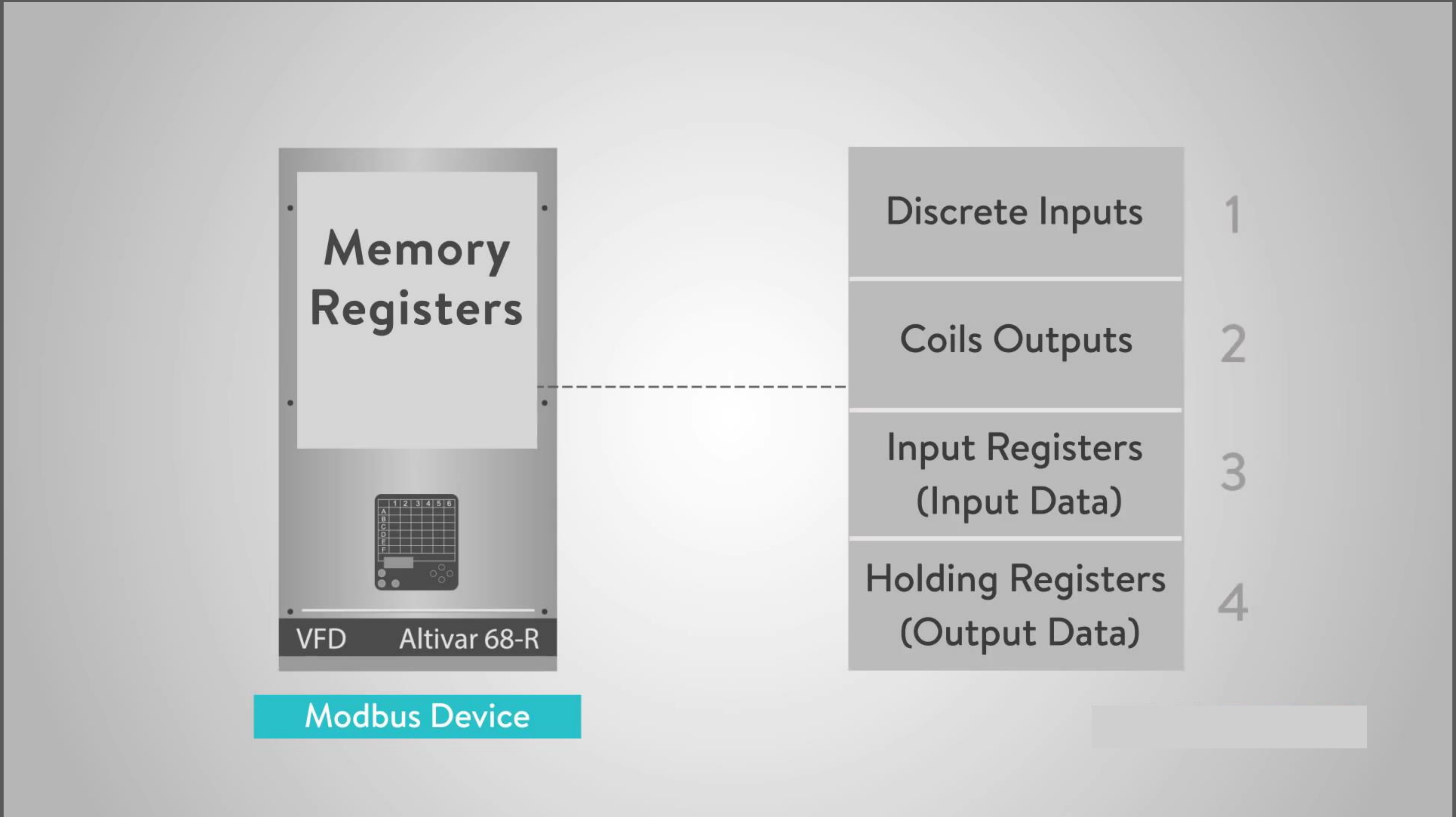
BUS DI CAMPO


Master
Schneider Electric
Request
Slave
VFD Altivar 68-R
PROTECTION RELAY
MERLIN GERIN
Slave
Acromag
Acromag
Slave
Schneider Electric
Majelis
Slave

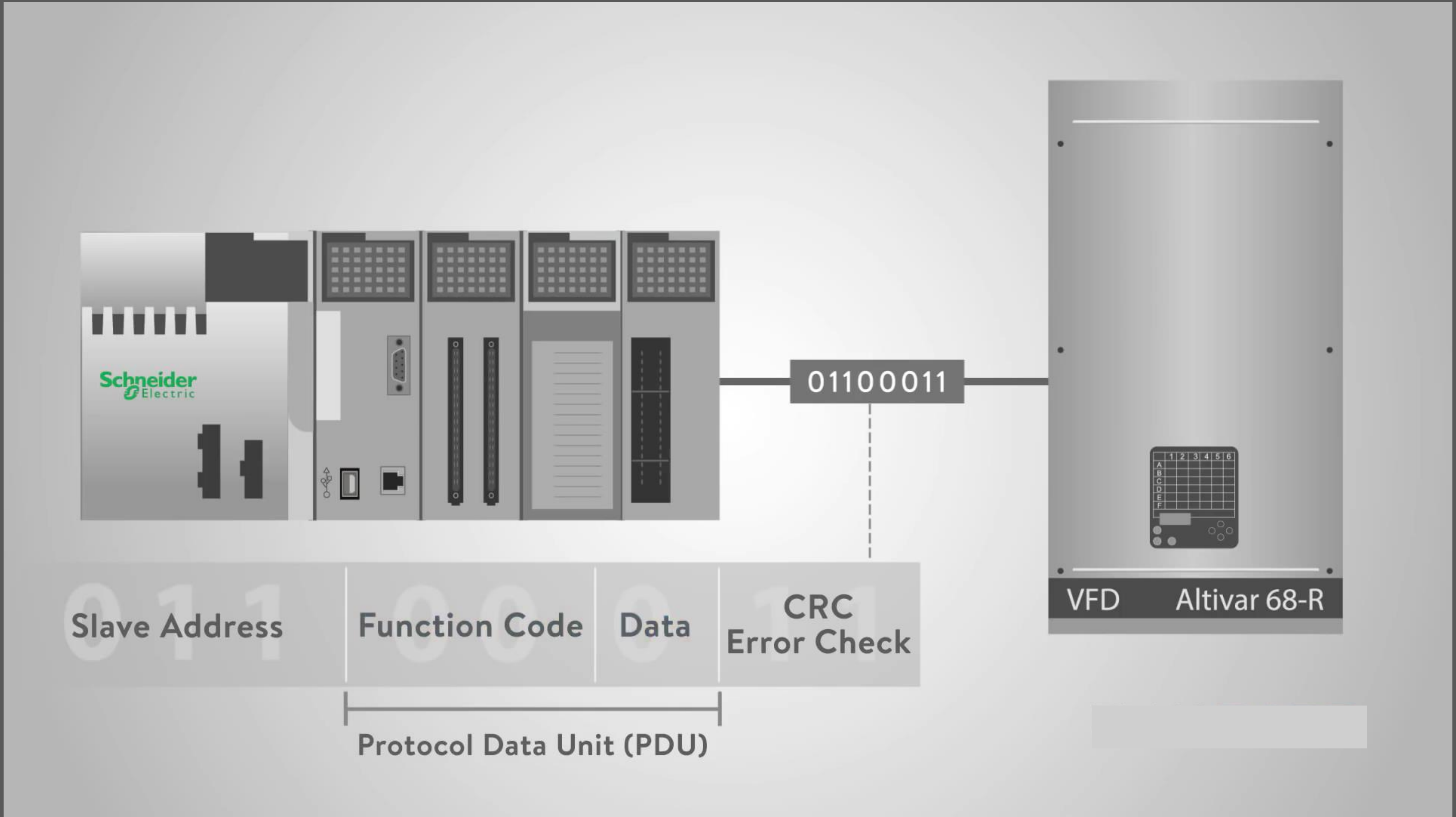

Master
Schneider Electric
21 001101
Slave Address 21
Function Code
Data
CRC Error Check
21 Slave
VFD Altivar 68-R
22 Slave
PROTECTION RELAY
MERLIN GERIN
Acromag
Acromag
23 Slave
Schneider Electric
Majelis
24 Slave

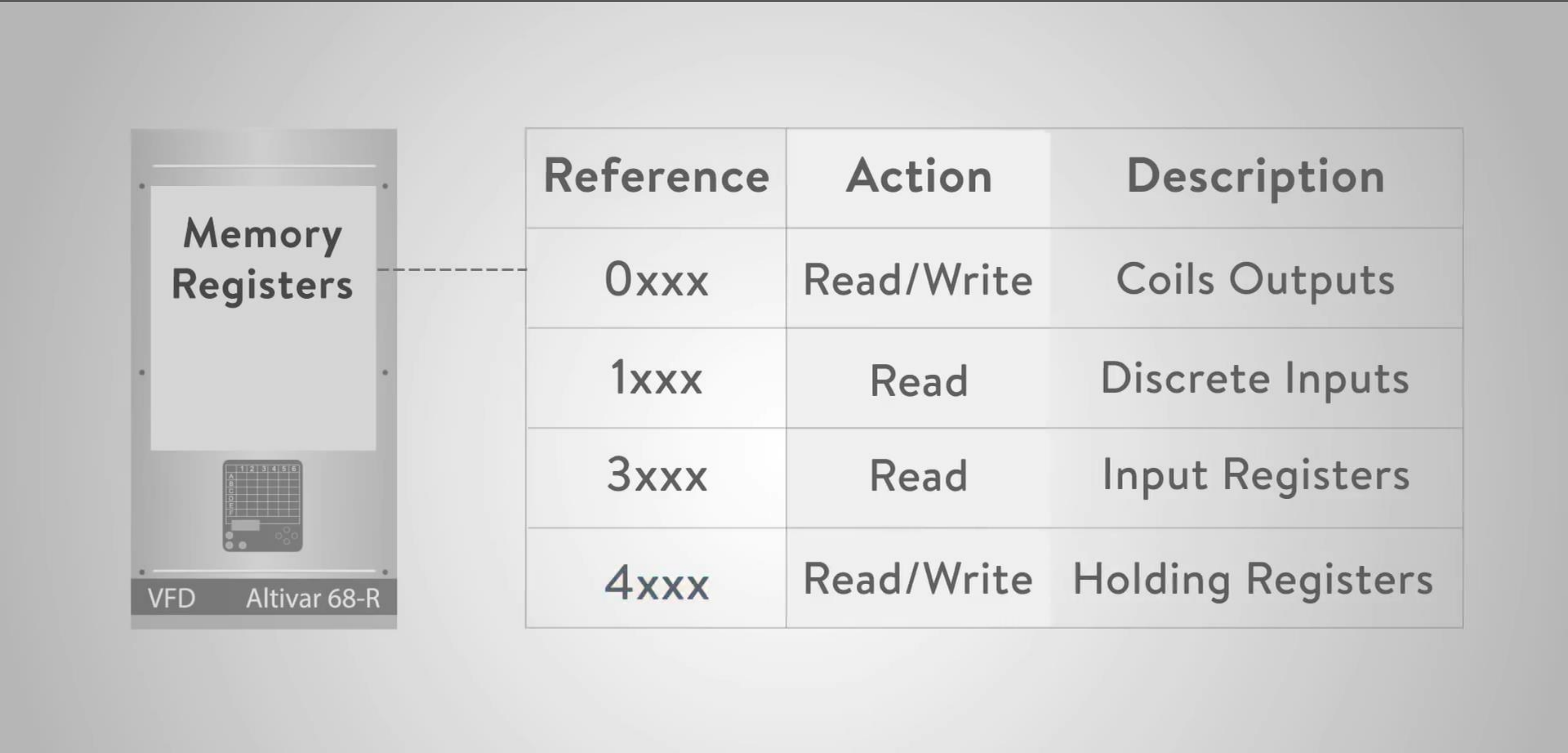

Master
Slave Address
21
Function Code
Data
CRC
Error Check
21
001101
21
001101
21
001101
21
001101
21
Slave
22
Slave
23
Slave
24
Slave
VFD Altivar 68-R
PROTECTION RELAY
MERLIN GERIN
Acromag
Acromag
Schneider Electric
Majelis


Schneider Electric
Memory Registers
10 01 11 00
Inputs
01
00
10
11
Outputs
00
10
11
01
Control
Monitor
Configure
VFD
Altivar 68-R

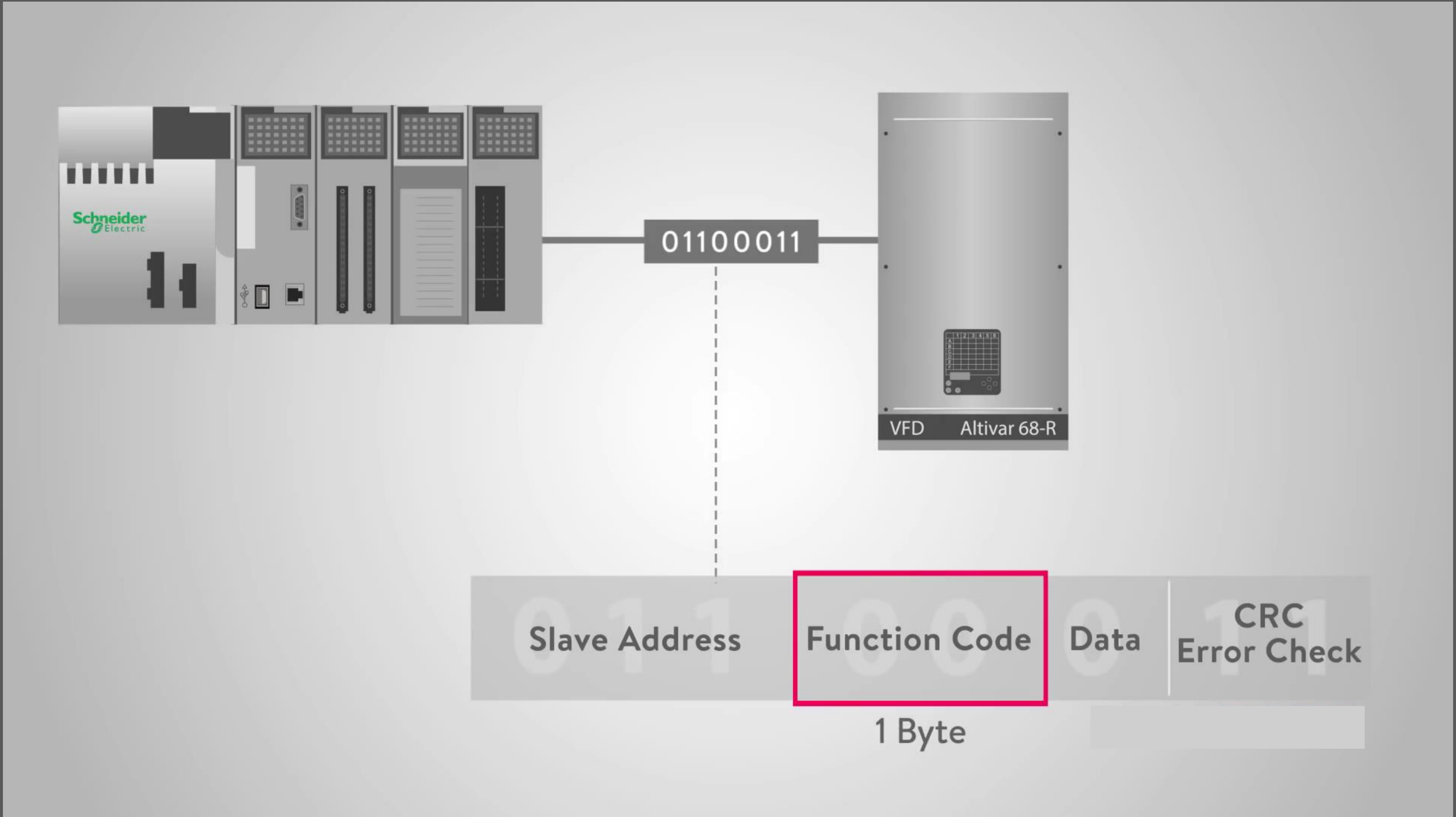

Memory Registers
VFD
Altivar 68-R
Modbus Device
Discrete Inputs
1
Coils Outputs
2
Input Registers (Input Data)
3
Holding Registers (Output Data)
4

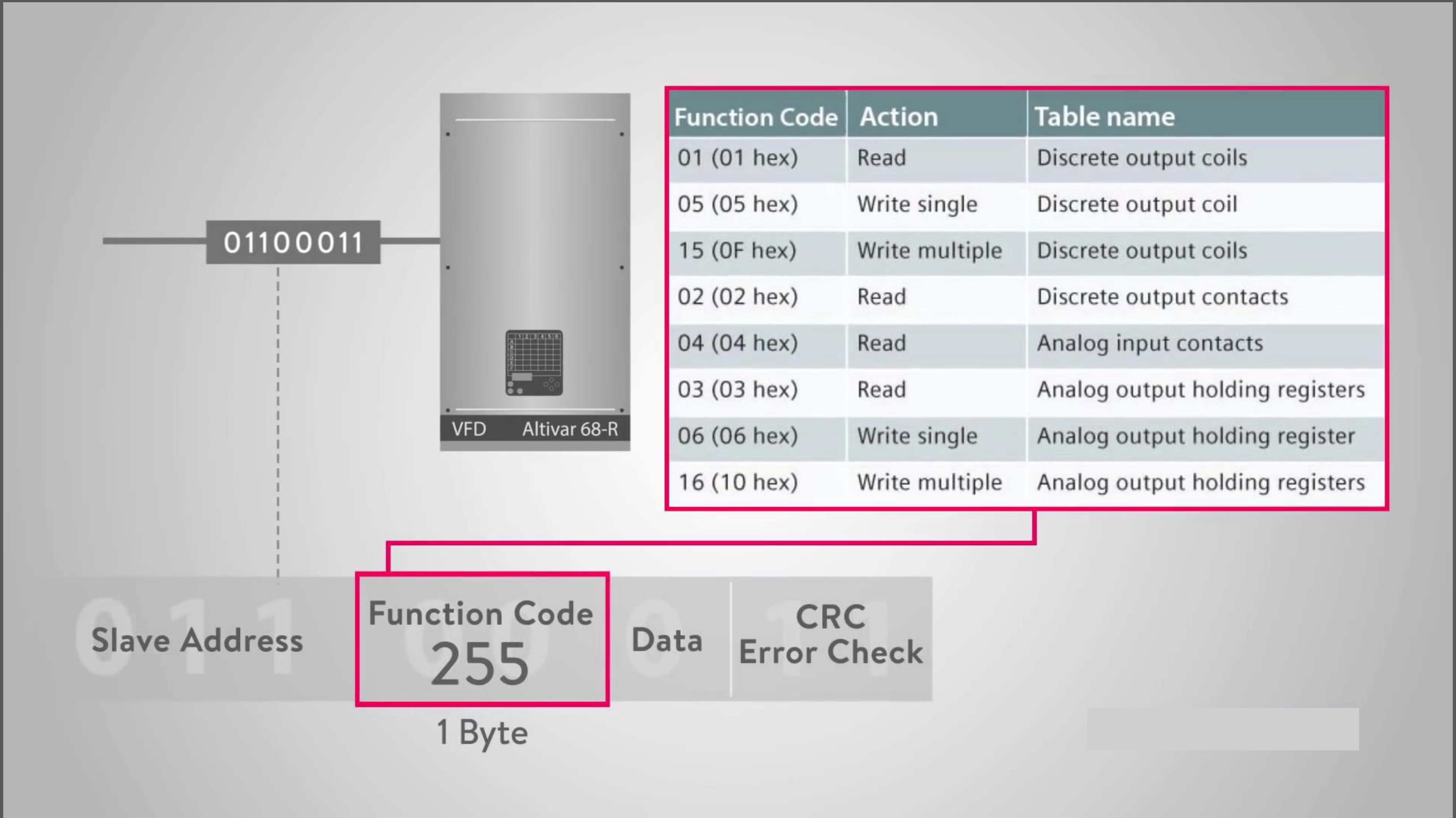
BUS DI CAMPO


Schneider Electric
01100011
Slave Address
Function Code
Data
CRC Error Check
Protocol Data Unit (PDU)
VFD
Altivar 68-R


Memory Registers
VFD
Altivar 68-R

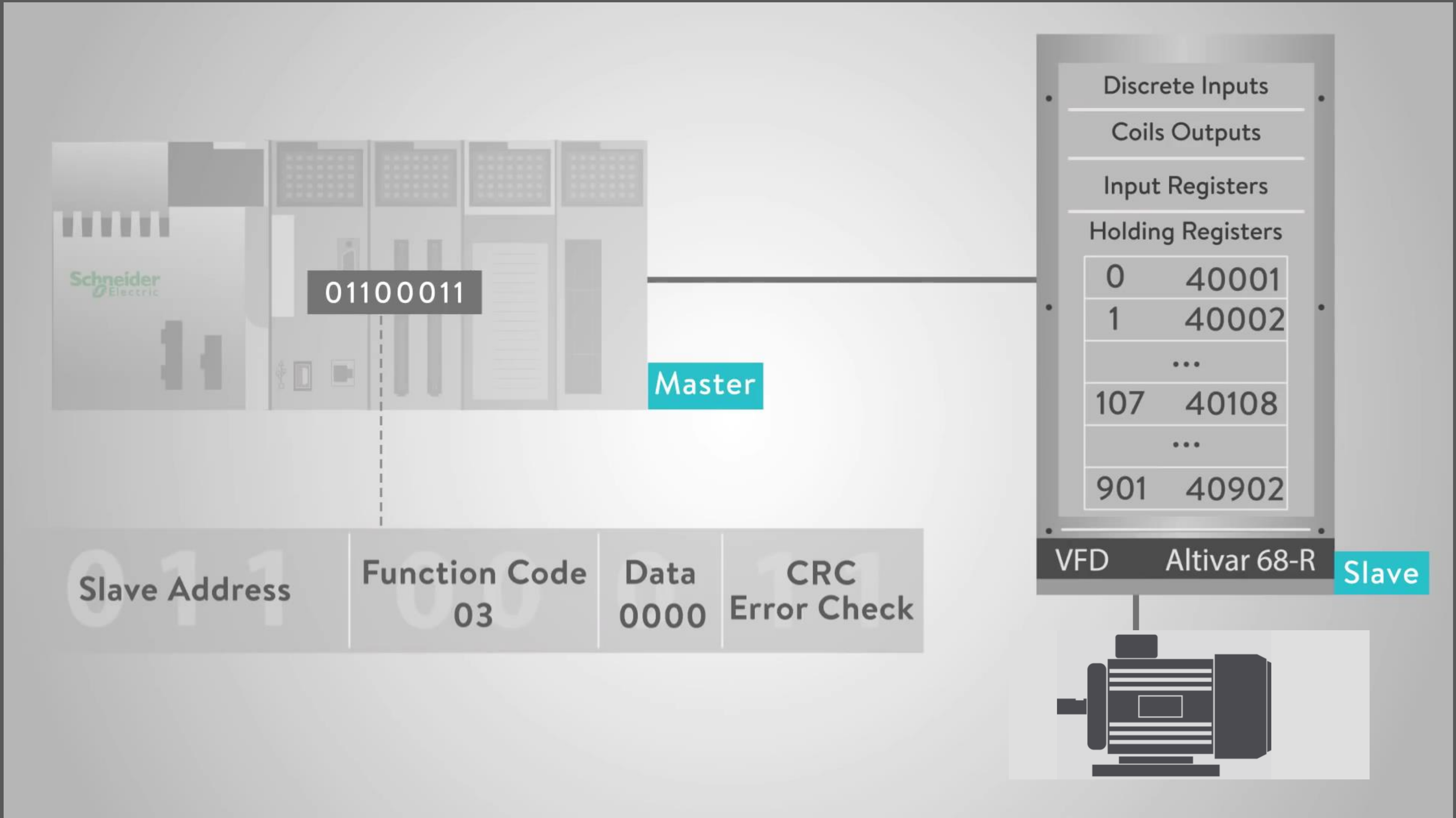
Reference	Action	Description
0xxx	Read/Write	Coils Outputs
1xxx	Read	Discrete Inputs
3xxx	Read	Input Registers
4xxx	Read/Write	Holding Registers

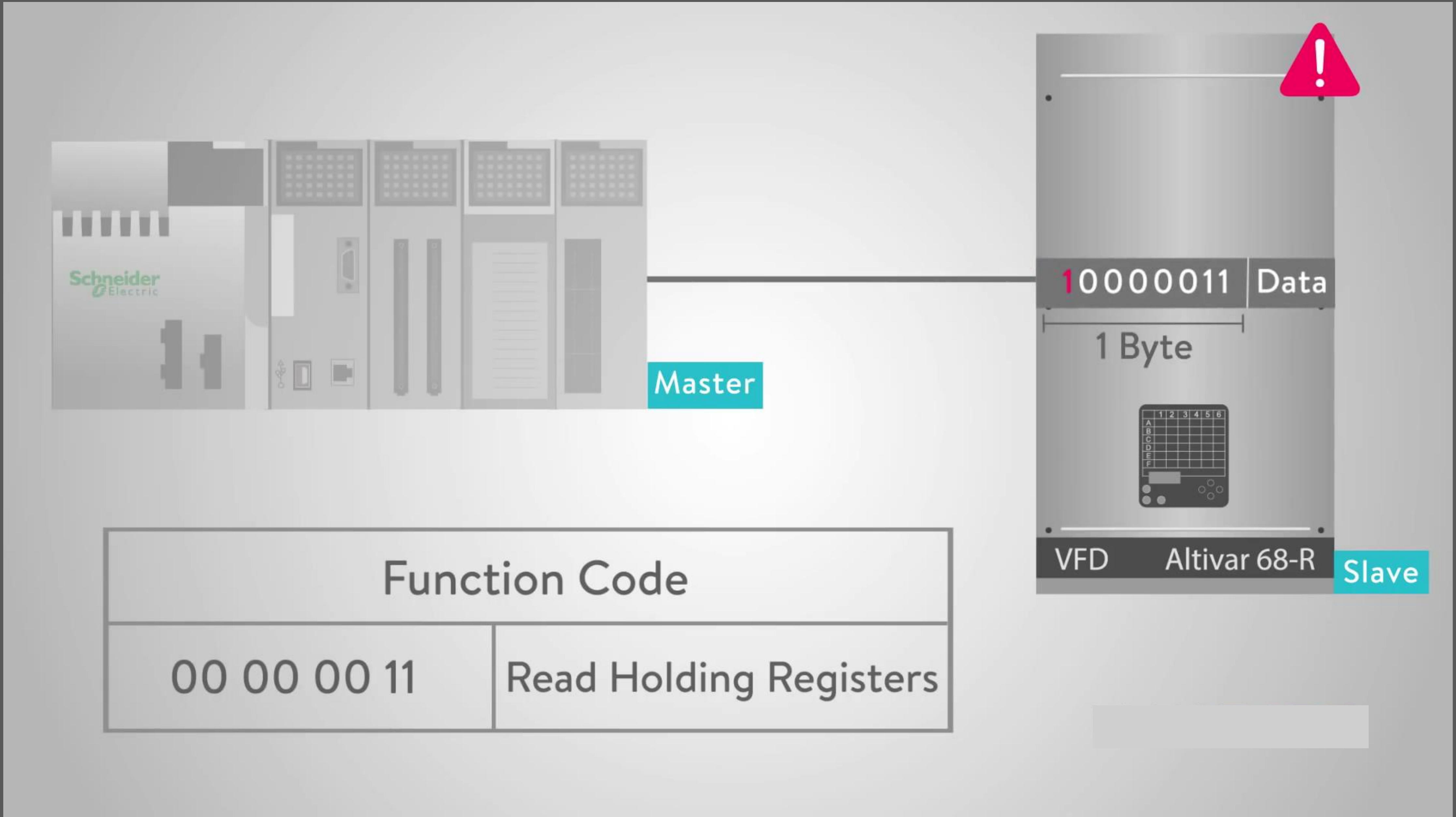

Schneider Electric
01100011
VFD
Altivar 68-R
Slave Address
Function Code
Data
CRC
Error Check
1 Byte



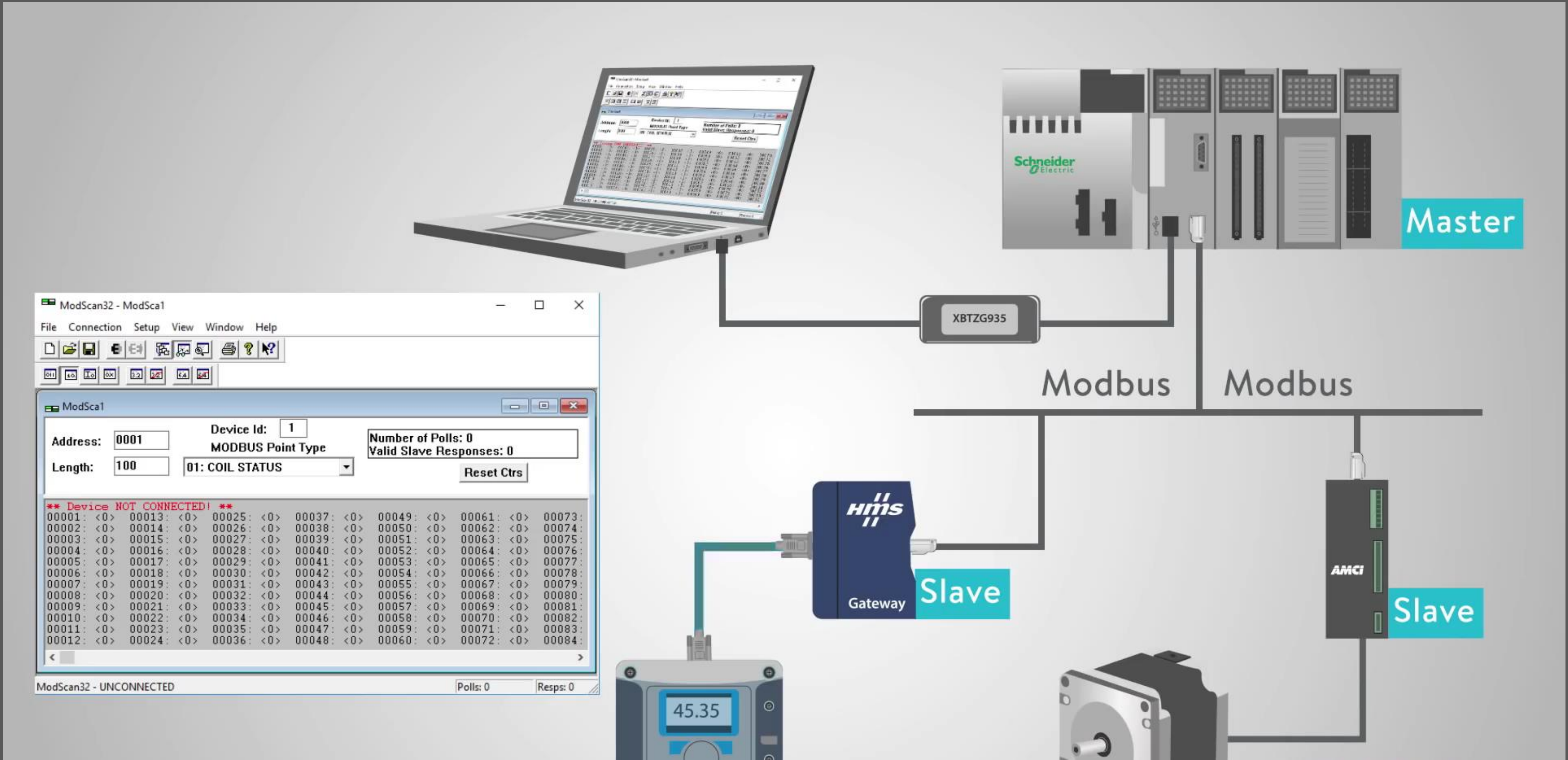
Function Code	Action	Table name
01 (01 hex)	Read	Discrete output coils
05 (05 hex)	Write single	Discrete output coil
15 (0F hex)	Write multiple	Discrete output coils
02 (02 hex)	Read	Discrete output contacts
04 (04 hex)	Read	Analog input contacts
03 (03 hex)	Read	Analog output holding registers
06 (06 hex)	Write single	Analog output holding register
16 (10 hex)	Write multiple	Analog output holding registers

01100011
VFD
Altivar 68-R
Slave Address
Function Code
255
Data
CRC
Error Check
1 Byte


Schneider Electric
01100011
Master
Slave Address
Function Code 03
Data 0000
CRC Error Check
Discrete Inputs
Coils Outputs
Input Registers
Holding Registers
0 40001
1 40002
...
107 40108
...
901 40902
VFD Altivar 68-R
Slave


Schneider Electric
Master
10000011
Data
1 Byte
VFD
Altivar 68-R
Slave

Function Code	
00 00 00 11	Read Holding Registers

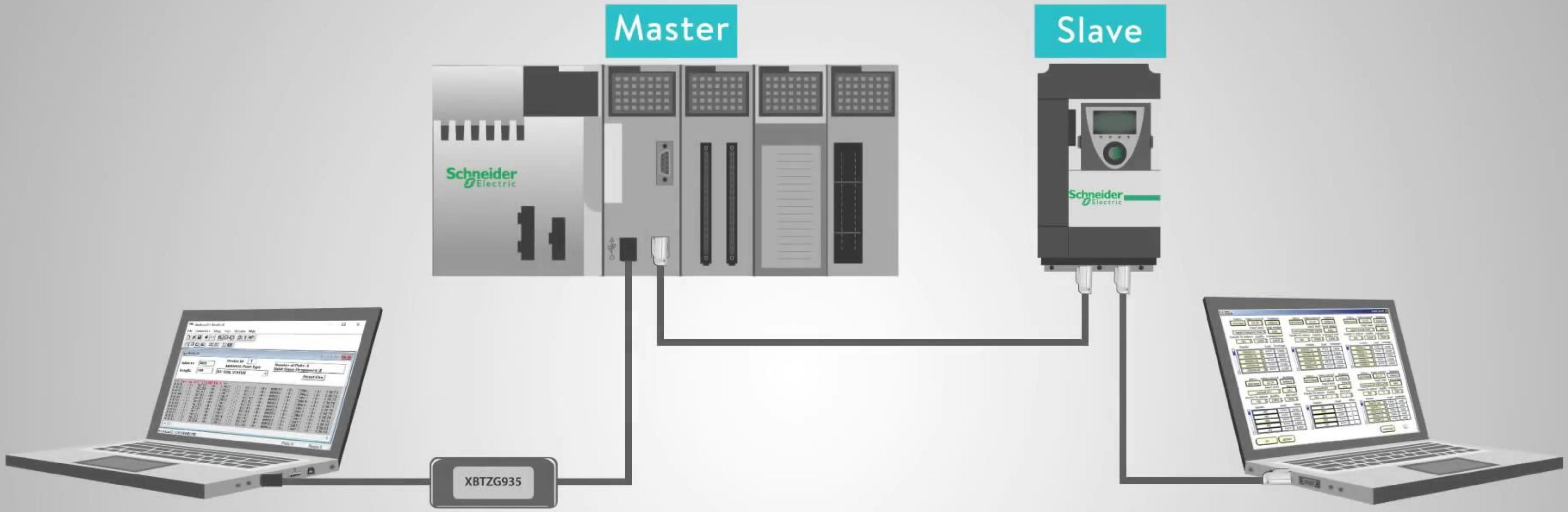

ModScan32 - ModSca1
File Connection Setup View Window Help
ModSca1
Reset Ctrs
Schneider Electric
Master
XBTZG935
Modbus
Modbus
HMS
Gateway
Slave
AMCI
Slave
45.35

Address: 0001
Length: 100
Device Id: 1
MODBUS Point Type
01: COIL STATUS
Number of Polls: 0
Valid Slave Responses: 0

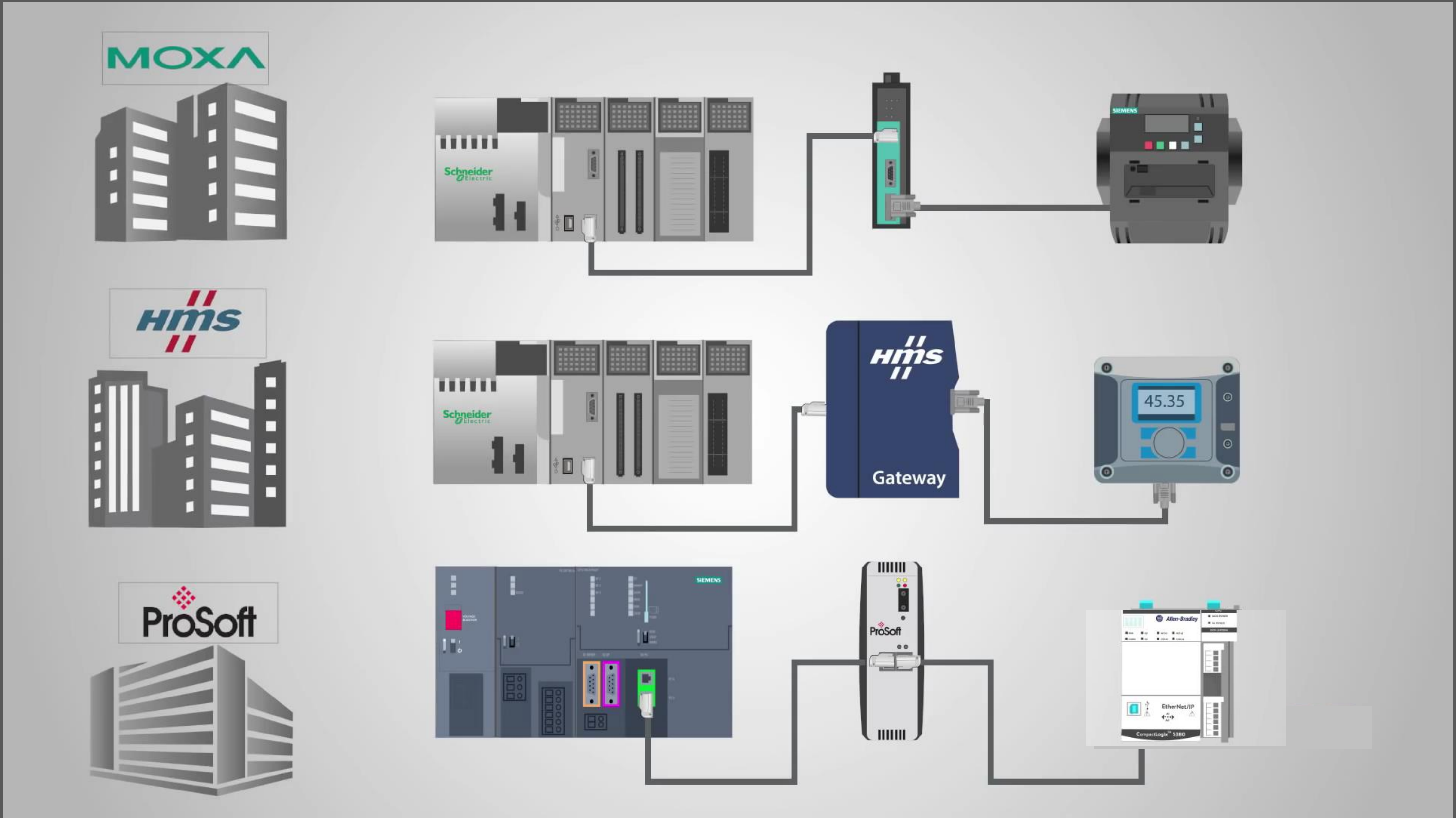
```
** Device NOT CONNECTED! **
00001: <0>   00013: <0>   00025: <0>   00037: <0>   00049: <0>   00061: <0>   00073:
00002: <0>   00014: <0>   00026: <0>   00038: <0>   00050: <0>   00062: <0>   00074:
00003: <0>   00015: <0>   00027: <0>   00039: <0>   00051: <0>   00063: <0>   00075:
00004: <0>   00016: <0>   00028: <0>   00040: <0>   00052: <0>   00064: <0>   00076:
00005: <0>   00017: <0>   00029: <0>   00041: <0>   00053: <0>   00065: <0>   00077:
00006: <0>   00018: <0>   00030: <0>   00042: <0>   00054: <0>   00066: <0>   00078:
00007: <0>   00019: <0>   00031: <0>   00043: <0>   00055: <0>   00067: <0>   00079:
00008: <0>   00020: <0>   00032: <0>   00044: <0>   00056: <0>   00068: <0>   00080:
00009: <0>   00021: <0>   00033: <0>   00045: <0>   00057: <0>   00069: <0>   00081:
00010: <0>   00022: <0>   00034: <0>   00046: <0>   00058: <0>   00070: <0>   00082:
00011: <0>   00023: <0>   00035: <0>   00047: <0>   00059: <0>   00071: <0>   00083:
00012: <0>   00024: <0>   00036: <0>   00048: <0>   00060: <0>   00072: <0>   00084:
```

ModScan32 - UNCONNECTED
Polls: 0
Resps: 0

BUS DI CAMPO


Master
Slave
Schneider Electric
Schneider Electric
XBTZG935

BUS DI CAMPO


MOXA
Schneider Electric
SIEMENS
HMS
Schneider Electric
HMS
Gateway
45.35
ProSoft
SIEMENS
ProSoft
Allen-Bradley
EtherNet/IP
CompactLogix 5380