PROFIBUS

Design and

Good Practices

www.profibus.com.sg

ERP

MES

Ethernet backbone

PROFI NET®

PROFI BUS®

PROFIBUS PA

PROFIBUS PA

PROFIBUS DP

PA coupler
PA link

Author / Title of the presentation

■ To create hierarchy in the network, PROFIBUS defines 2 types of stations: active (**masters**) and passive (**slaves**).

master

slave

commands

responses
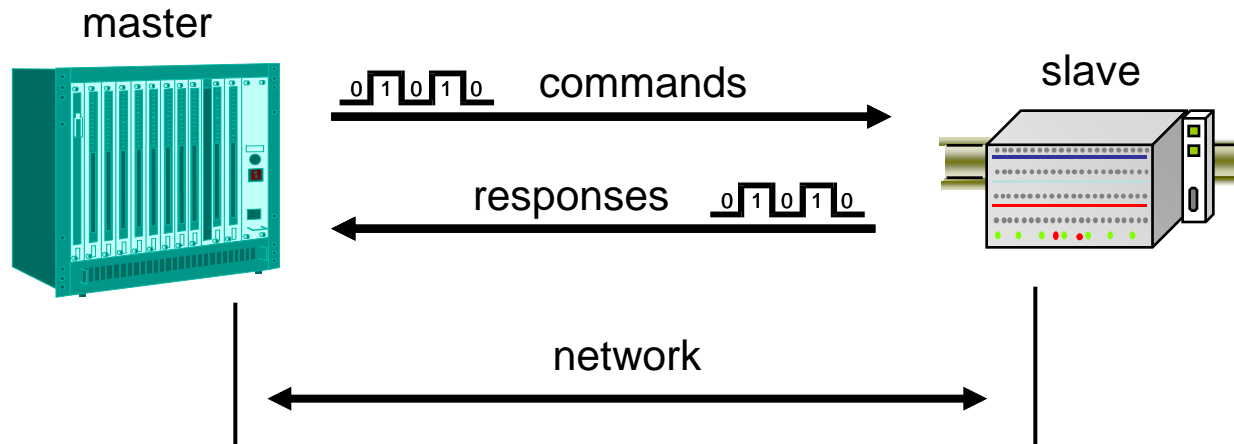
network

➢ At least **1 master** is mandatory.

➢ PROFIBUS networks allow **multiple masters**.

➢ In total **127 stations** can be addressed (masters + slaves).

Dominique Chabauty / PROFIBUS Design and good practices

PROFIBUS Supports 3 transmission media

RS 485
2-wire CU-cable for general purposes

MBP-IS
2-wire CU-cable with the option for power over the bus and Ex-protection

Fiber Optic
Highest EMC protection and wide distances

Coupler

Coupler

Fiber optic cable

Dominique Chabauty / PROFIBUS Design and good practices

Agenda

PROFIBUS Family

Communication Medias

Topologies

Cable length

Devices Rules

Installation Rules

Troubleshooting

Training

App. Profiles II

PA Devices	RIO for PA	SEMI	......	PROFIdrive V2.0 and V3.0	Identification Systems	Weighing & Dosage	Encoder

Integration Technologies

App. Profiles I

Common Application Profiles (optional):
PROFIsafe, Time Stamp, Redundancy, etc.

Comm.

IEC 61158/61784

PROFIBUS DP

FDL + DP-V0...V2

Physical Layer

RS 485	NRZ
RS 485-IS	Intrinsic Safety

Fiber Optics:	Glass Multi Mode
	Glass Single Mode
	PCF / Plastic Fiber

MBP	Manchester Bus Powered
MBP-LP	Low Power
MBP-IS	Intrinsic Safety

Descriptions (GSD, EDD) Tools (DTM, Configurators)

Dominique Chabauty / PROFIBUS Design and good practices
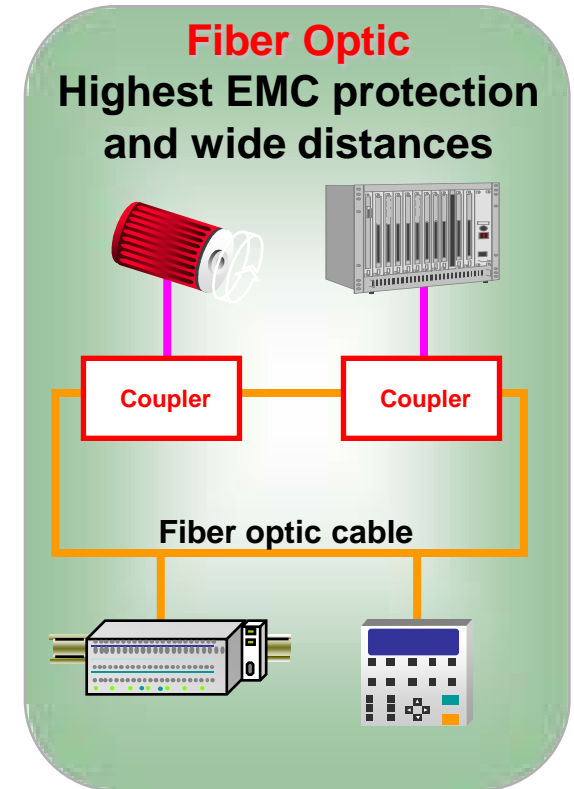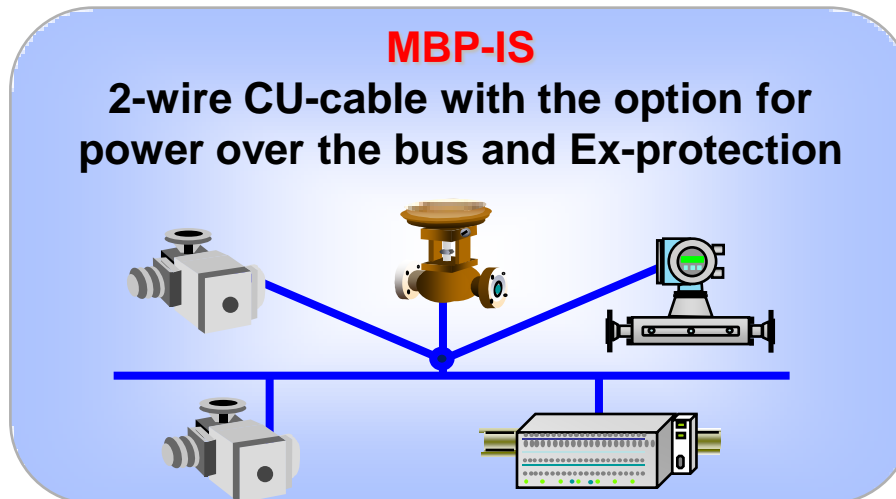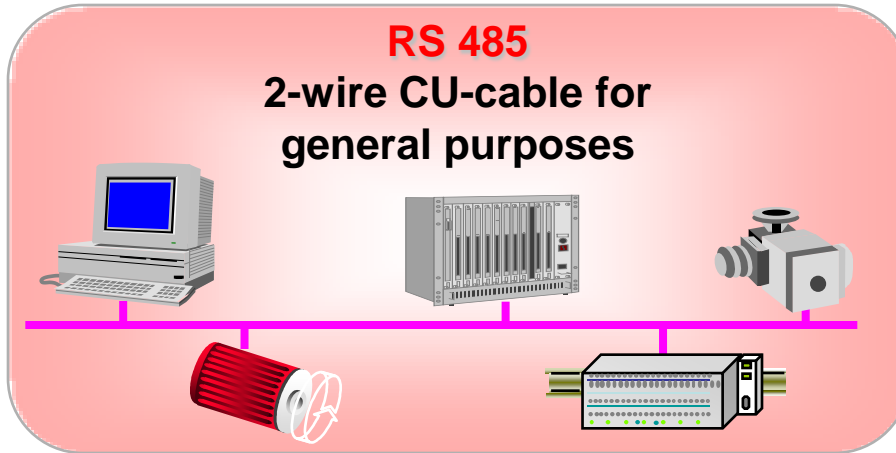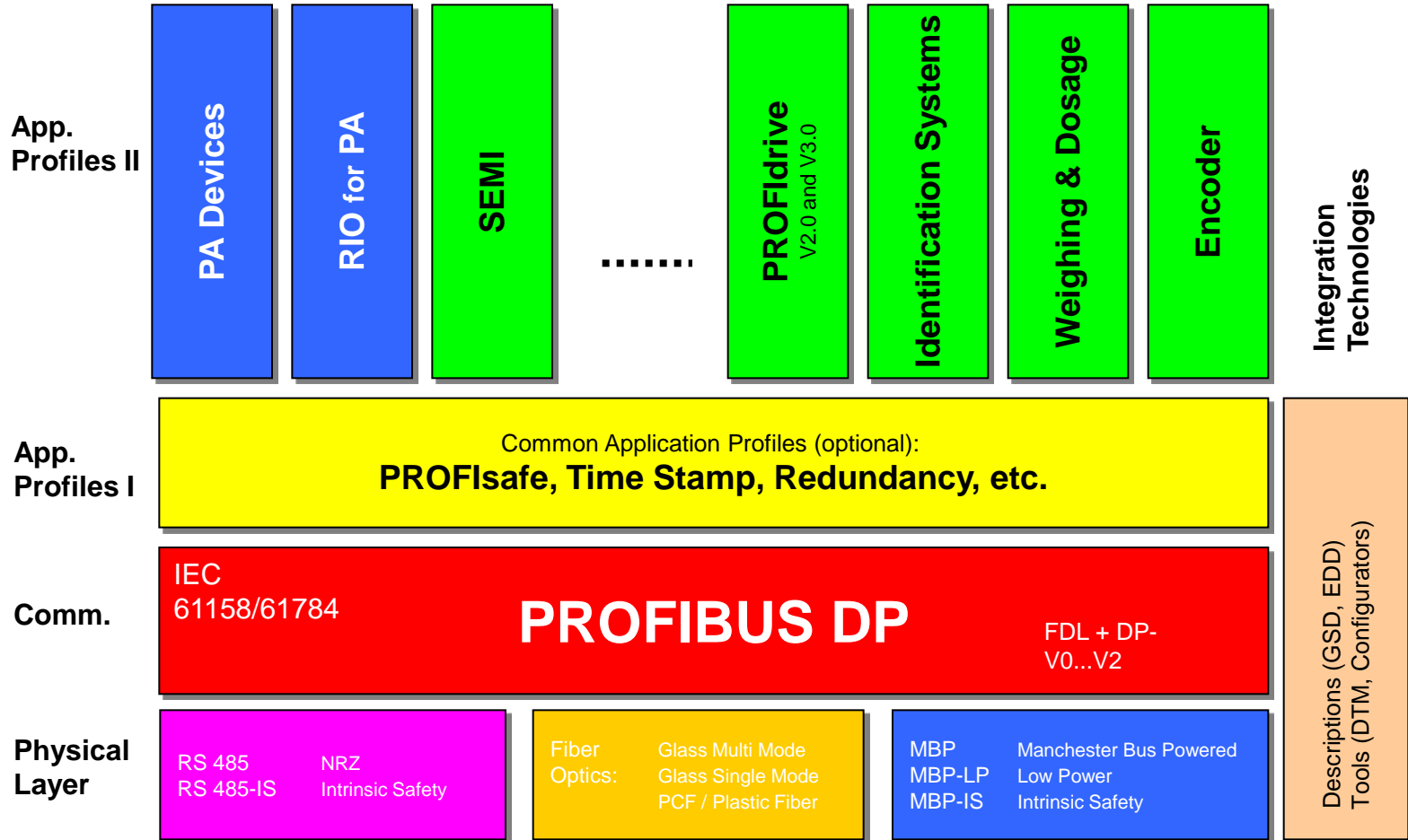
PROFIBUS communicates over a two wire bus structure.

listen, taking over and answering

sending

listen

9

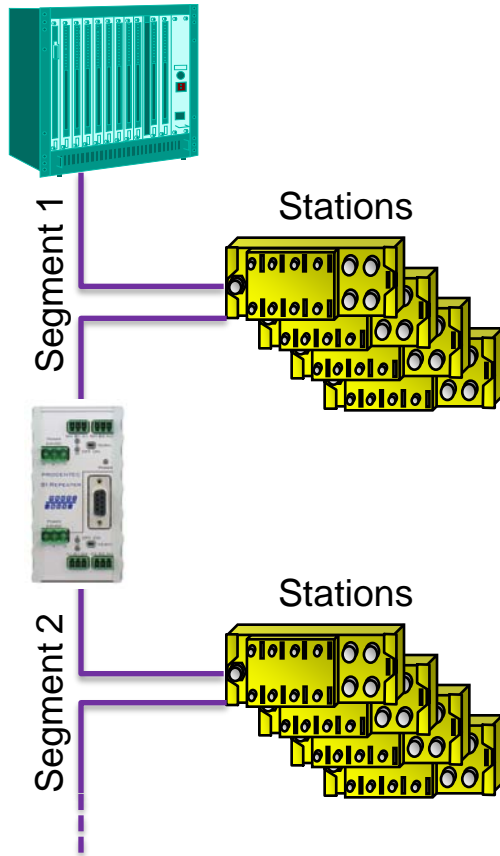0 1 0 1 0

1

117

5

43

listen

listen
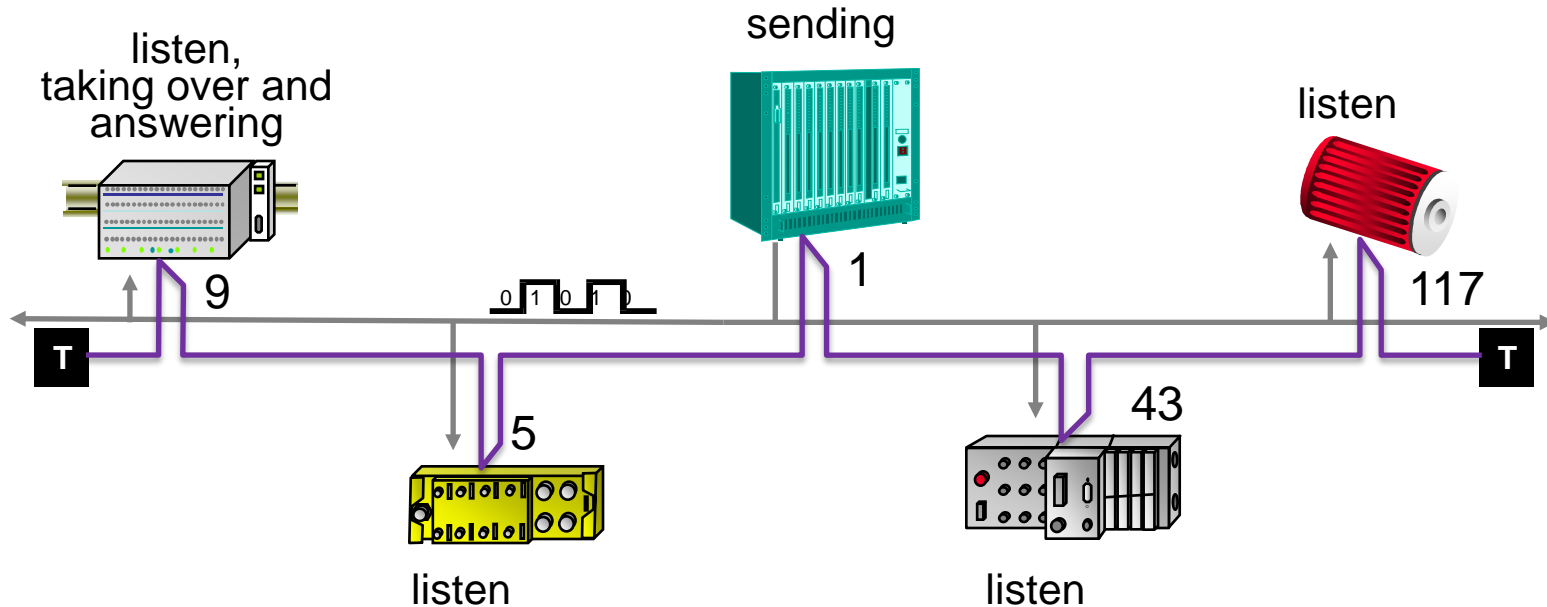
- Devices are addressed through a network address (0..126).
- Devices are coupled in parallel to the bus.
- Devices can be hot swapped and position does not matter.
- Each segment is terminated at both end with an active termination
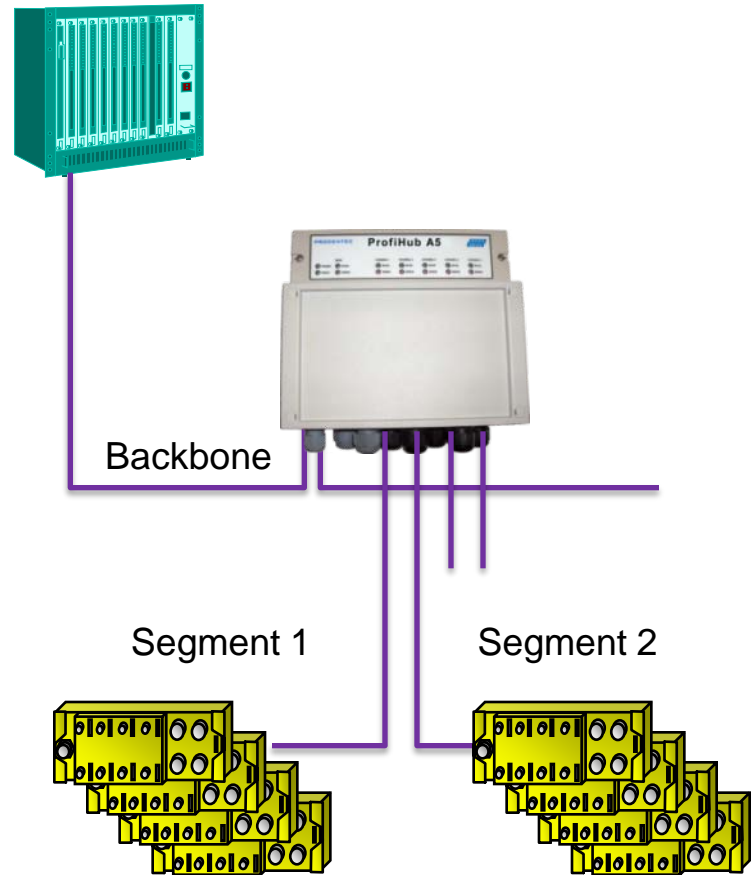- Spurs should be avoided as length is very limited

PROFIBUS DP Topologies - Repeaters

Single Repeaters

PROFIBUS Hubs

Segment 1

Stations

Segment 2

Stations

Backbone

Segment 1

Segment 2

Benefit: Isolate part of your network from EMC/Noise

Dominique Chabauty / PROFIBUS Design and good practices

Classic Topology

Ring Topology

Fiber optic cable

Coupler

Coupler

Coupler

Coupler

Coupler

Coupler

Fiber optic cable
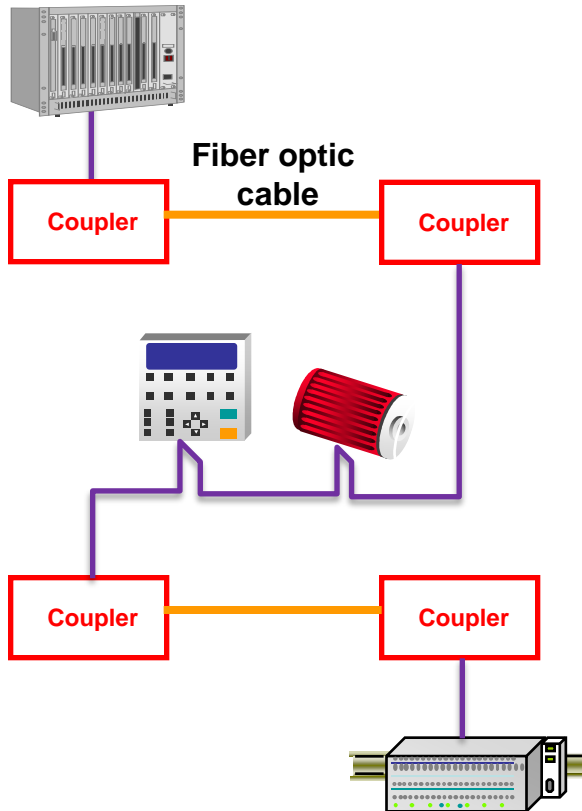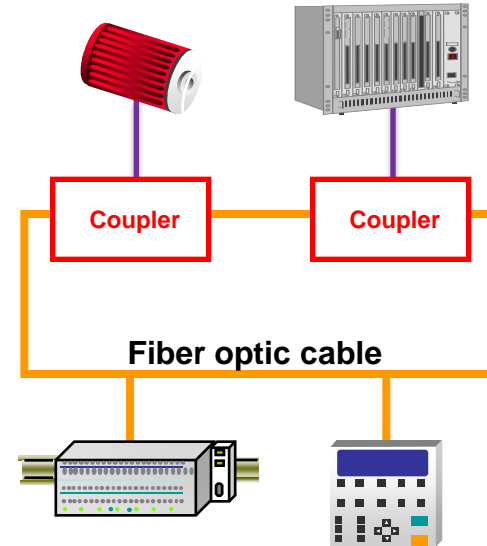
Benefits: Long distances and EMC/Noise isolation

Connect your slaves through wireless couplers
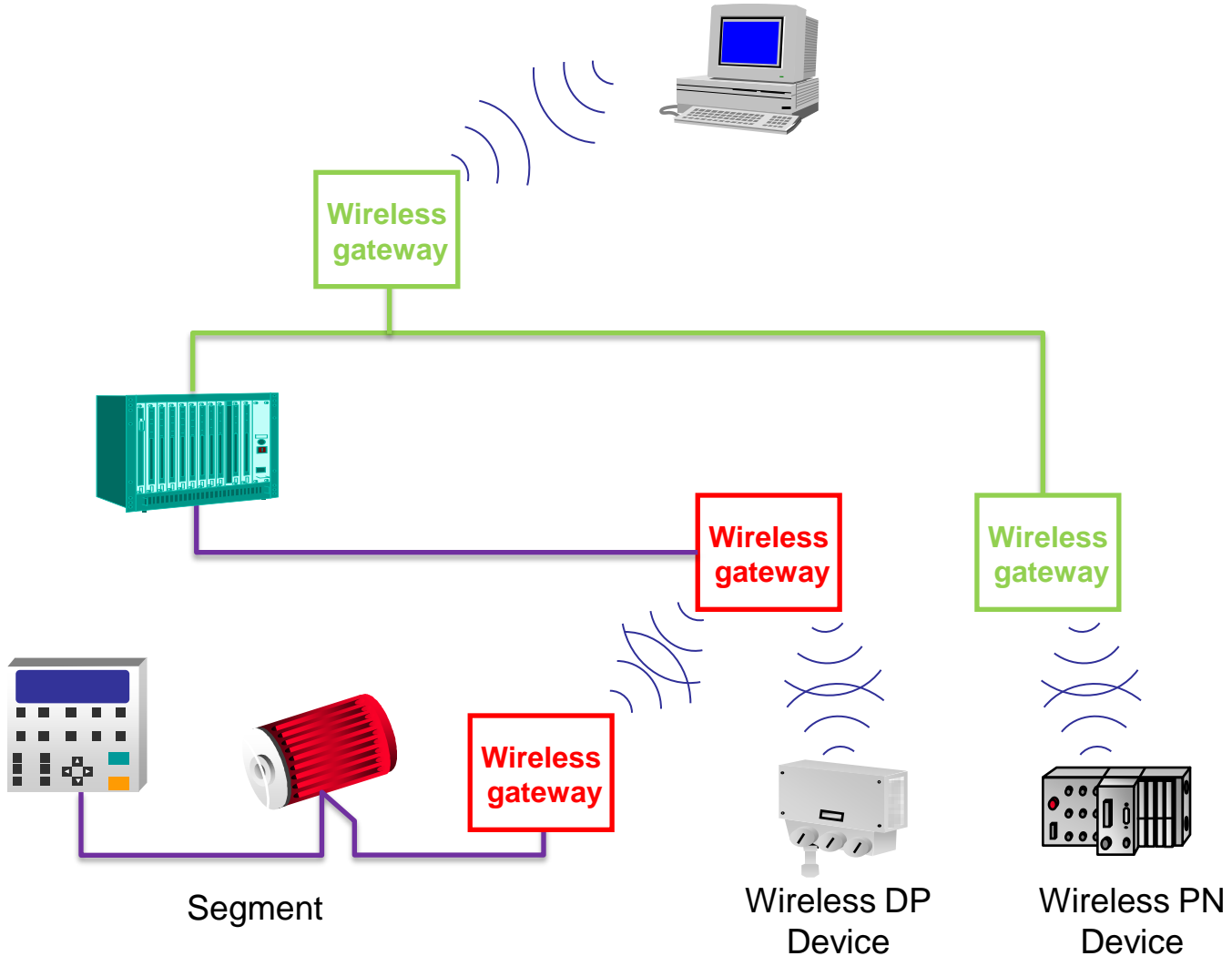
Wireless gateway

Wireless gateway

Wireless gateway

Wireless gateway

Segment

Wireless DP Device

Wireless PN Device

Dominique Chabauty / PROFIBUS Design and good practices

Agenda

PROFIBUS Family

Communication Medias

Topologies

Cable length

Devices Rules

Installation Rules

Troubleshooting

Training

RS 485

RS 485

RS 485

RS 485

RS 485

coupler

coupler

coupler

coupler

glasvezel

glasvezel

RS 485

RS 485

1.0

DCS/PLC

PROFIBUS DP

DP/PA-Link

24 V

PROFIBUS PA

Junction Box

Segment

"T"

Dominique Chabauty / PROFIBUS Design and good practices

PROFIBUS PA Topologies - Redundancy

Coupler Redundancy

PROFIBUS DP

DP/PA-coupler, redundant (M = master)

IM 153, redundant

- **Coupler-Redundancy**

Active **F**ield **S**plitter

AFS

PROFIBUS PA

■ Bus termination

□ Automatic bus termination
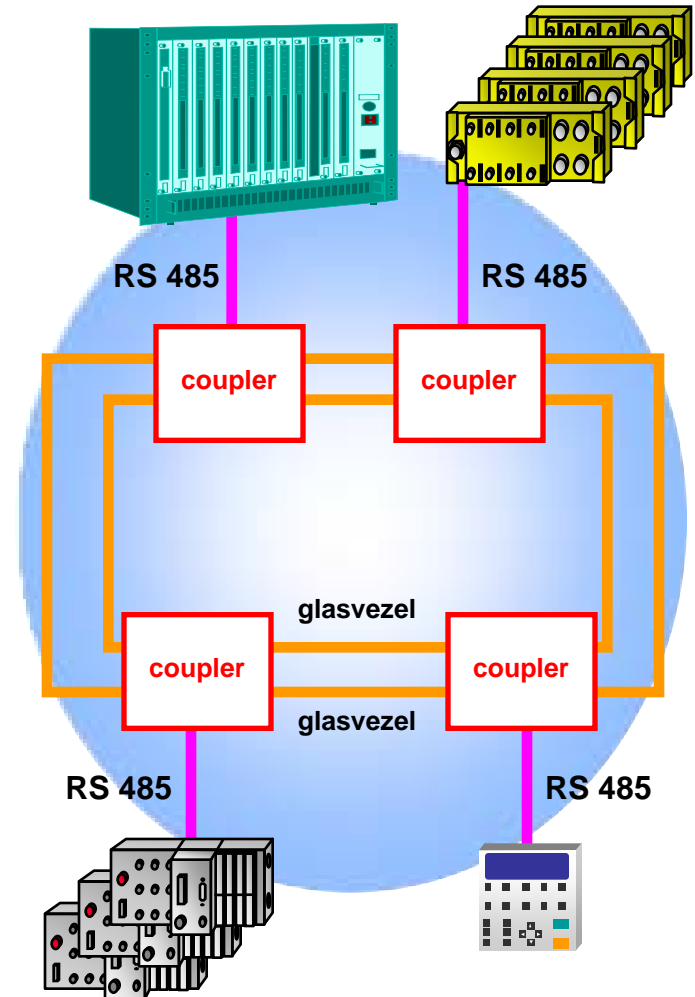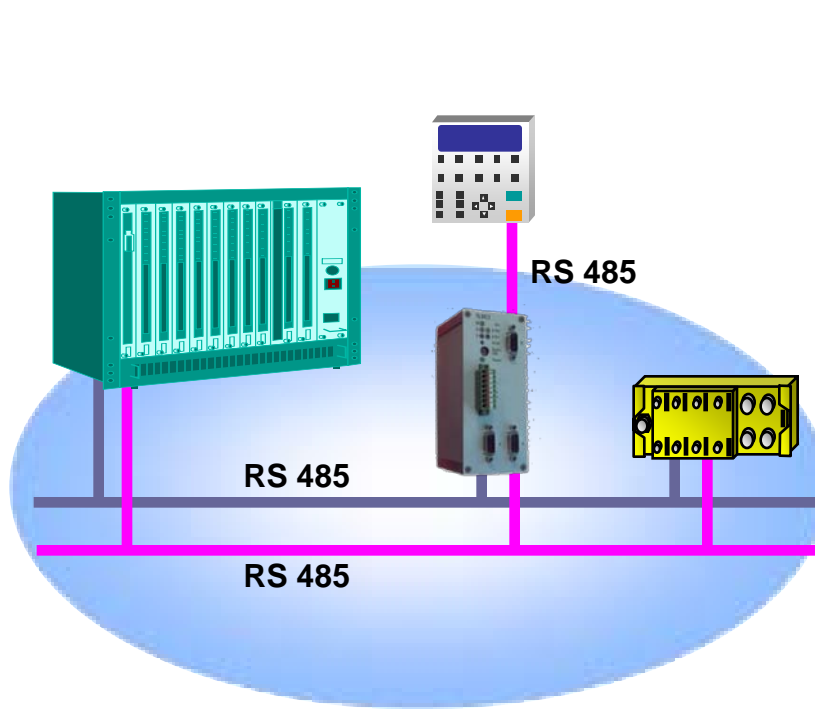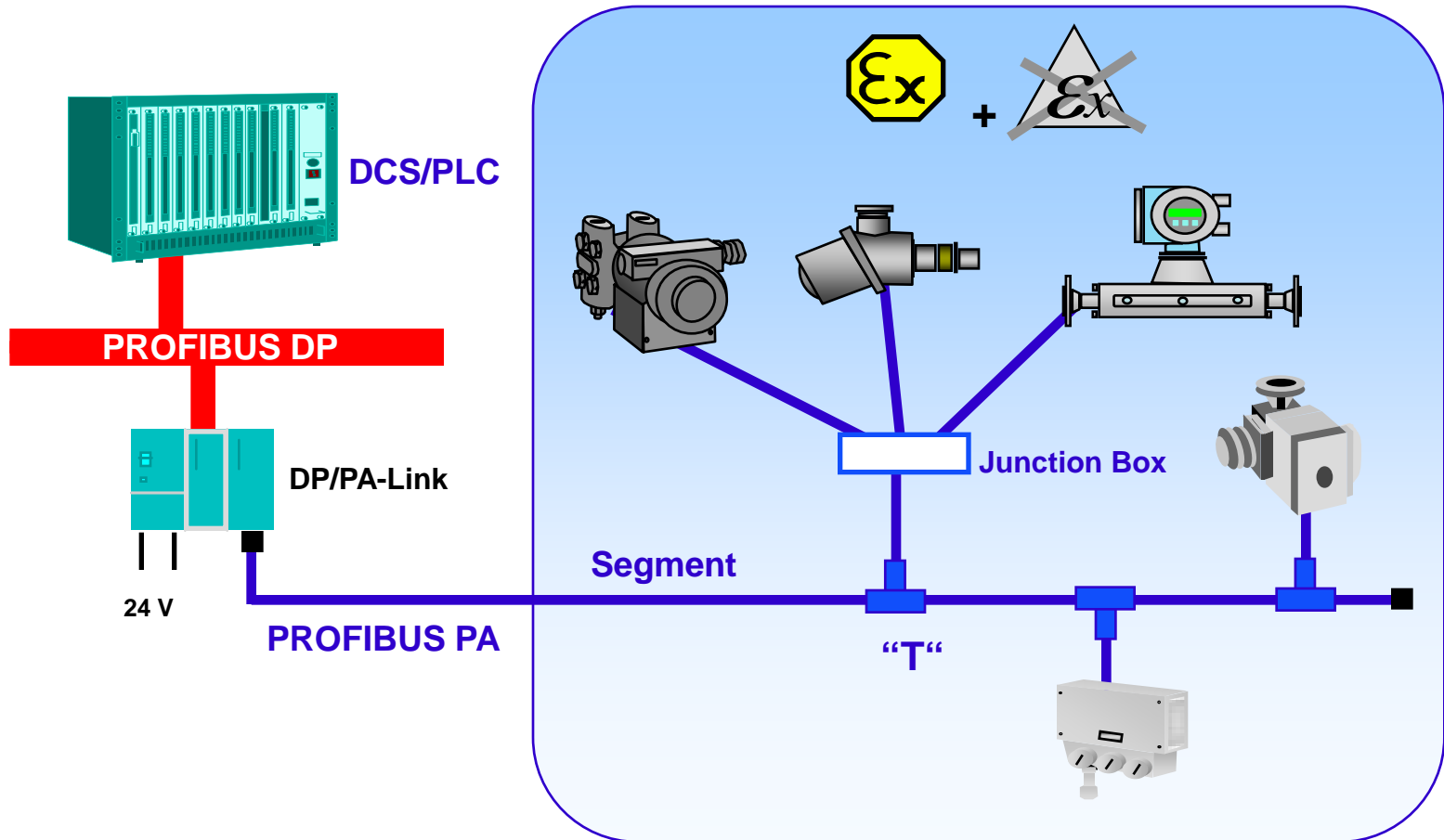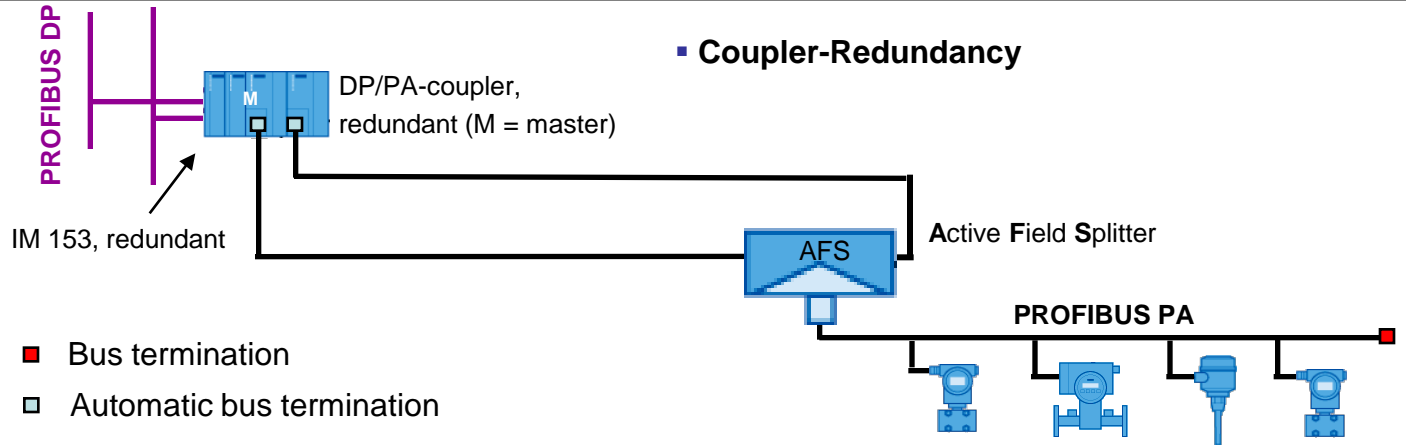
PA Ring Redundancy

PROFIBUS DP

DP/PA-coupler, redundant (M = Master)

IM 153, redundant

- **Coupler-Redundancy**
- **Media redundancy based on a ring topology**

Active **F**ield **D**istributor

AFD

AFD

AFD

AFD

PROFIBUS PA

Dominique Chabauty / PROFIBUS Design and good practices
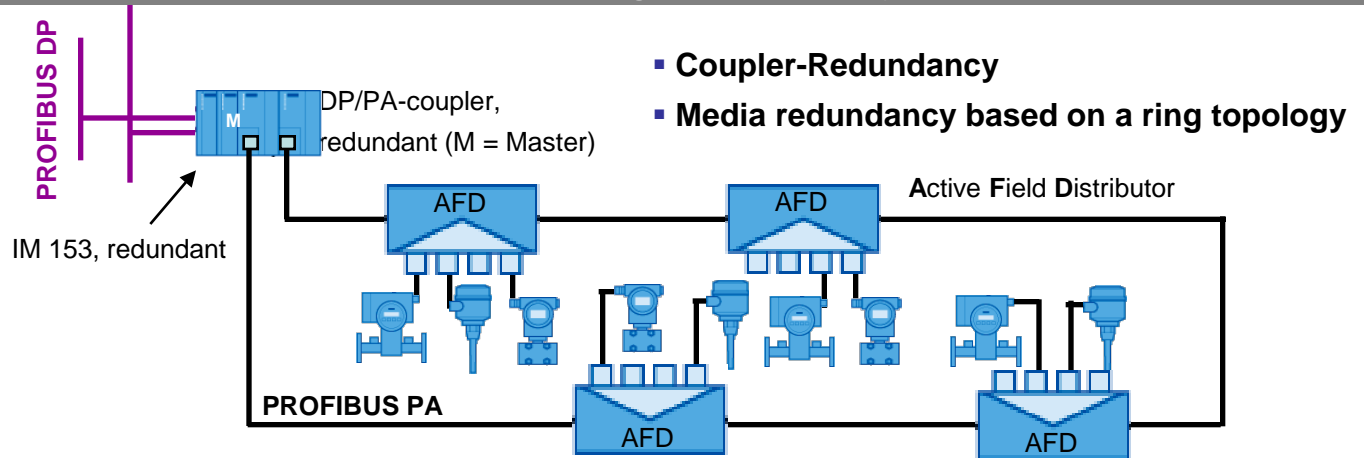
PROFIBUS offers the user the possibility to choose from 10 transmission speeds (RS 485).

9,6	19,2	45,45	93,75	187,5	500	1500	3000	6000	12000 kbps

Remarks:

◗ The transmission speed determines the maximum cable length and vice versa.

◗ The transmission speed has to be set identically at all the masters on the same bus.

◗ Most slaves detect the baudrate automatically.

◗ Because of economic and technical reasons some products do not support all transmission speeds.

◗ Some older products do not support 45,45 kbps.

2.1

PROFIBUS DP – Cable Length

🔳 Baudrate vs Cable Length

Baudrate (kbit/s)	9.6	19.2	45.45	93.75	187.5	500	1500	3000	6000	12000
Segment length (m)	1200	1200	1200	1200	1000	400	200	100	100	100
Segment length (feet)	3940	3940	3940	3940	3280	1310	656	328	328	328

⚠️ **3 baudrate transitions in which the cable length reduces with more than 50 %.**

🔳 These lengths are defined for 1 segment with 32 bus loads!

2.1

Device Rules - Network

▰ PROFIBUS Address Map

0	Service-, diagnosis- and programming tool
1..**2**	Masters (class 1)
3..125	Slaves (total **123** or 124)
126	Address for: "Set Slave Address"
127	Broadcast address

- ▰ Most configuration tools block address 0 and 126 for slaves.
- ▰ Address 126 is a default address for slaves with software address settings.
- ▰ Address 127 is a broadcast address (only visible with a busmonitor).
- ▰ Maximum 124 DP slaves per bus!!!!!!!

Device Rules - DP Segments

■ Maximum 32 loads per RS485 segments

Max 30 Stations   Max 31 Stations
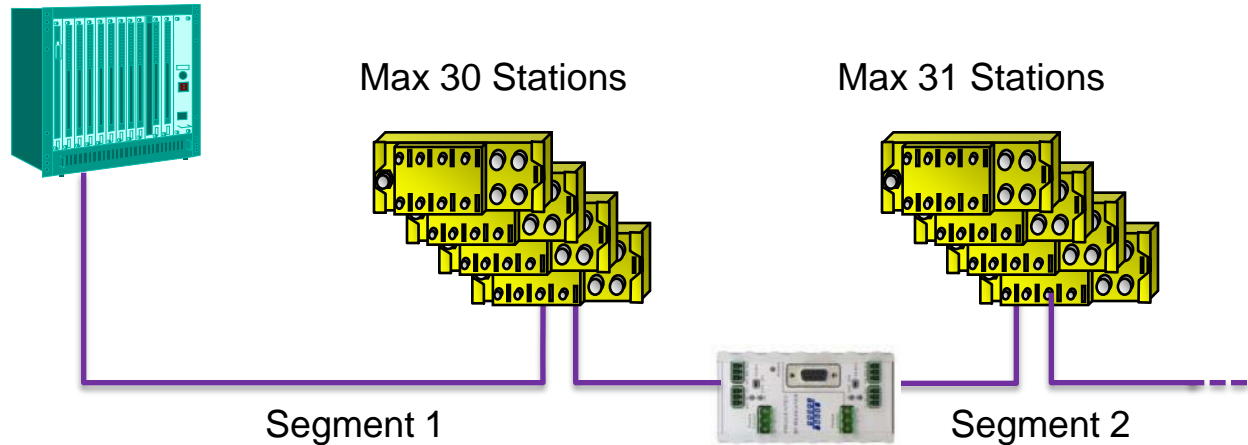
Segment 1   Segment 2

■ Devices that generate new segments:
  - ■ Repeaters
  - ■ Fiber Optic Couplers
  - ■ Wireless gateways

■ After these devices, PROFIBUS segment rules are the same.

Dominique Chabauty / PROFIBUS Design and good practices

Grounding & Shielding

- PROFIBUS is digital communication, not 4-20mA
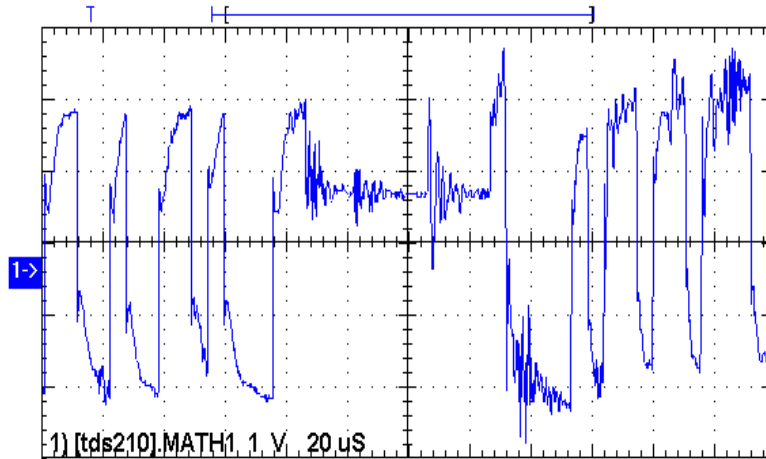- Ground at both end
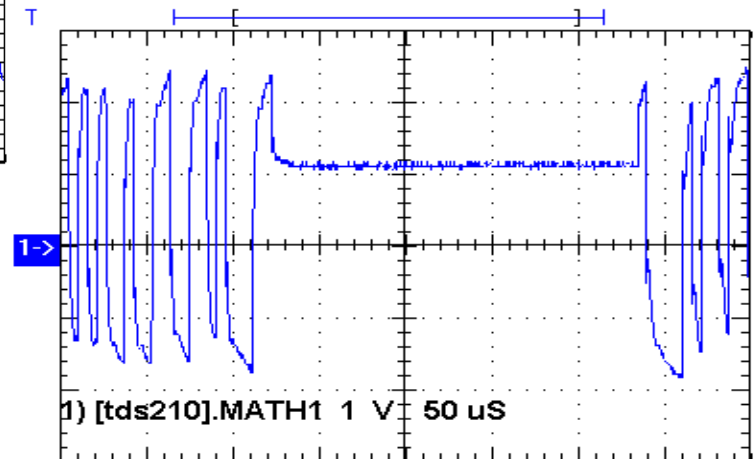- Ungrounded shield has no effect
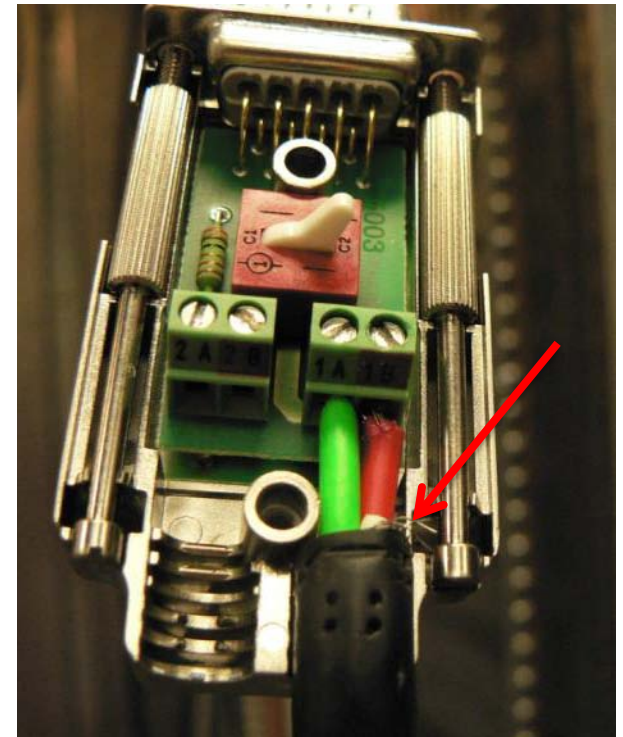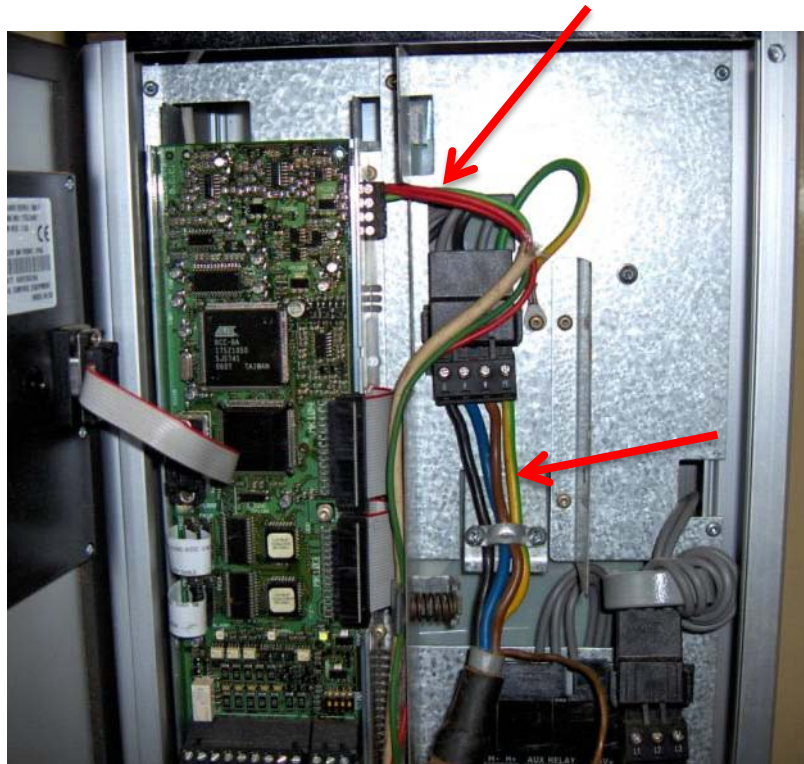
Installation rules

- **Power Lines**
  - Digital communication is sensitive to power lines
  - Watch out for cable runs in trays
  - Respect distances for air separation

Power line too close

Power line are removed

Some examples with Power Lines

Dominique Chabauty / PROFIBUS Design and good practices
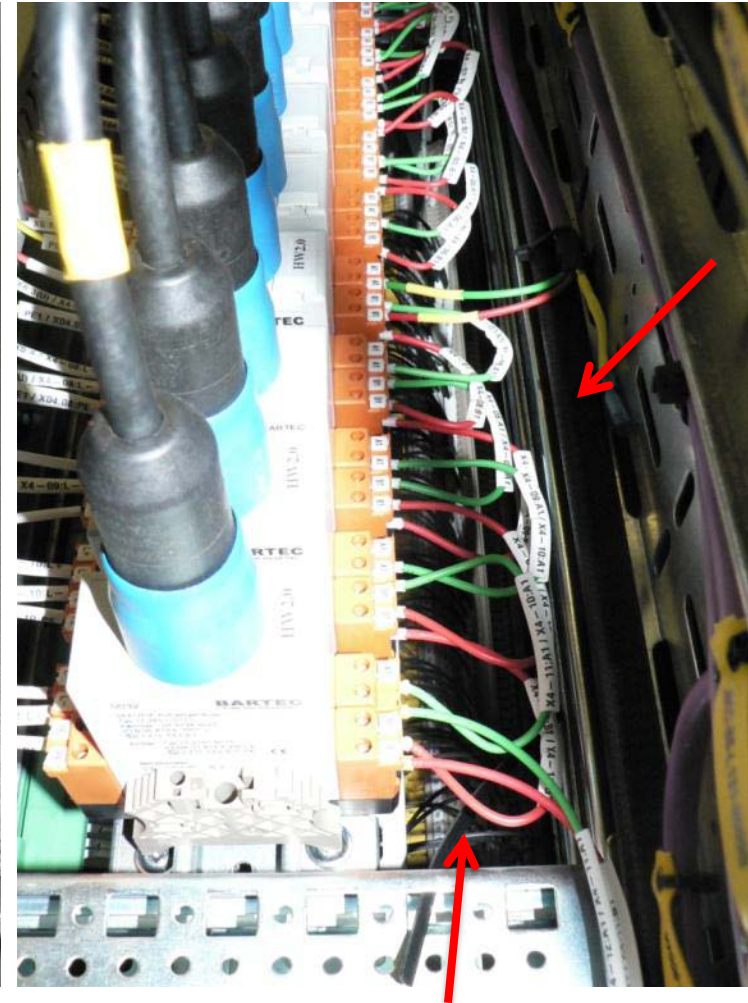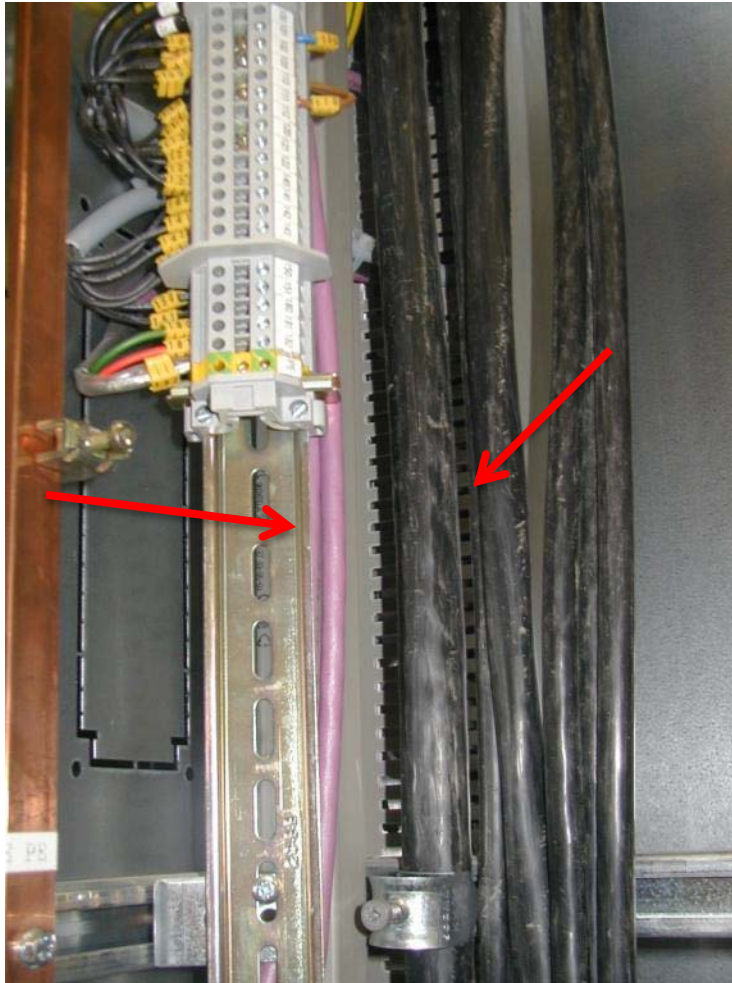
Installation rules

- Proper wiring and component selection
  - Wiring and cable termination is critical
  - Wrong component selection leads to bad installation
  - Take environment in account (humidity, sunlight…)
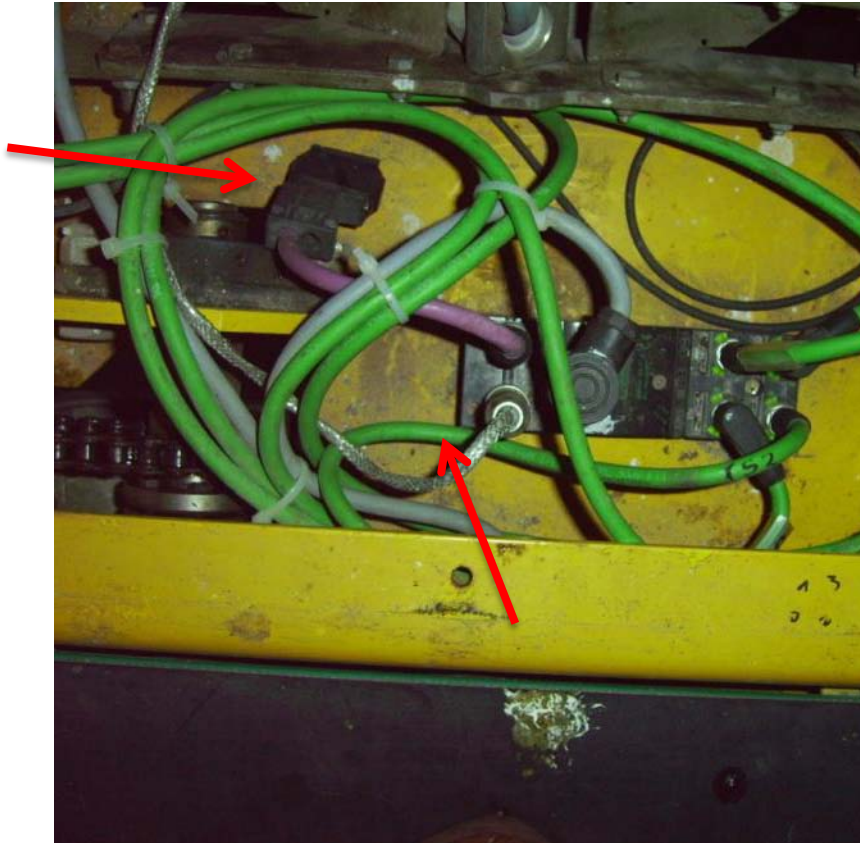
Dominique Chabauty / PROFIBUS Design and good practices

▮ Recognizing bad installations
  ▮ You cannot use the multimeter, this is digital comm.
  ▮ Specific tools are required

Cable Tester

Oscilloscope
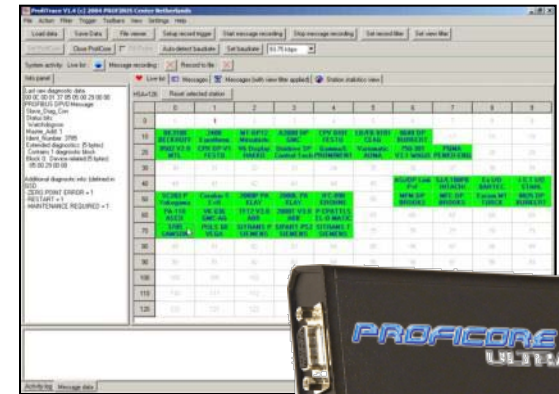
Analyzer

  ▮ Find wiring errors such as short circuit
  ▮ Identify missing termination and EMC
  ▮ Capture error messages and find the source of your system shutdown
  ▮ Cost and time saving by using the right tools!

Good signal

Missing termination

Dominique Chabauty / PROFIBUS Design and good practices
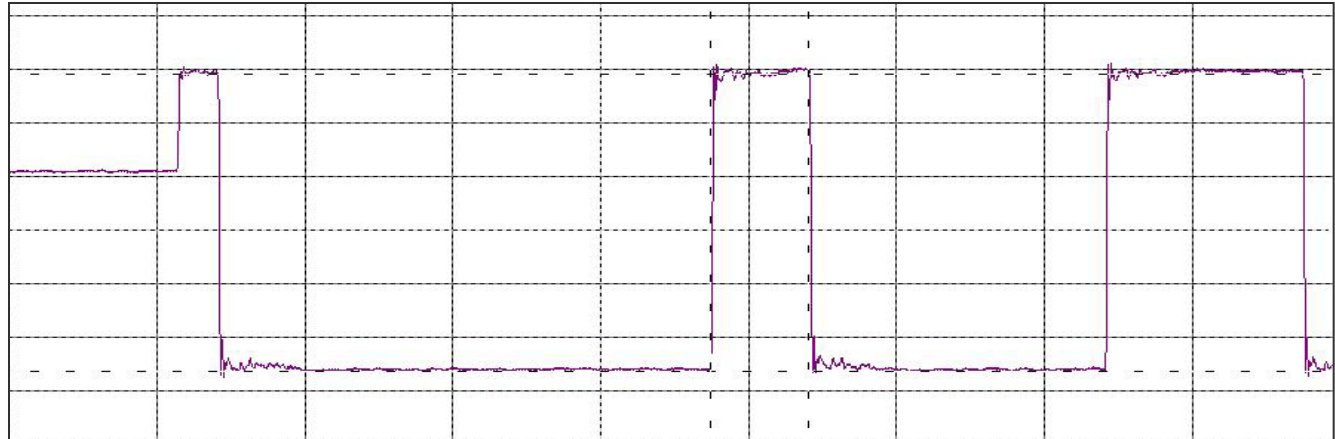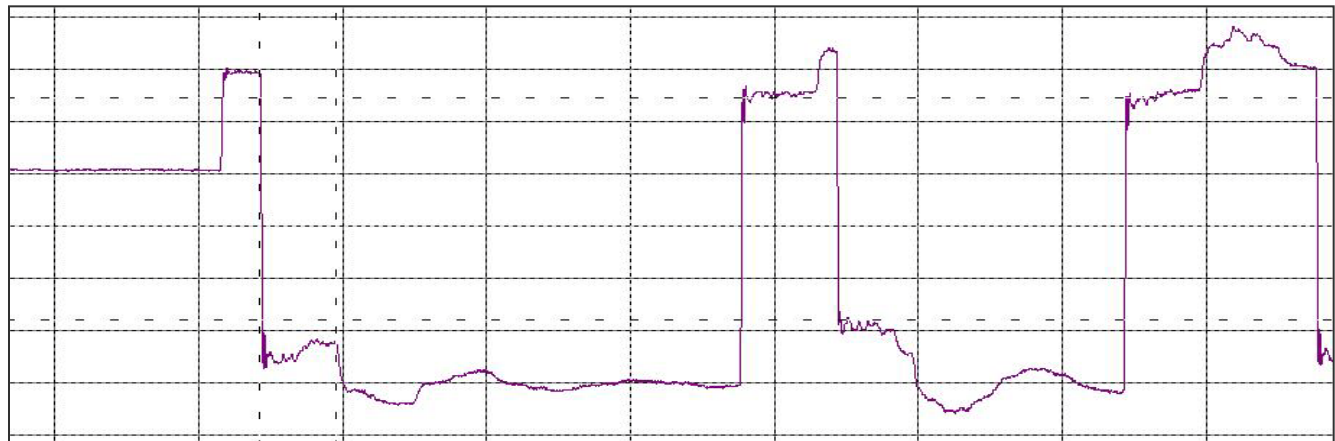
Capture all PROFIBUS messages
Useful for random errors
Shows underlying conditions
Device diagnostic

FrameNr	Timestamp	Idle time	Attention	Frame	Addr	Service	Msg type	Req/Re
3664497	22-May-2...	43 Bit		SD4	0->2	Token pass	Pass token	
3664498	22-May-2...	40 Bit		SD2	2->10	SRD_HIGH	Data Exchange	Req
3664499	22-May-2...	16 Bit		SD2	2<-10	DL	Data Exchange	Res
3664500	22-May-2...	39 Bit		SD2	2->12	SRD_HIGH	Data Exchange	Req
3664501	22-May-2...	18 Bit		SD2	2<-12	DL	Data Exchange	Res
3664502	22-May-2...	39 Bit		SD2	2->14	SRD_HIGH	Data Exchange	Req
3664503	22-May-2...	17 Bit		SD2	2<-14	DL	Data Exchange	Res
3664504	22-May-2...	39 Bit		SD2	2->20	SRD_HIGH	Data Exchange	Req
3664505	22-May-2...	36 Bit	Parity error	Illegal				
3664506	22-May-2...	172 Bit		SD2	2->20	SRD_HIGH	Data Exchange	Req
3664507	22-May-2...	316 Bit		SD2	2->21	SRD_HIGH	Data Exchange	Req
3664508	22-May-2...	307 Bit	Repeat(lost)	SD2	2->21	SRD_HIGH	Data Exchange	Req
3664509	22-May-2...	316 Bit		SD2	2->22	SRD_HIGH	Data Exchange	Req
3664510	22-May-2...	307 Bit	Repeat(lost)	SD2	2->22	SRD_HIGH	Data Exchange	Req
3664511	22-May-2...	316 Bit		SD2	2->23	SRD_HIGH	Data Exchange	Req
3664512	22-May-2...	307 Bit	Repeat	SD2	2->23	SRD_HIGH	Data Exchange	Req
3664513	22-May-2...	36 Bit		SD2	2<-23	DL	Data Exchange	Res
3664514	22-May-2...	39 Bit		SD2	2->24	SRD_HIGH	Data Exchange	Req
3664515	22-May-2...	35 Bit		SD2	2<-24	DL	Data Exchange	Res
3664516	22-May-2...	40 Bit		SD2	2->25	SRD_HIGH	Data Exchange	Req
3664517	22-May-2...	49 Bit		SD2	2<-25	DL	Data Exchange	Res
3664518	22-May-2...	40 Bit		SD2	2->26	SRD_HIGH	Data Exchange	Req
3664519	22-May-2...	54 Bit		SD2	2<-26	DL	Data Exchange	Res
3664520	22-May-2...	40 Bit		SD2	2->27	SRD_HIGH	Data Exchange	Req
3664521	22-May-2...	62 Bit		SD2	2<-27	DL	Data Exchange	Res

Dominique Chabauty / PROFIBUS Design and good practices

▮ Certified Training by PROFIBUS International

Benefits
- Avoid basic errors that cost time and money
- Quality assurance for design and commissioning
- Faster project delivery
- Better installation, longer operation

Various courses available

- PROFIBUS Certified Engineer
- PROFIBUS Certified PA Module
- PROFIBUS Certified Installer

- PROFINET Certified Engineer

Certified by

The end

Thank you for listening