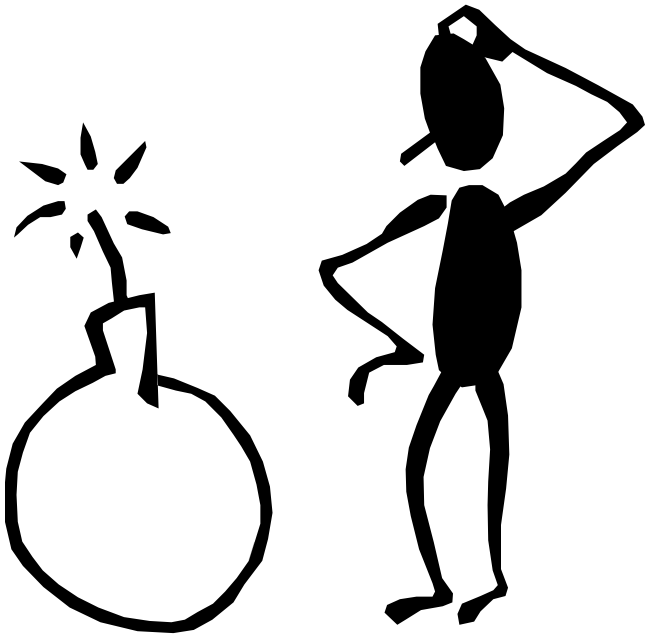
TROUBLE-SHOOTING PROFIBUS NETWORKS

A few words of some inexperienced engineers and marketeers:

‘The cabling is the easiest part of bus systems…..’

‘Yeah right!!!!!’



PROFIBUS Could fix your PROBLEM or be your PROBLEM !!

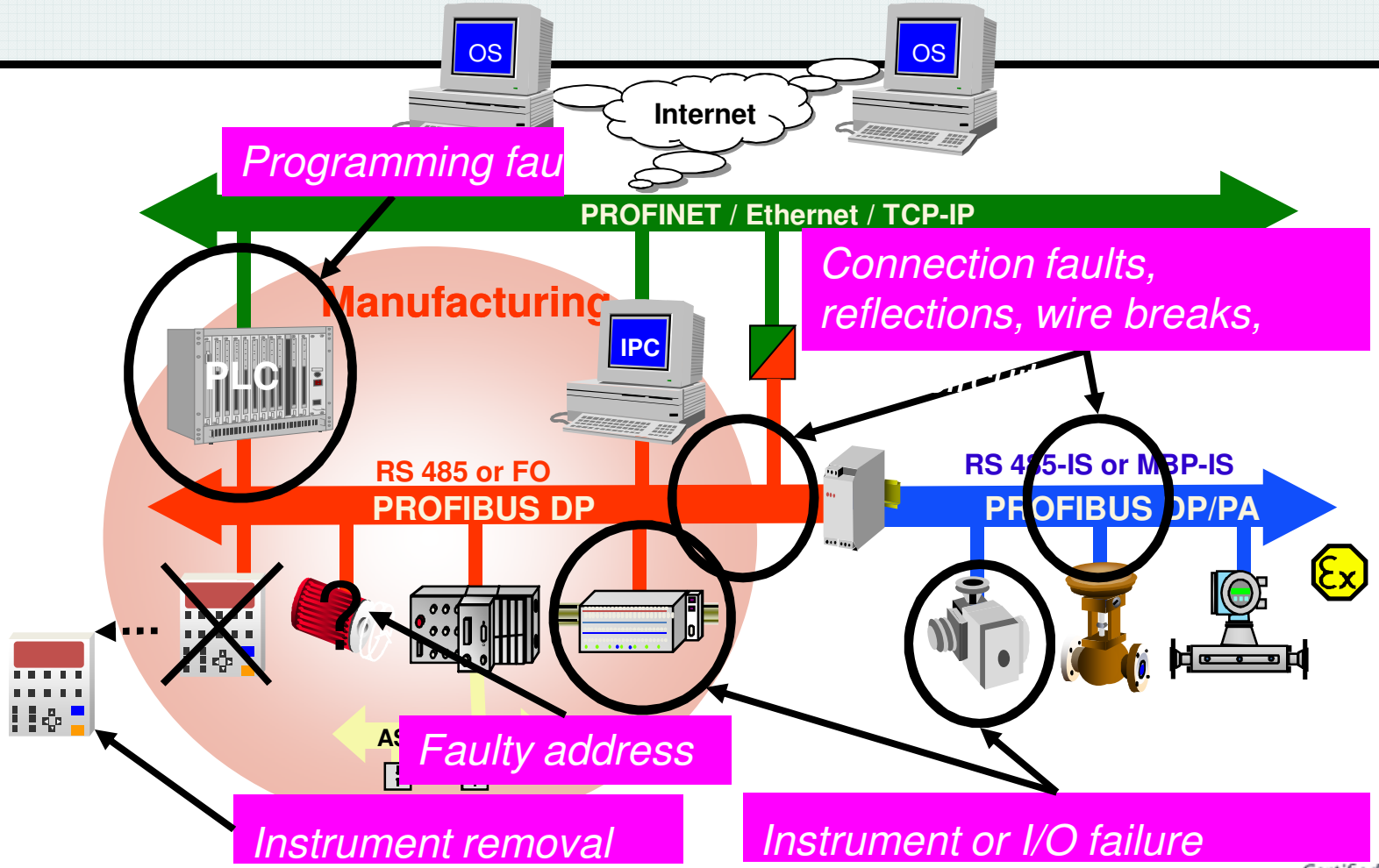
A change in working and thinking for the entire organization

The engineers and maintenance technicians who have just stepped out of the 4-20 mA technology had to understand a lot of new terms which makes the step to field busses very hard……

RS 485
Impedance
Propagation time
Stub lines
1m rule
Cross talk
Reflections
Grounding
IEC 61000-5-2
Losses
Skin effect

Not understanding these topics is not good for the 'Bus business!'

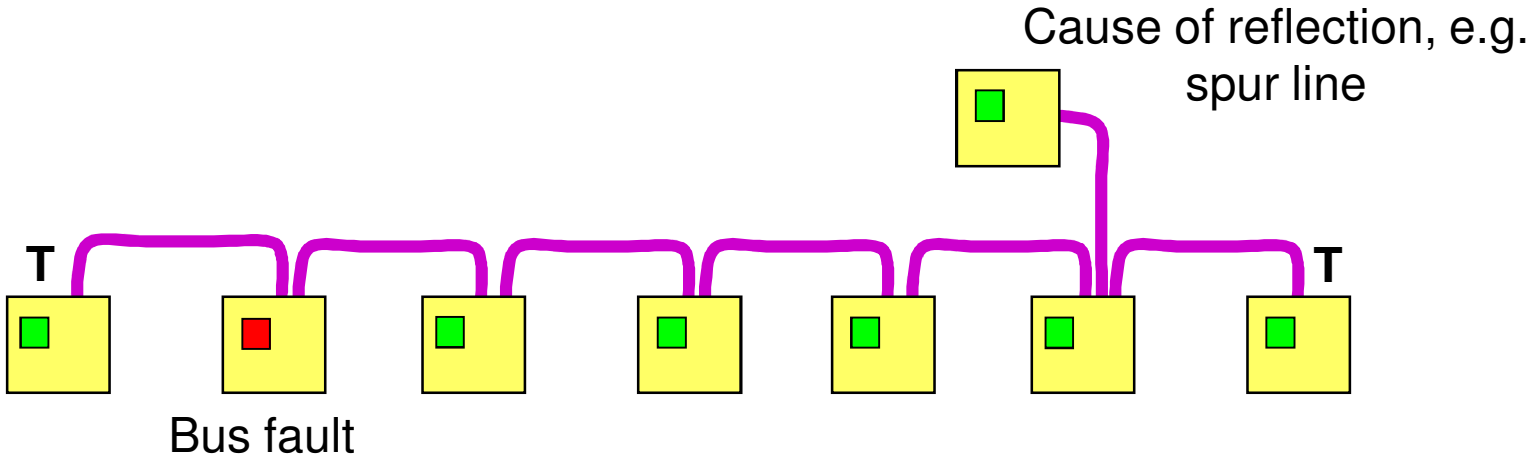
What can happen in a running installation?



Confusion about the LEDs!

Problems can be very difficult to diagnose without the correct tools and a systematic approach. Intermittent faults can be particularly difficult.

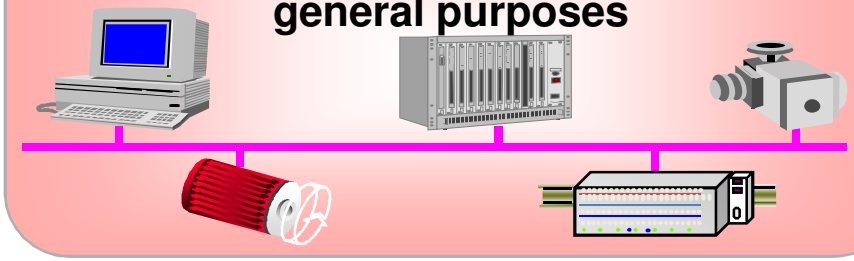
The main problem is that the devices that are most affected are often at the opposite end of the segment from the source of the reflection!



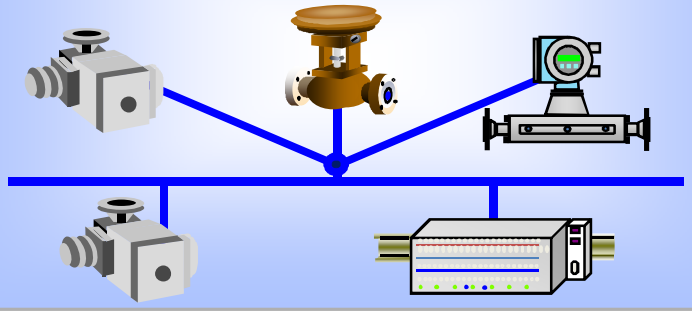
Basic principles

PROFIBUS supports 3 transmission media

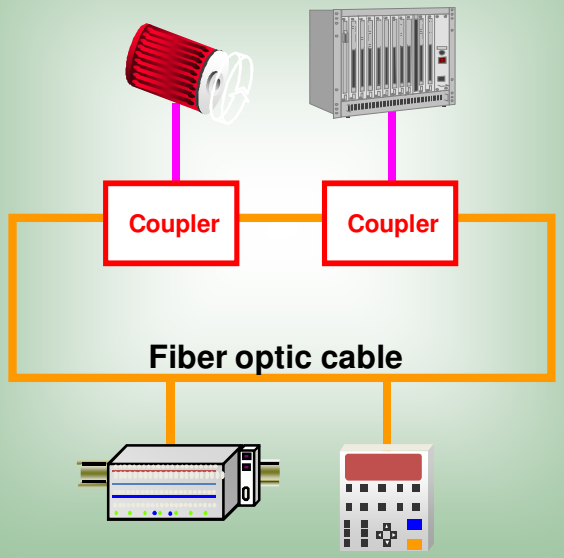
RS 485
2-wire CU-cable for general purposes



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

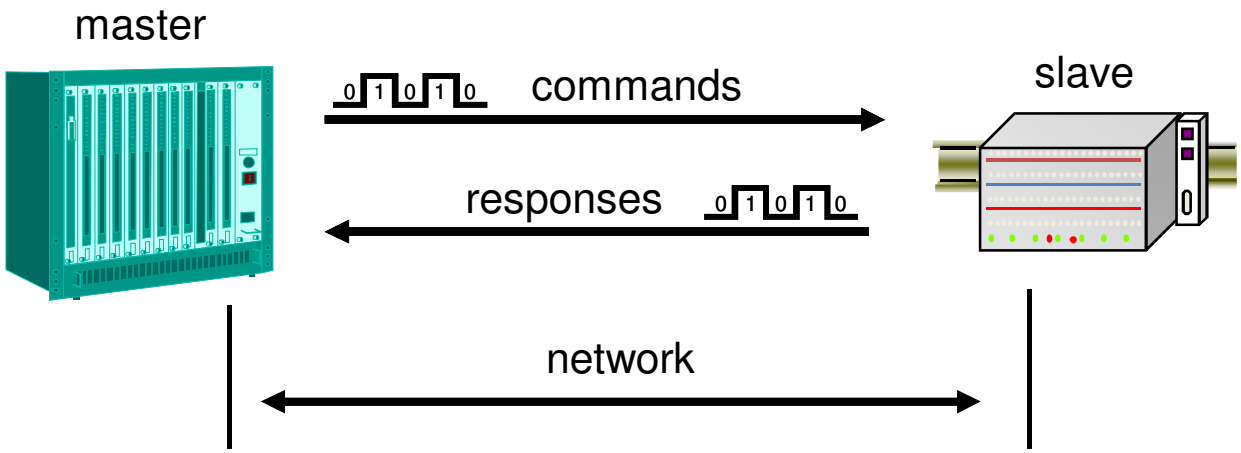


Fiber Optic
For highest EMC protection and wide distances



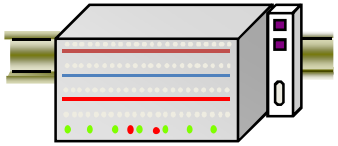
PROFIBUS is a master/slave network

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



- At least **1 master** is mandatory.
- PROFIBUS networks allow **multiple masters**.
- In total **127 devices** can be addressed (masters + slaves).

Slave



This station can interpret messages of a master and dependent on the interpretation, generate responses and send them to the specific master.

Slaves are NOT able to send messages on its own initiative.

Examples:

- *Remote I/O*
- *Sensors and actuators*

There are also PLC systems available which have slave functionality. They are slave on DP, but can control I/O locally.

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

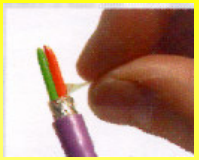
- Most configuration tools block address **0 and 126** for slaves.
- Address **126** is a default address for slaves with software address settings.
- Address **127** is a broadcast address (only visible with a busmonitor).

Maximum **124** DP slaves per bus!!!!!!!

PROFIBUS is RS485

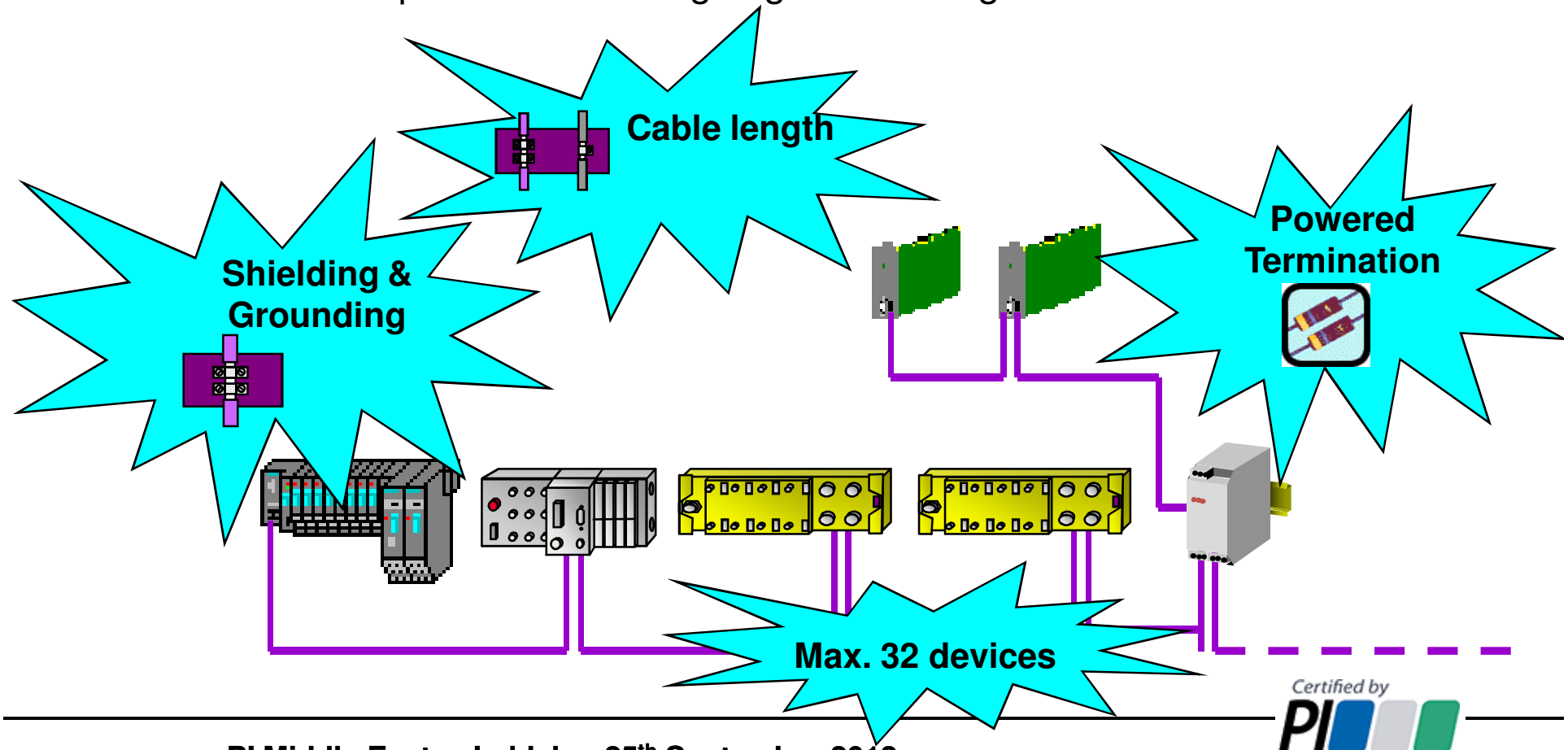
RS 485

- Baudrates from 9.6 kbit/s to 12 Mbit/s
- Shielded twisted pair cable
- 32 devices per segment
- Distance: 12 Mbit/s = 100 m; 1.5 Mbit/s = 200 m; ≤ 187.5 kbit/s = 1,000 m
- Distance extendable with repeaters

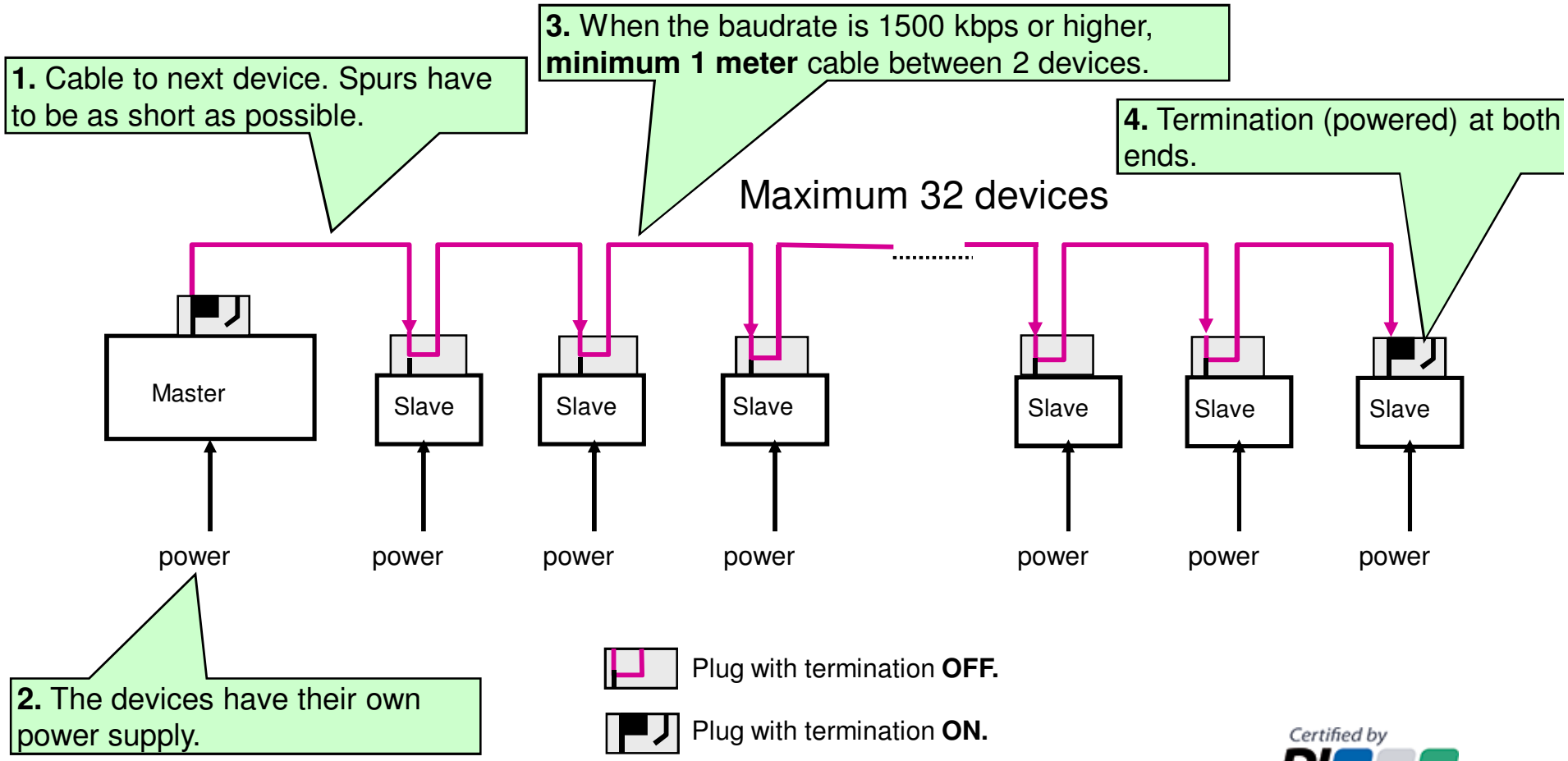


Design specifications

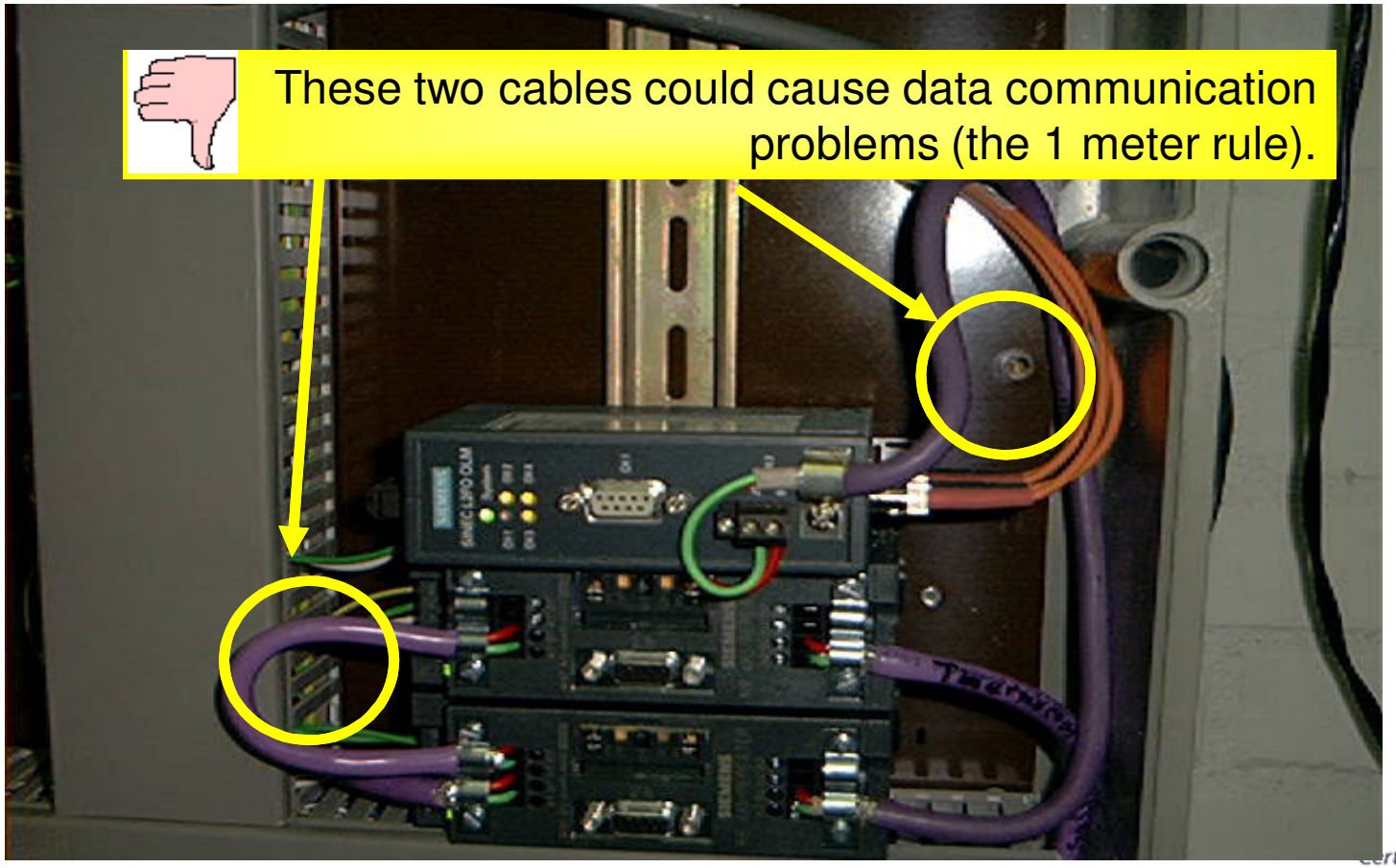
What are the critical points when designing RS 485 segments?



Topology



Example – Problems with the 1 meter rule

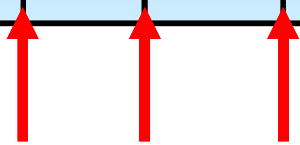


Example – Solution for the 1 meter rule

A strategic placement automatically takes care of the 1 meter rule.

Cable length versus Baudrate

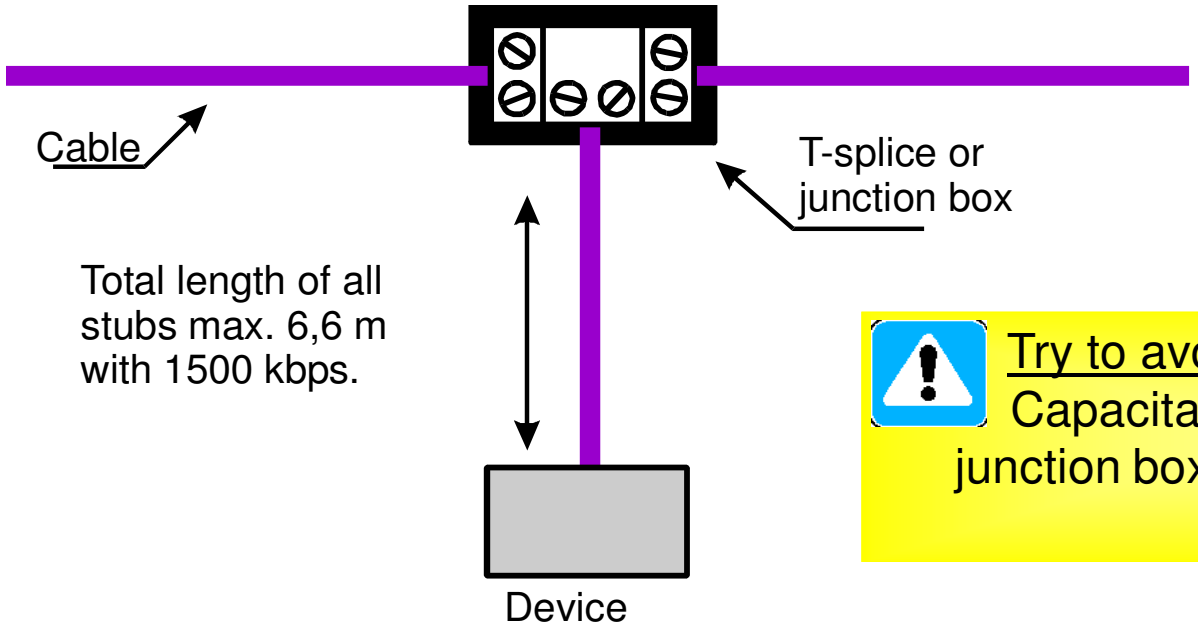
Baudrate (kbit/s)	9.6	19.2	45.45	93.75	187.5	500	1500	3000	6000	12000
Segment length (m)	1200	1200	1200	1200	1000	400	200	100	100	100
Segment length (feet)	3940	3940	3940	3940	3280	1310	656	328	328	328



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

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

Spurs

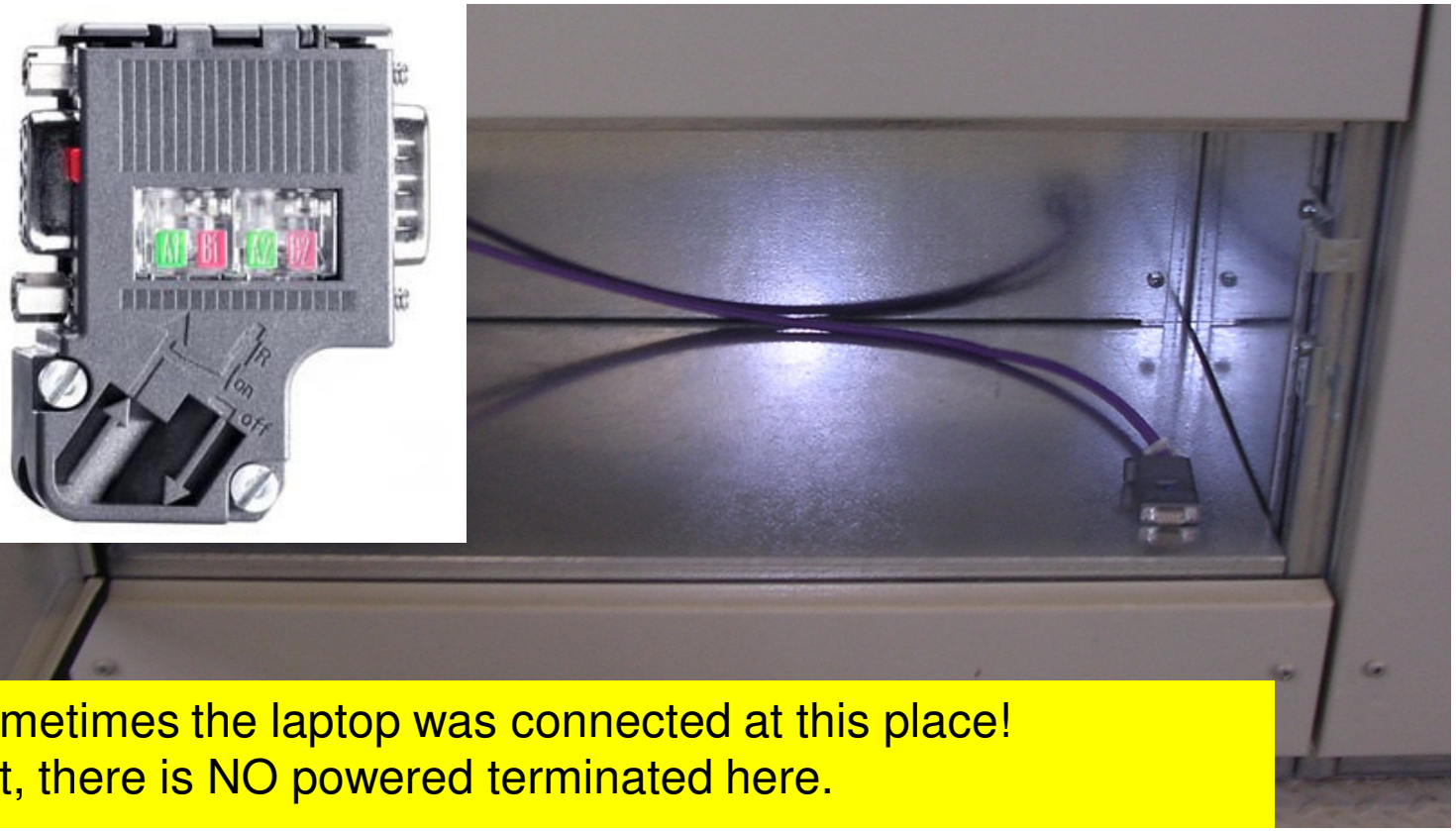


Try to avoid spurs with RS 485.
Capacitance of connectors and junction boxes is not well defined!

- Total **6,6 m** with **1500 kbps** (capacity of spurs = 0,2 nF)
- Total **20 m** with **500 kbps** (capacity of spurs = 0,6 nF)
- Total **33 m** with **187,5 kbps** (capacity of spurs = 1,0 nF)
- Total **100 m** with **93,75 kbps** (capacity of spurs = 3,0 nF)
- Total **500 m** with **9,6 and 19,2 kbps** (capacity of spurs = 15 nF)

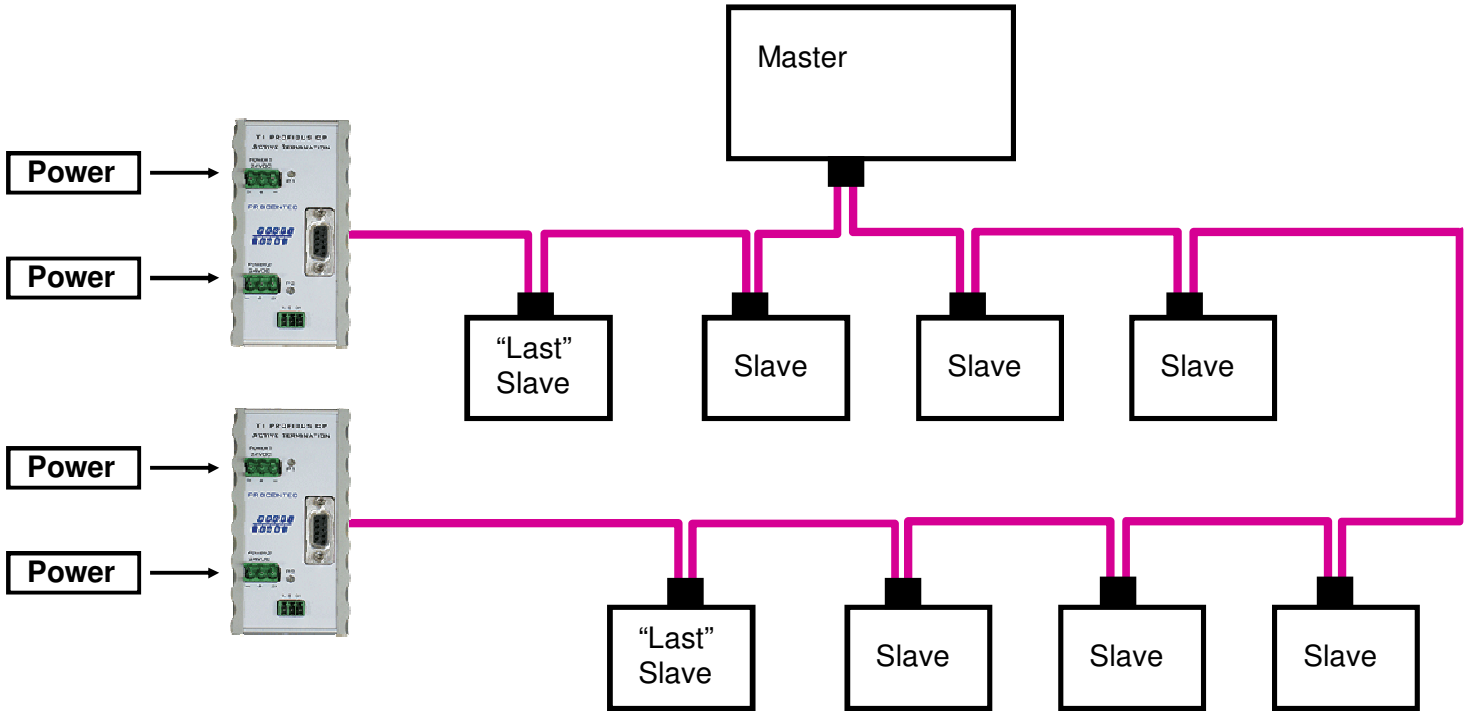
The length is a sum of all the spurs in the segment!

He was correct! The termination is switched ON.



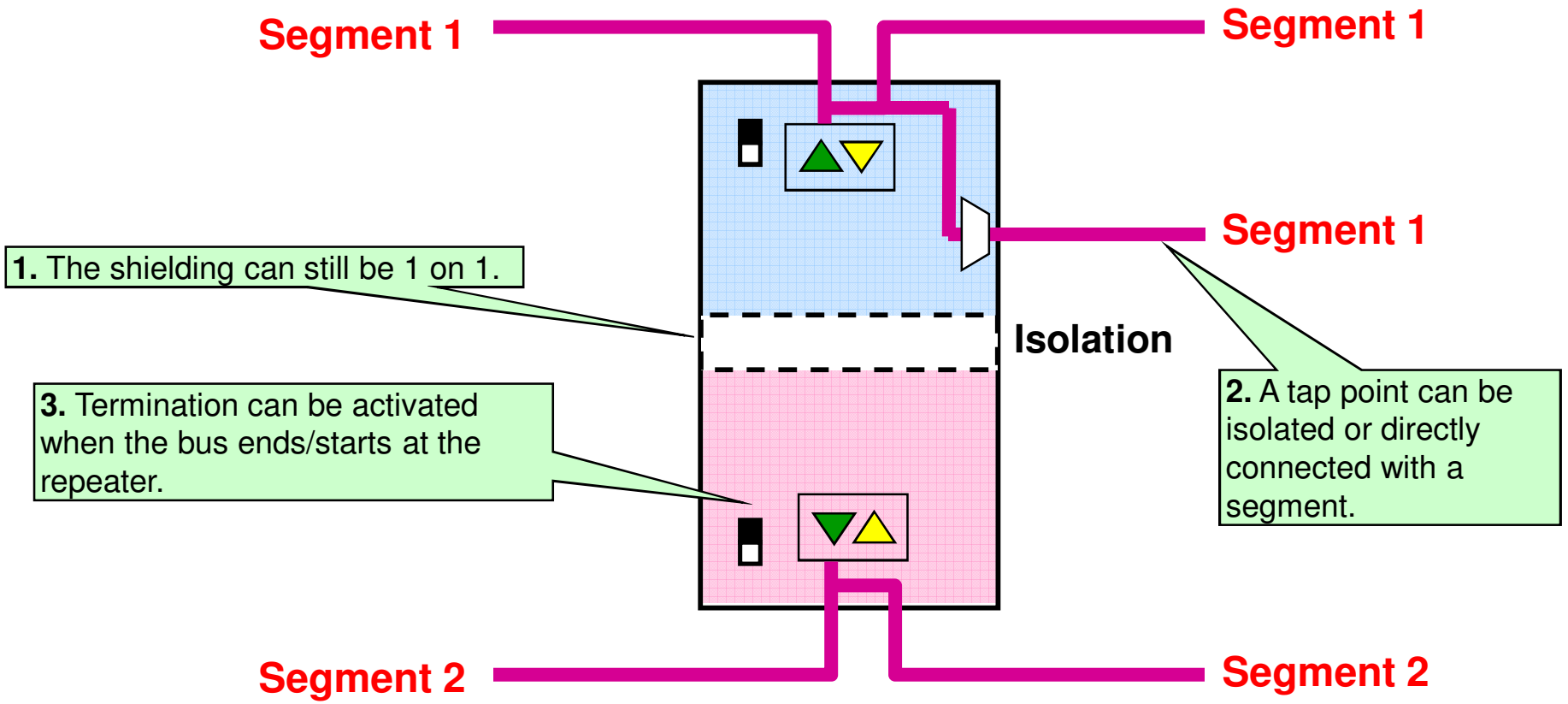
Sometimes the laptop was connected at this place!
But, there is NO powered terminated here.

Active Termination



In this segment every station can be removed or powered down without disrupting the network.

Repeaters - Structure

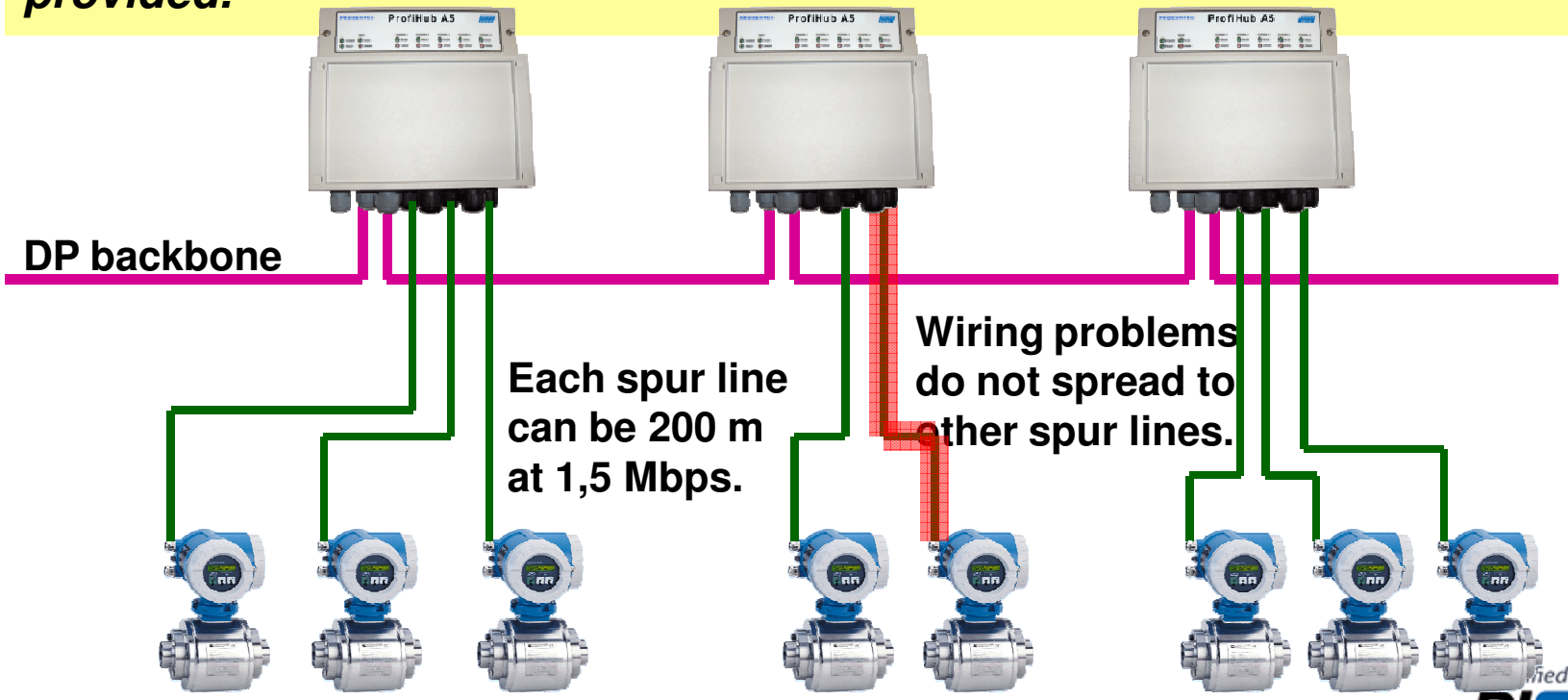


Wrong wiring of repeaters

Now they have 41 devices on the same segment!

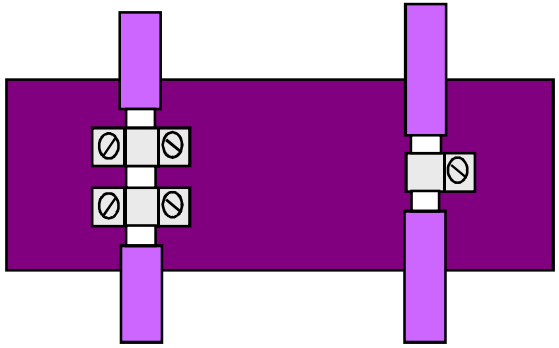
Hubs are more efficient for repeater backbones

Long spur lines to instruments and the possibility to remove/insert them during operation. Short circuit protection on each spur line is automatically provided.



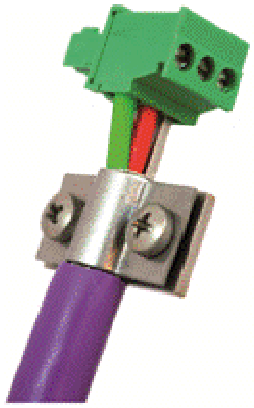
What does IEC61000-5-2 say about grounding?

- **Ground as many points as possible.** This reduces the resistance (less noise).



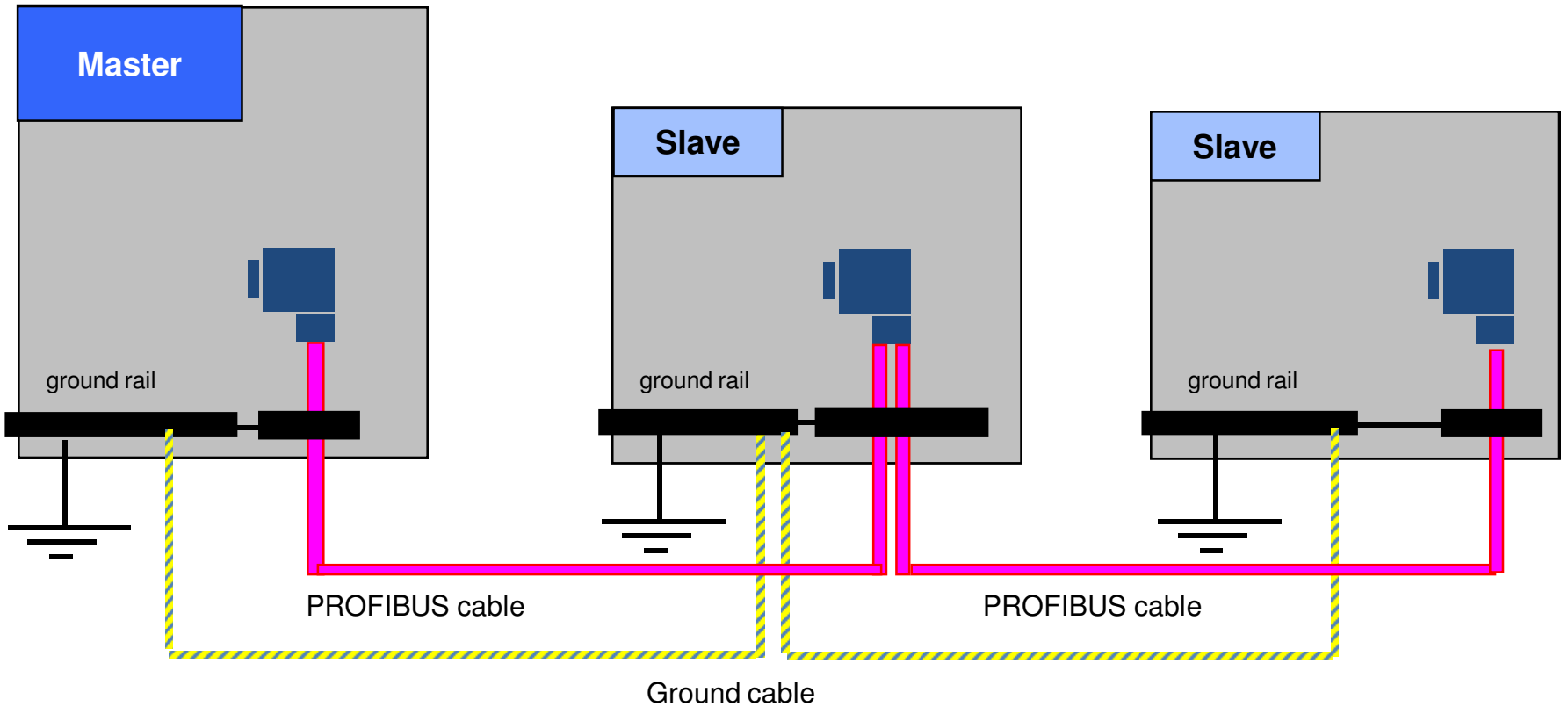
- Be careful of the amount of current flowing through the shield. When the current gets too high, use;
  - fiber optic
  - extra ground cable
  - repeaters with isolation

- Avoid the use of ‘pigtails’.

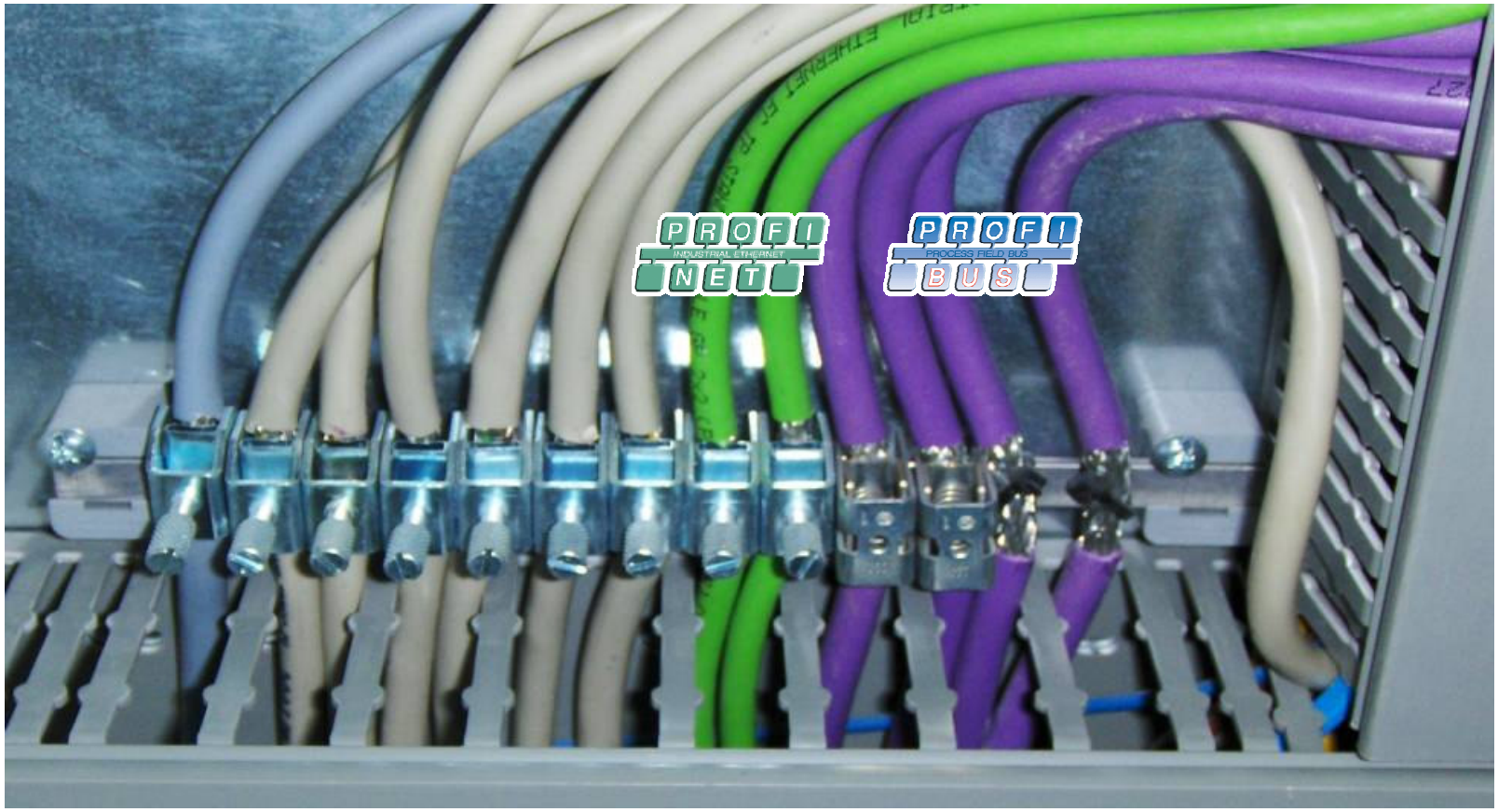


- Avoid connection with the ‘minus’ of power supplies.

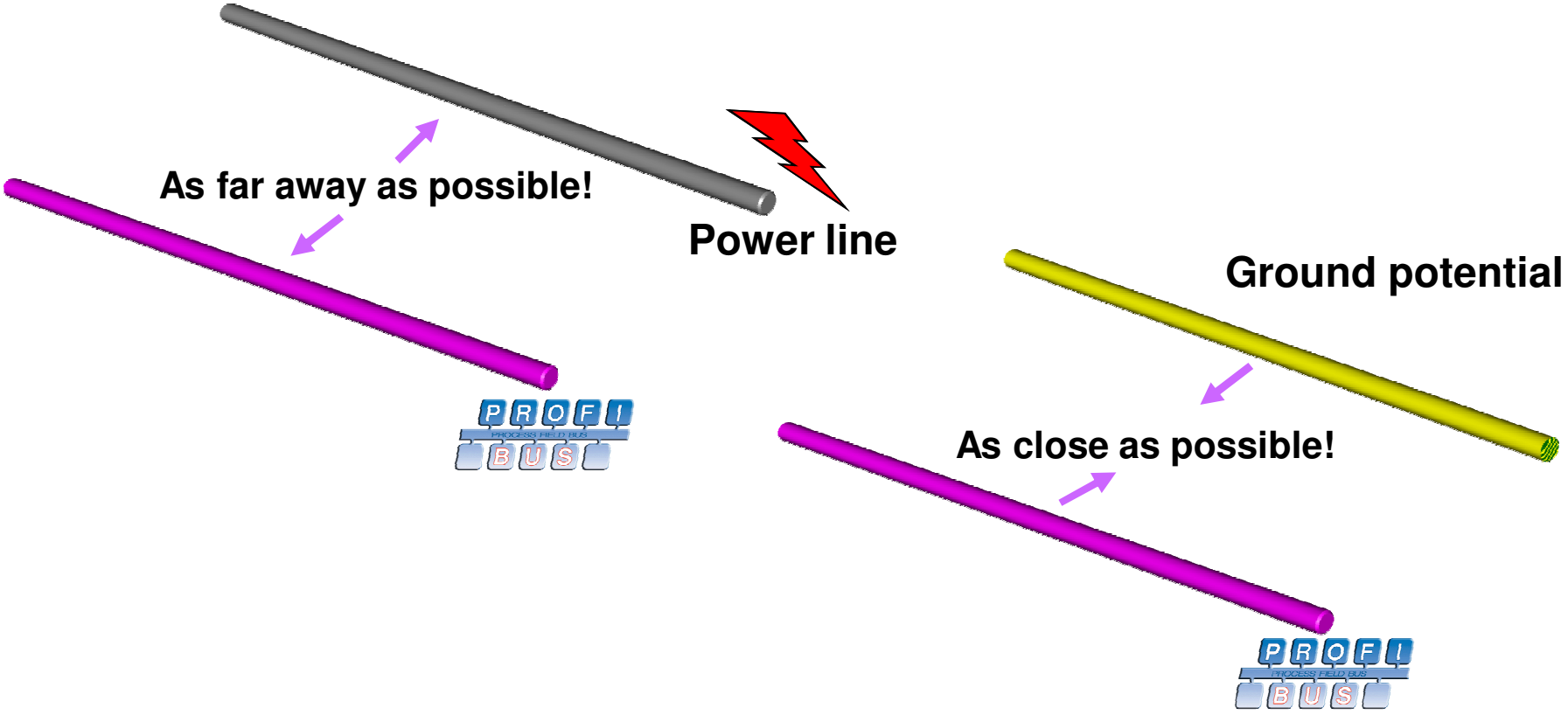
Grounding and shielding between cabinets



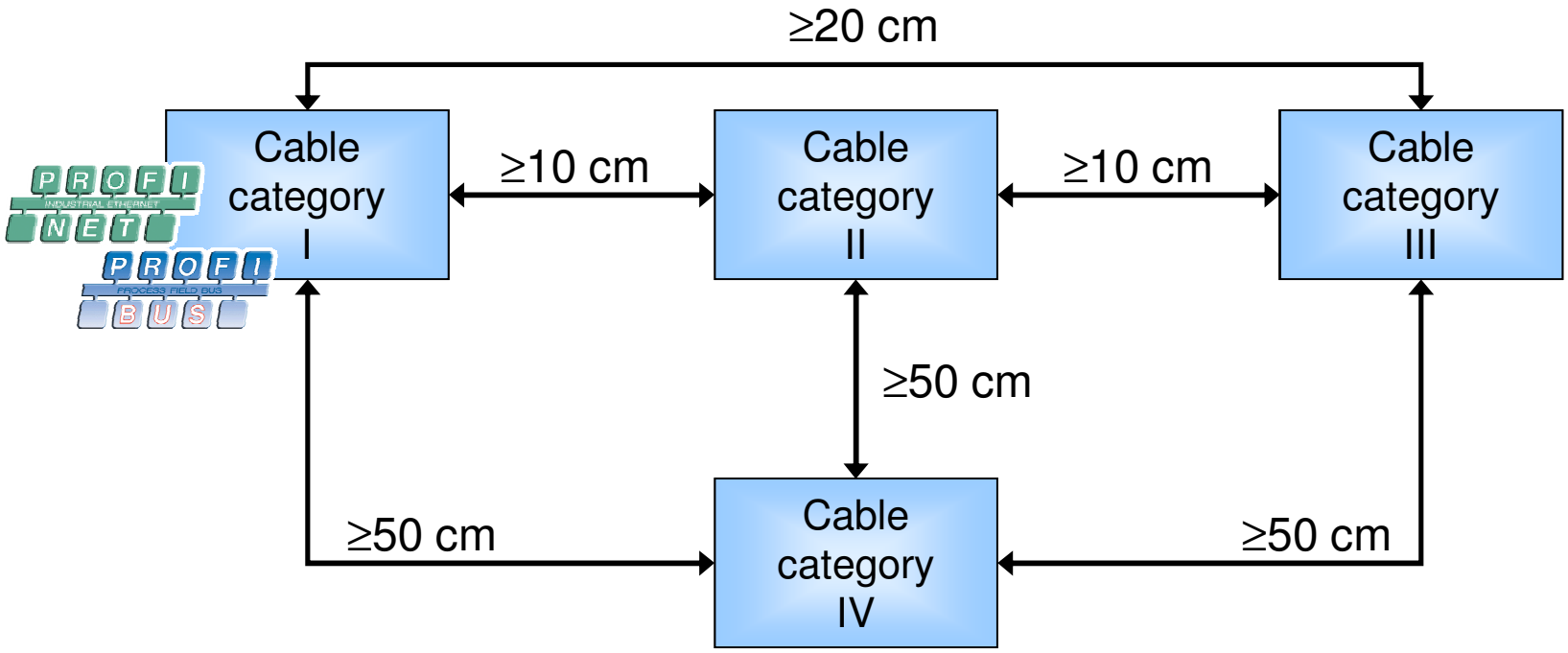
Additional grounding points



Policy of separation

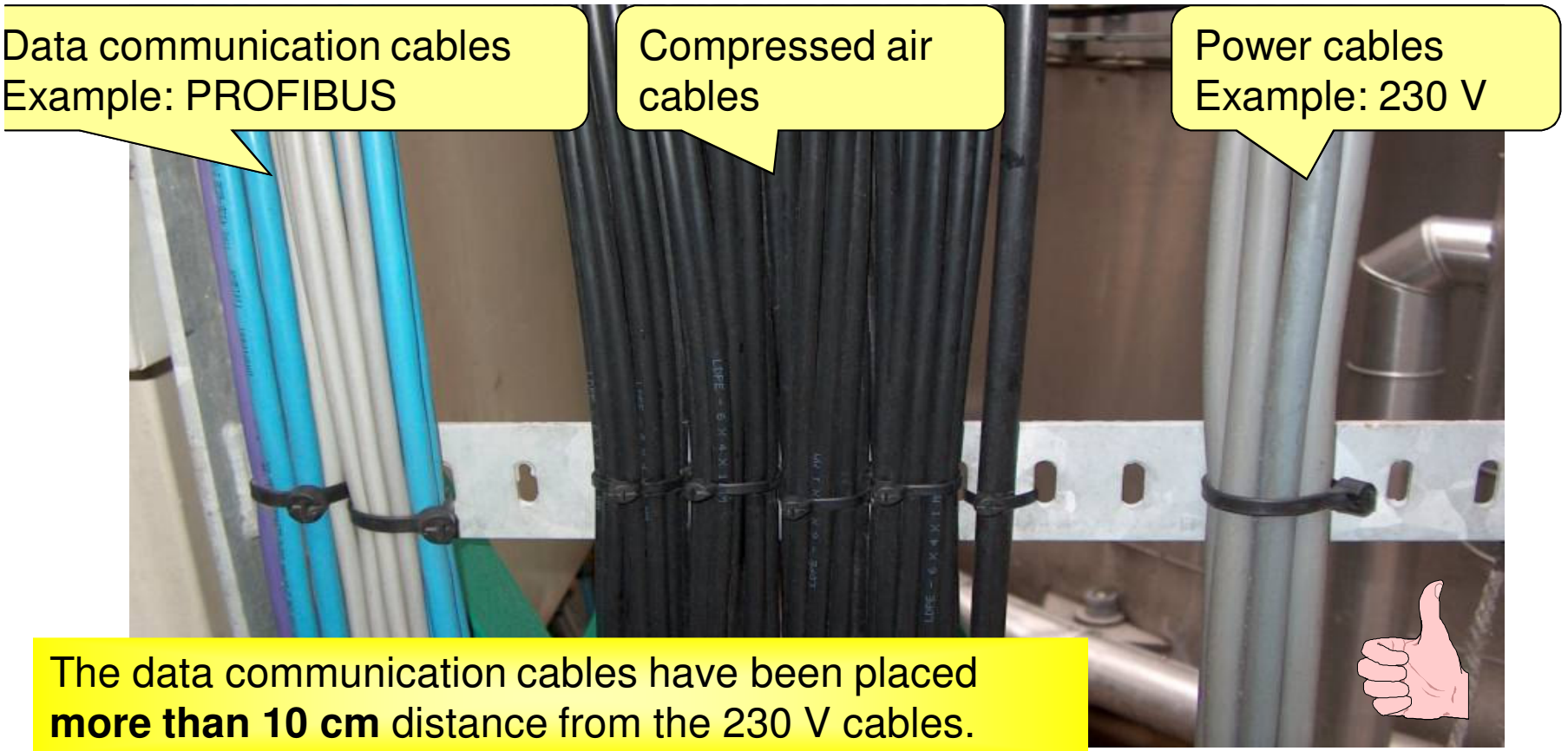


Air Gaps



The air gaps are based on air space. In case of grounded metal plates, the distances can be reduced. Cables of different categories may cross each other.

Example - Air gaps



The data communication cables have been placed **more than 10 cm** distance from the 230 V cables.

Test- and measurement tools

Handheld tools

- **Siemens BT200**
- **ComSoft Nettest II**

Functions:

- Wire breaks/short circuits
- Voltage or shielding faults
- Localizing faults
- Measuring cable lengths
- Termination detection
- List of slaves
- Logging

Non active segments (masters have been removed)!

Oscilloscopes

1st: Large + Difficult

2nd: Expensive

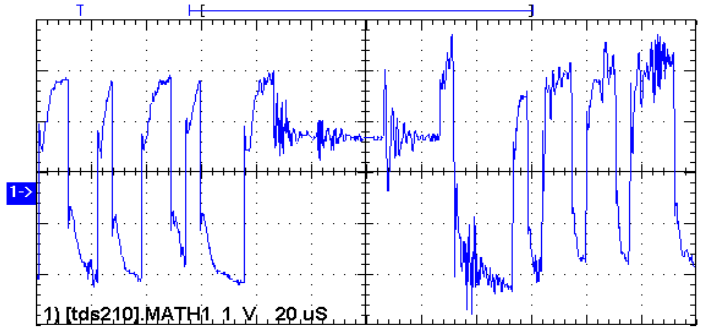
3rd: Difficult

4th: Small, Fast and Easy

Functions

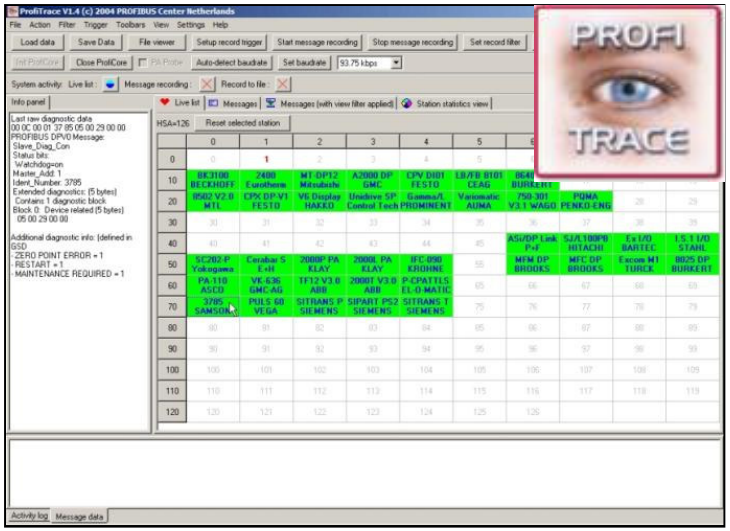
- Amplitude
- Reflections
- Noise
- EMC

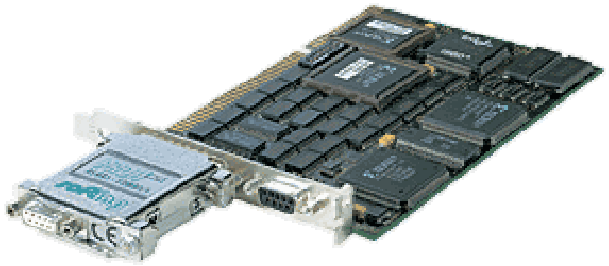
The oscilloscope is the only tool that can display the bus signals!



Busmonitors / Analyzers

- **ProfiTrace 2 - PROCENTEC**
- Bus check - Softing
- PBScope - T+H
- IT-Monitor - ITM / ComSoft / TMG-itec
- Amprolyzer





USB

Active network!

Functions

- Live List
- Messages
- Device diagnosis
- Cycle times
- Logging

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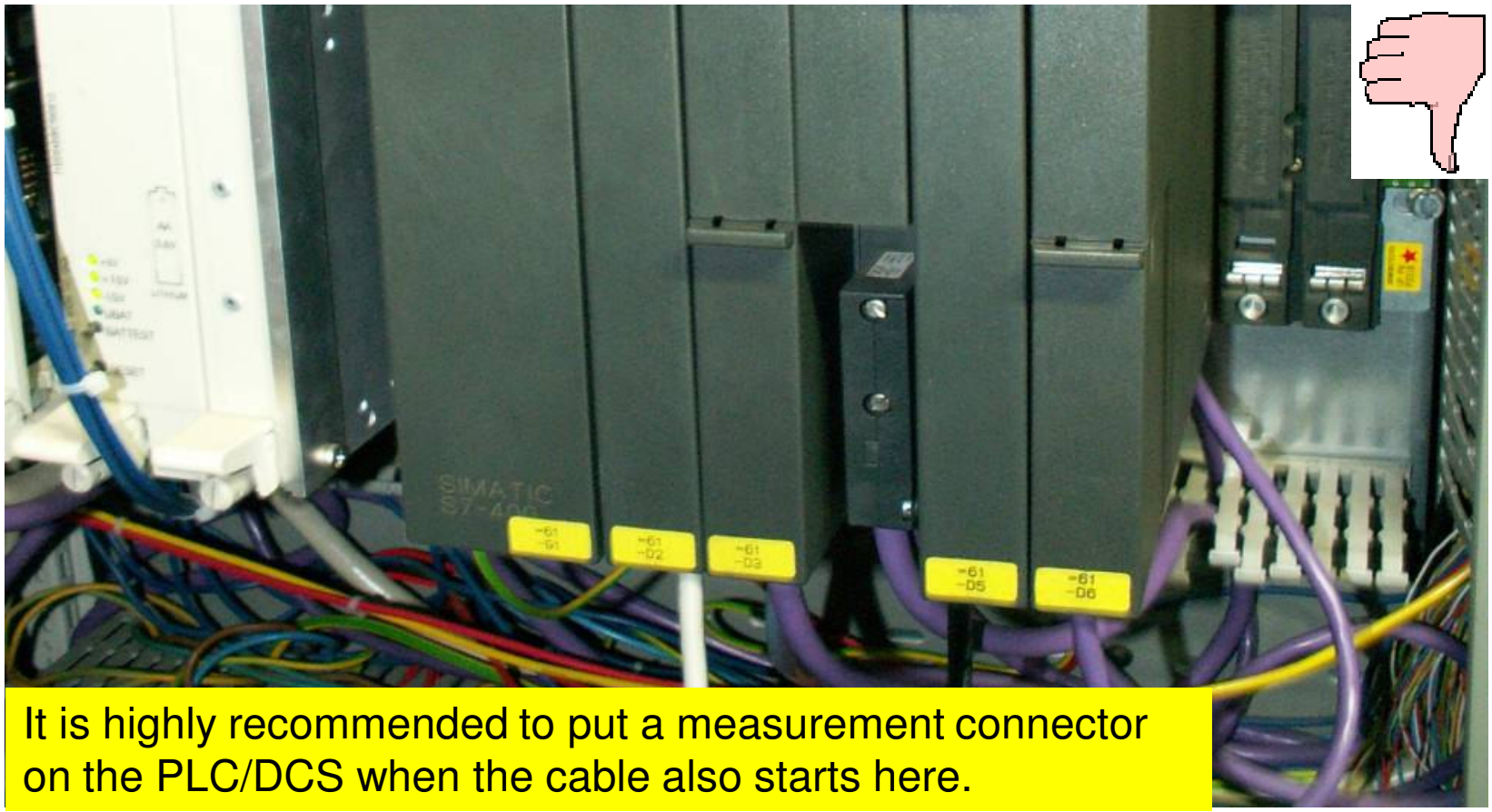
SEP. 2012

Example – No measurement connectors



It is highly recommended to put a measurement connector on the PLC/DCS when the cable also starts here.

ASM – PROCESS AUTOMATION
PICC / PITC SAUDI ARABIA
asmestablishment.com

Facts and Fiction

The most important tools for troubleshooting a network during operation are an oscilloscope and a busmonitor/analyzer.

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Facts and Fiction

A multi-meter is not useable for dynamic signal measurement!

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Strategy of troubleshooting

Classifications of most common PROFIBUS problems

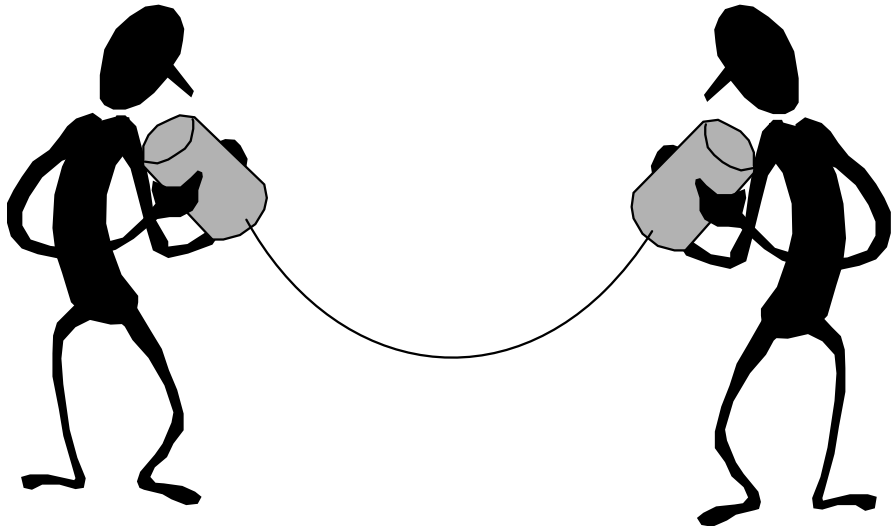
Physical level

- Device is **NOT** communicating anymore
- **Periodically** no communication with a device

← The worst one

Application level

- Invalid data (calibration or bug)
- Device diagnostics (I/O problems)

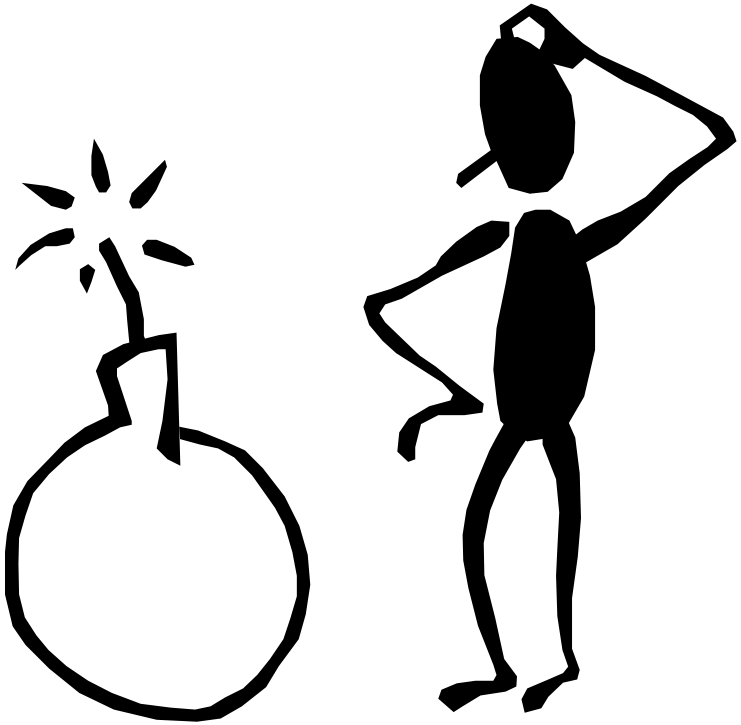


What kind of fault finding methods are at hand?

1) Analyzer ← most important!

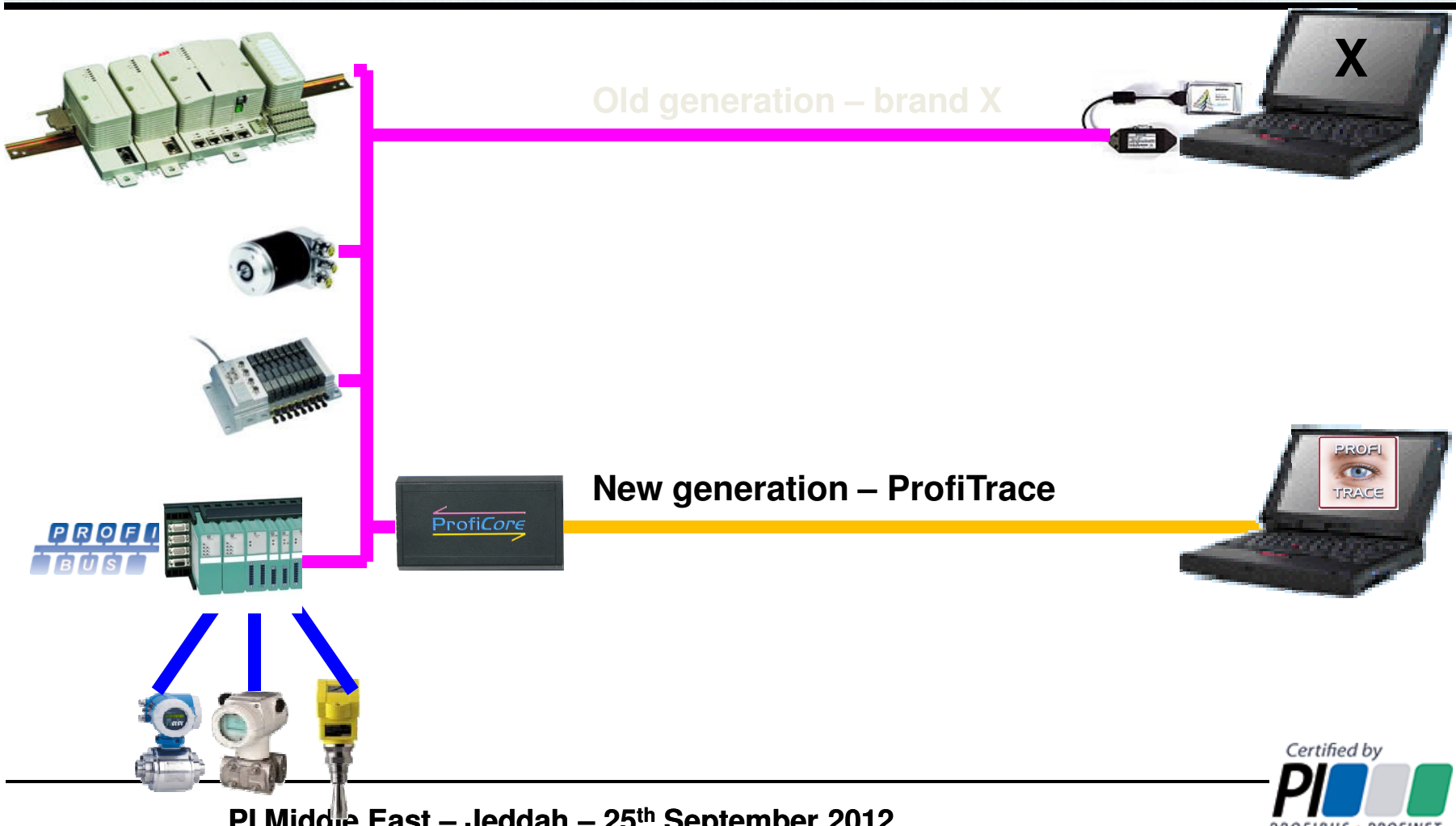
2) Electrical measurement

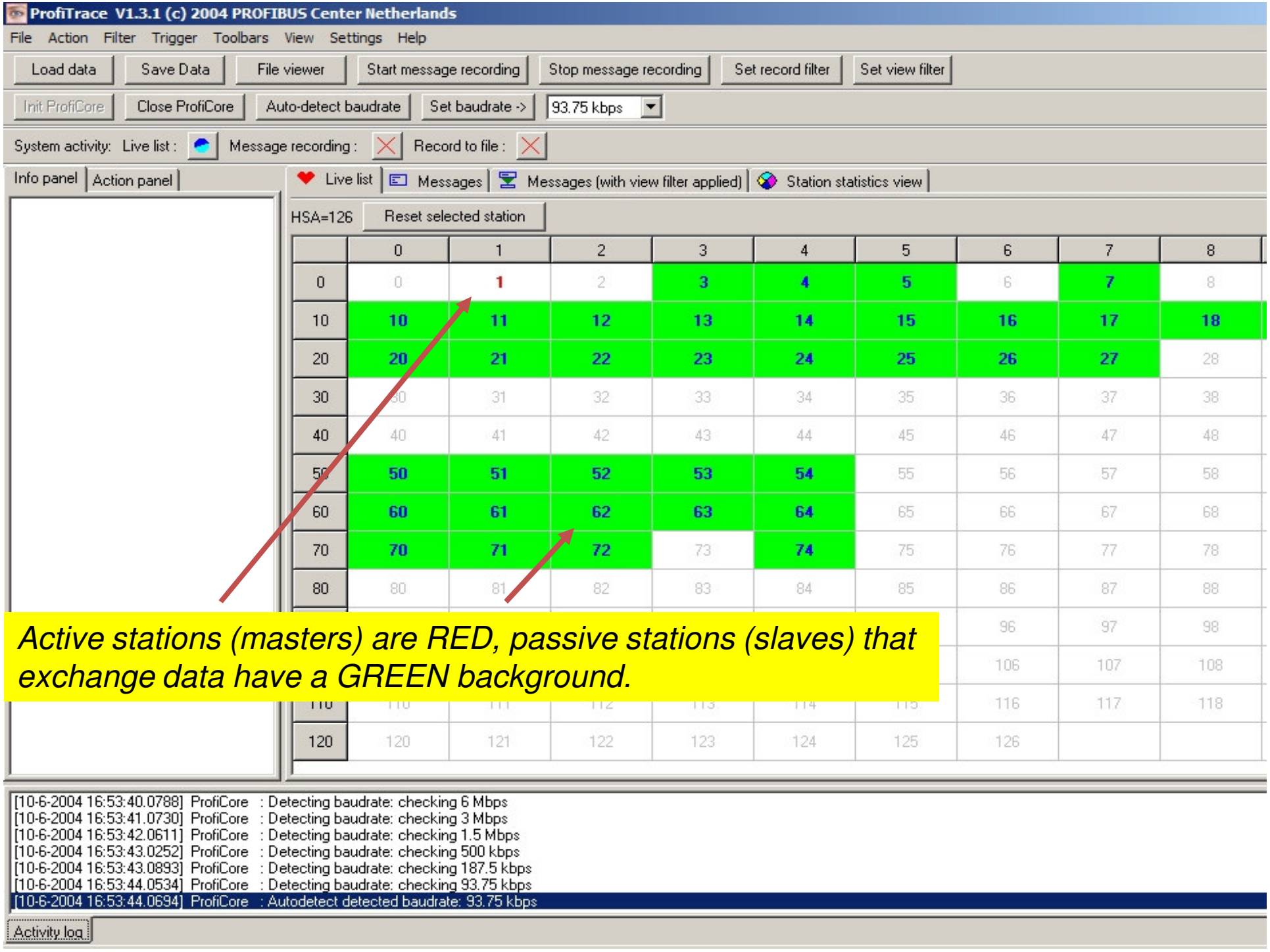
3) Visual inspection



The sequence above is also the way of working for localizing and solving 'problems'.

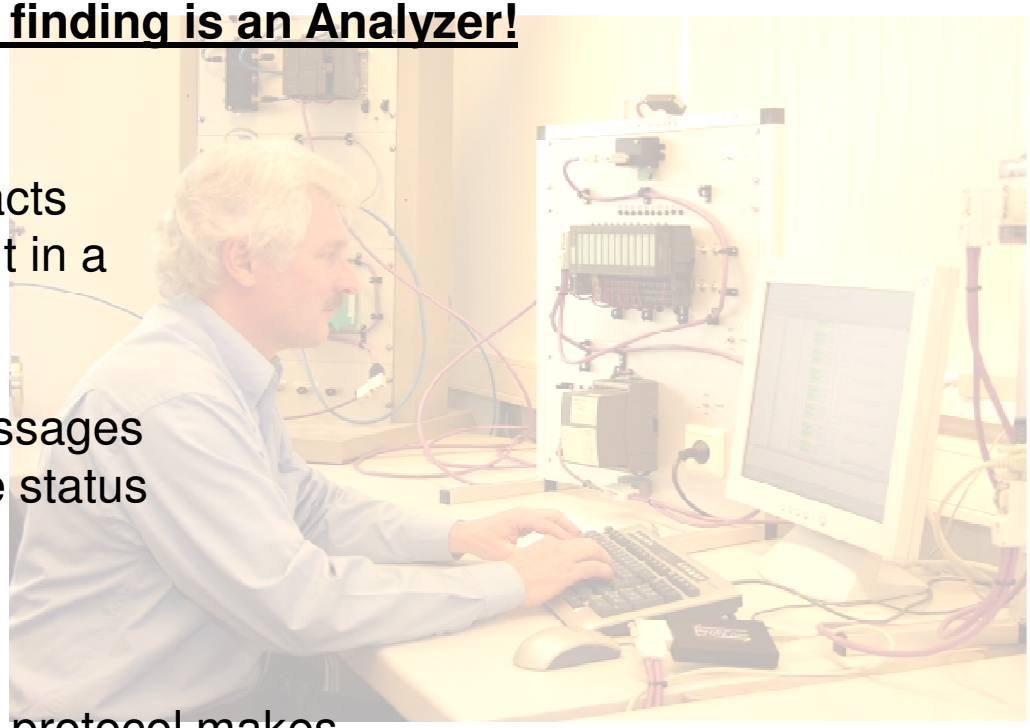
Infrastructure




ProfiTrace V1.3.1 (c) 2004 PROFIBUS Center Netherlands
File Action Filter Trigger Toolbars View Settings Help
Load data
Save Data
File viewer
Start message recording
Stop message recording
Set record filter
Set view filter
Init ProfiCore
Close ProfiCore
Auto-detect baudrate
Set baudrate ->
93.75 kbps
System activity: Live list :
Message recording :
Record to file :
Info panel
Action panel
Live list
Messages
Messages (with view filter applied)
Station statistics view
HSA=126
Reset selected station
Active stations (masters) are RED, passive stations (slaves) that exchange data have a GREEN background.
[10-6-2004 16:53:40.0788] ProfiCore : Detecting baudrate: checking 6 Mbps
[10-6-2004 16:53:41.0730] ProfiCore : Detecting baudrate: checking 3 Mbps
[10-6-2004 16:53:42.0611] ProfiCore : Detecting baudrate: checking 1.5 Mbps
[10-6-2004 16:53:43.0252] ProfiCore : Detecting baudrate: checking 500 kbps
[10-6-2004 16:53:43.0893] ProfiCore : Detecting baudrate: checking 187.5 kbps
[10-6-2004 16:53:44.0534] ProfiCore : Detecting baudrate: checking 93.75 kbps
[10-6-2004 16:53:44.0694] ProfiCore : Autodetect detected baudrate: 93.75 kbps
Activity log

Analyzer

The most important tool for fault finding is an Analyzer!



This is a PC application which extracts messages from the bus and saves it in a database.

The technician can analyze the messages and come to a conclusion about the status of the instruments.

The predictability of the PROFIBUS protocol makes the use of a busmonitor very easy.....

Facts and Fiction

Busmonitors do not have a network address, but are a Physical bus load on the cable!

The End

For Any Questions;
info@profibus-sa.com

The PICC / PITC website is:
www.profibus-sa.com

By; Ali Magboul
THANK YOU…

References:

- **PROFIBUS INSTALLATION GUIDELINES**
- **T&ME PROCENTEC COURSE**