Go digital. Go PROFINET.

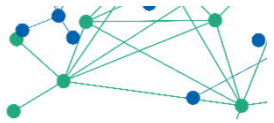
The Communication Standard for the digital Transformation.

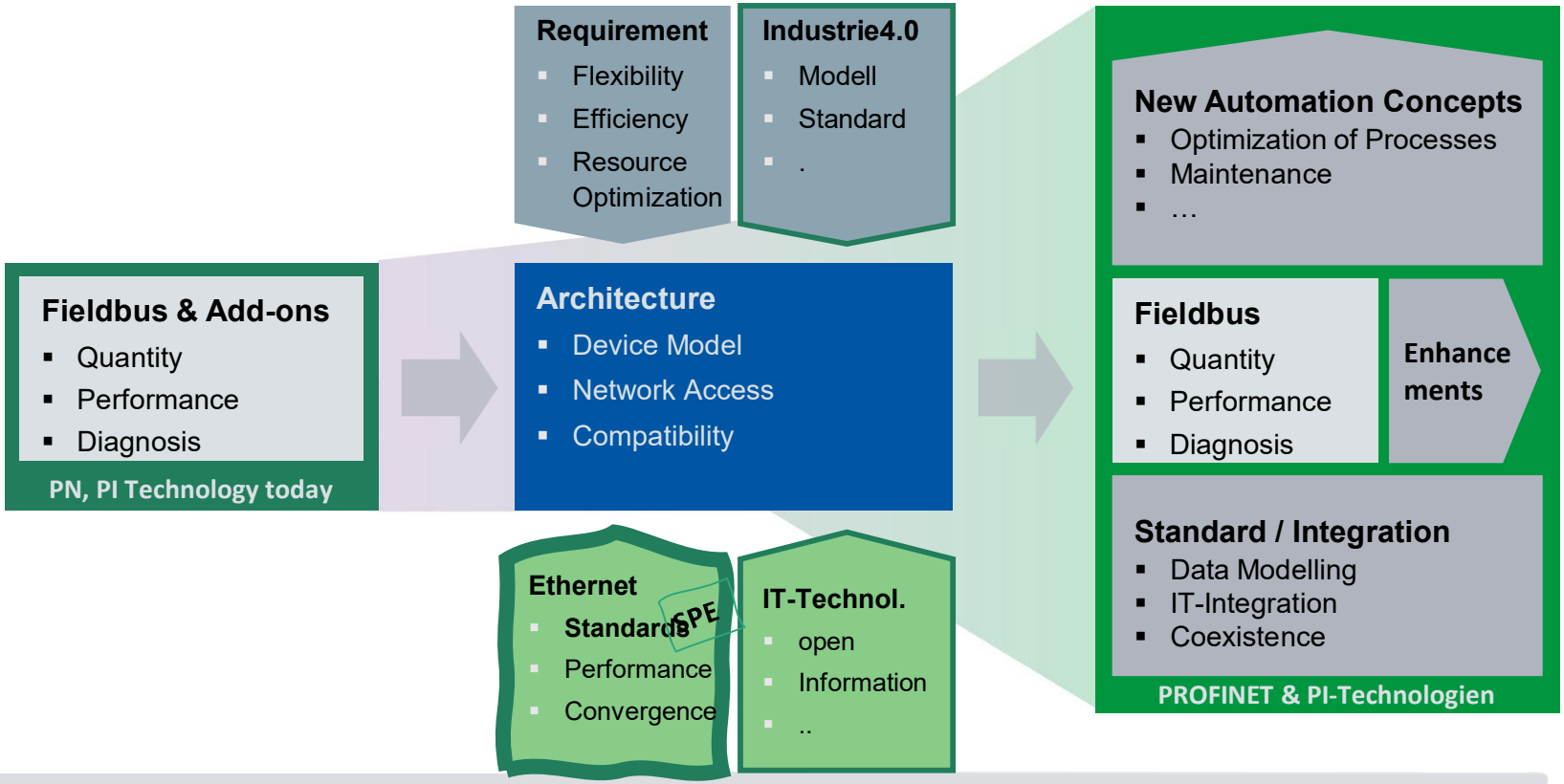
Single Pair Ethernet

- **Motivation**
- **Use Cases**
- **Standardization**

PI (PROFIBUS & PROFINET International)
Xaver Schmidt/Project Group Industrie 4.0

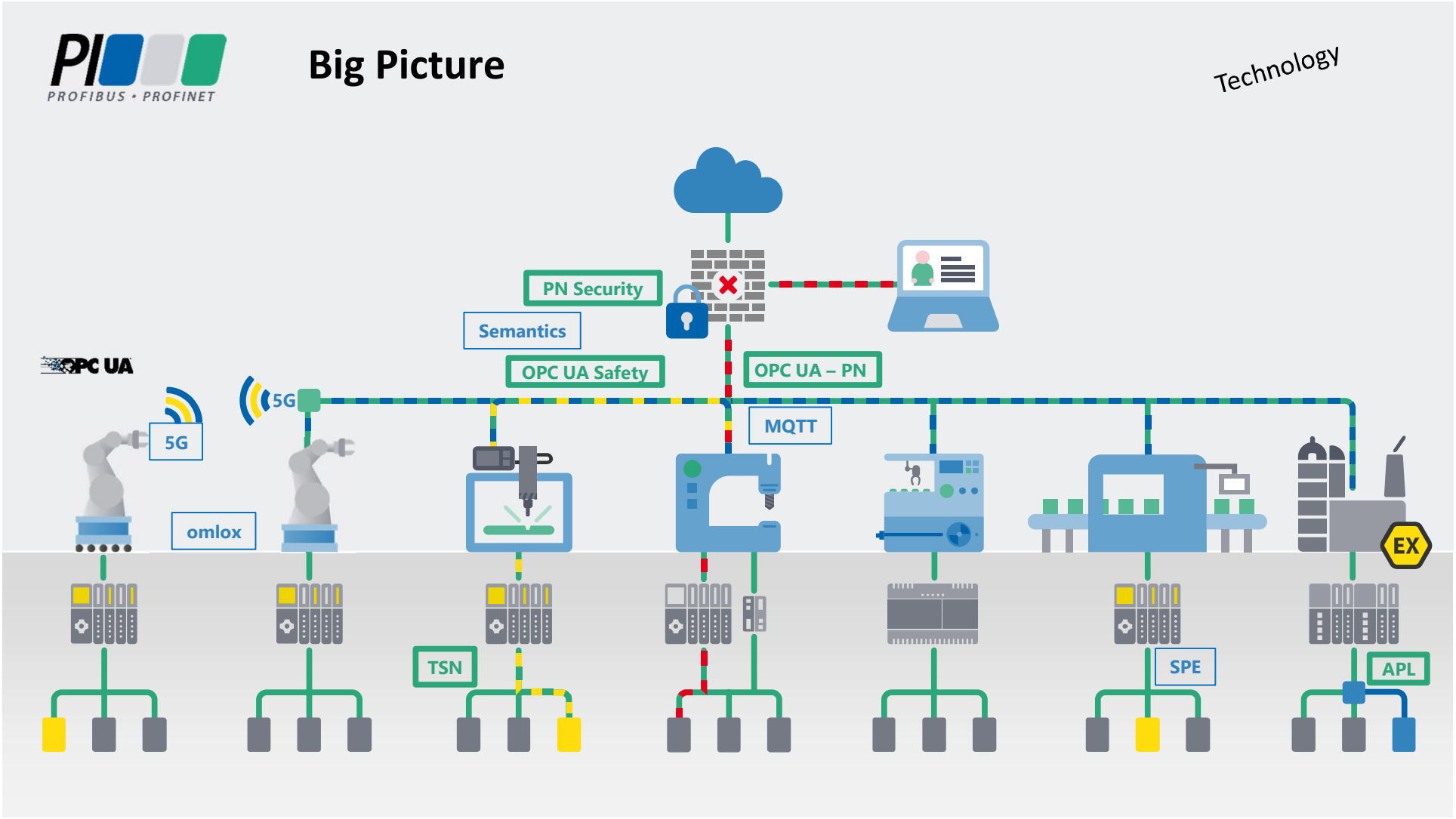
PI‘s role in the future
From Communication to Information





Big Picture

Technology



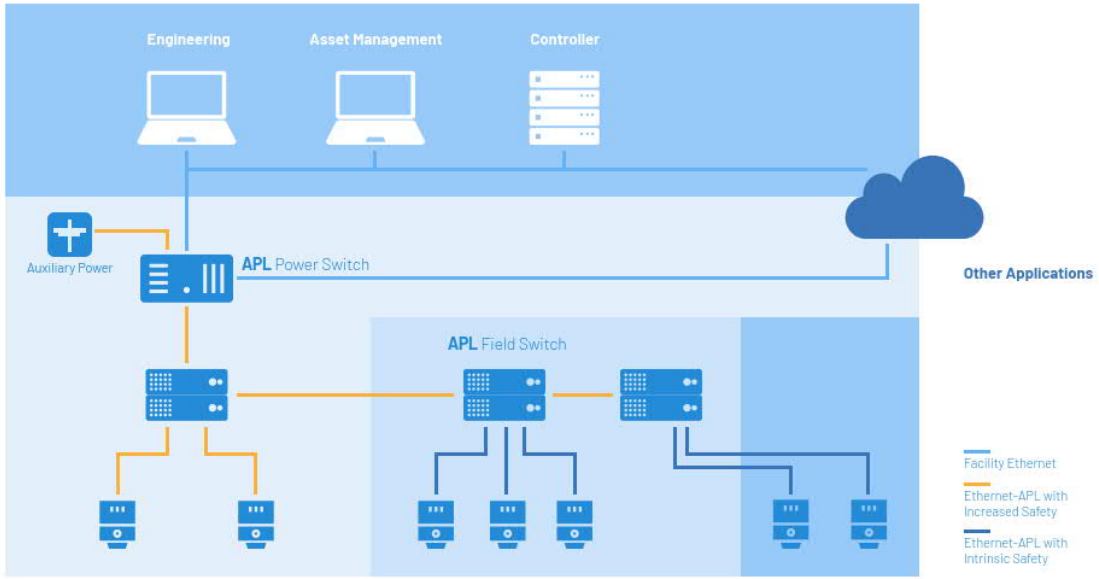


Figure 5: Example topology for long cable reach with up to 1000 m between switches on the trunk

Source: WP Ethernet-APL

Ethernet To The Field of Process Plants

- Advanced Physical Layer for Ethernet: Ethernet-APL
- IEEE 802.3cg with 10Mbit/s = 10BASE-T1L
- IEC TS 60079-42 (2WISE) for 2-wire intrinsically safe Ethernet
- APL port profiles with multiple power levels for use in
  - explosion hazardous areas and
  - non-hazardous areas

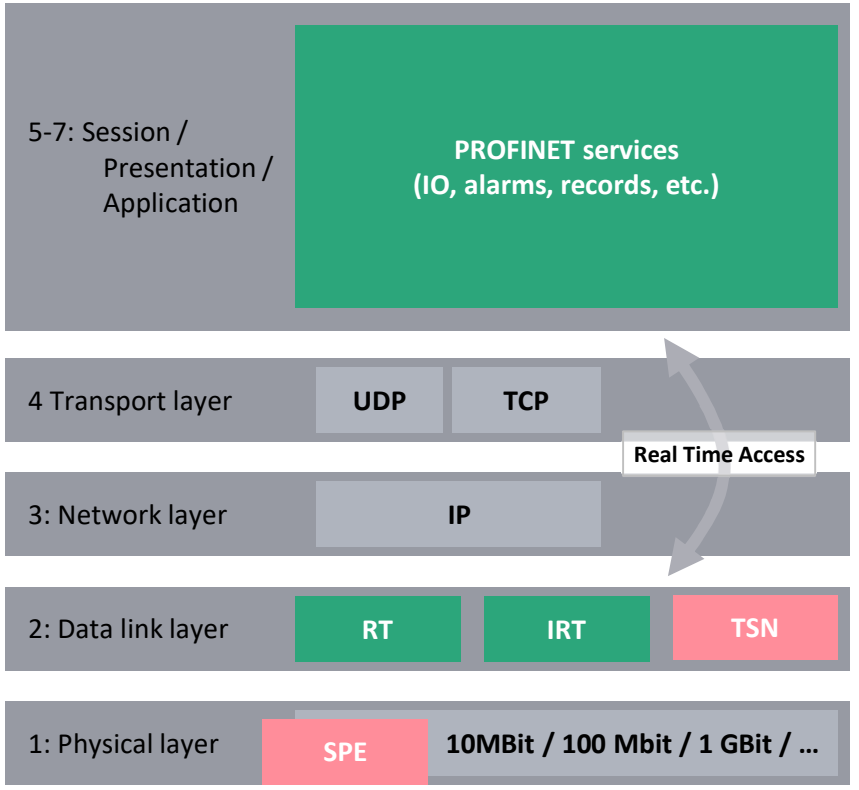
Modular PROFINET-Architecture with SPE

- **Proven PROFINET- Services**
  - Configuration, Parametrization, Diagnosis,..
  - Profile: PROFIsafe, PROFIdrive, PROFIenergy, PA,…

  => Unchanged User Application

- Layer 2: Time Sensitive Networking: TSN

- **Layer 1: Flexibility on the Physical Layer**



SPE-Technology-FAMILY

- Single Pair Ethernet
  - **Only 2 Wires**
  - Different Link speeds
  - Different Lengths
  - Different Power over Data Line ratings
  - Switched, Multidrop (10M)
  - No Autoneg
  - Future enhancements
  - Automotive, Industry, Building

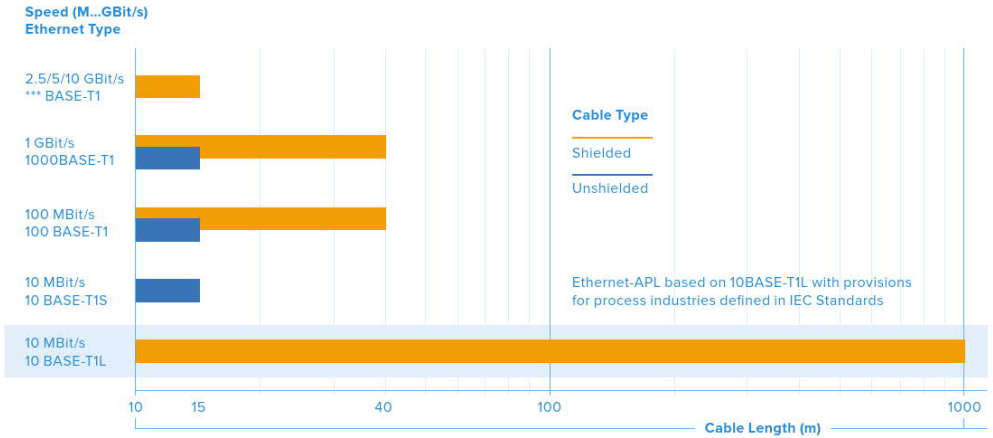


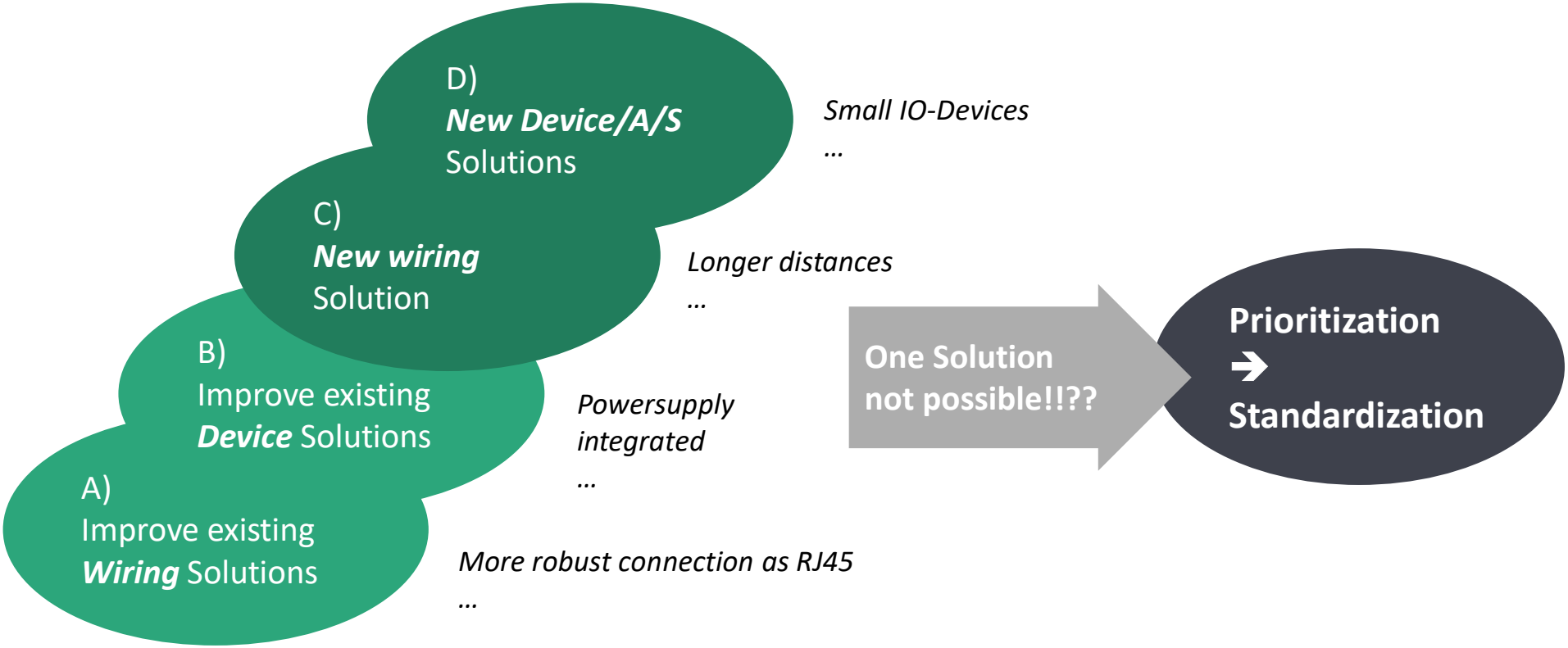
Figure 3: Ethernet-APL and Types of Single-Pair Ethernet defined in IEEE 802.3

Source: WP Ethernet-APL

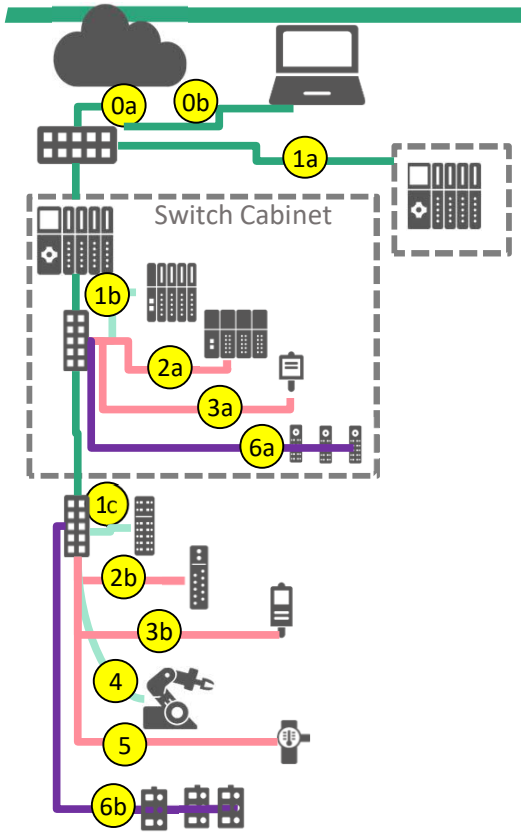
➔ Multiple Combinations

➔ ➔ what is needed, what is reasonable, which steps,…

Use Cases Classes

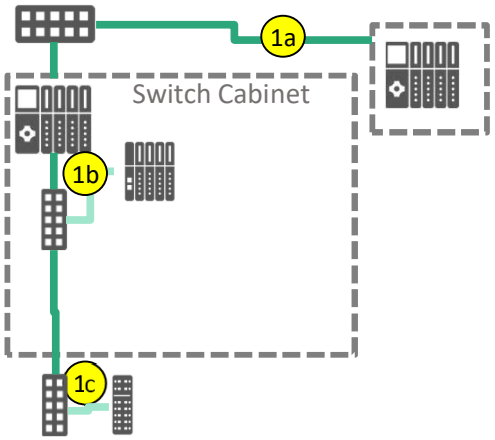


Use Case Overview



	Usecase	Benefit
0a	Connection to IT	Out of Scope
0b	Connection to PC	Out of Scope
1a	Machine to Machine Wiring	Improve PN wiring
1b	Cabinet Wiring (Backbone)	Improve PN wiring
1c	Field Wiring (Backbone)	Improve PN wiring
2a	Devices in the Cabinet – PoDL	Improve PN + PS wiring, new devices
2b	Devices in the Field – PoDL	Improve PN + PS wiring, new devices
3a	Sensors/Actuators in Cabinet - PoDL	Direct Connection of Sensors/Actors
3b	Sensors in the Field – PoDL	Direct Connection of Sensors/Actors
4	Flexible Wire Applications	Higher cable flexibility
5	Long distance applications	Replace FO
6a	Multidrop in Cabinet	New device class
6b	Multidrop in Field	New device class

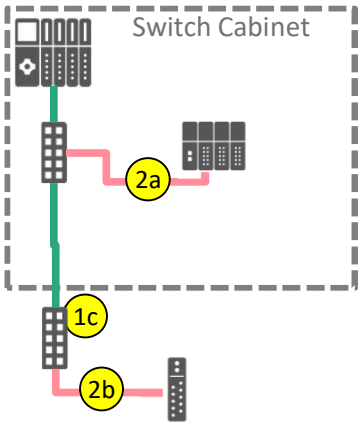
Use Case: Improve Wiring



	Usecase	Benefit
1a	Machine to Machine Wiring	Improve PN wiring: - Faster commisioning - More robust connectors - Smaller footprints - …
1b	Cabinet Wiring (Backbone)	
1c	Field Wiring (Backbone)	

Used SPE feature set	To be checked
100M, 1G …	15m/40m OK/NOK New Device variants ..

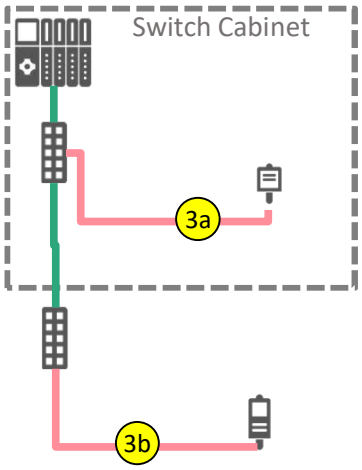
Use Case: Improve PN + PS wiring



	Usecase	Benefit
2a	Devices in the Cabinet – PoDL	Improve PN + PS wiring, new devices - .. - Integrated Power Supply - Less cables - …
2b	Devices in the Field – PoDL	

Used SPE feature set	To be checked
100M, 1G …	15m/40m OK/NOK Which PoDL Variant New Device variants ..

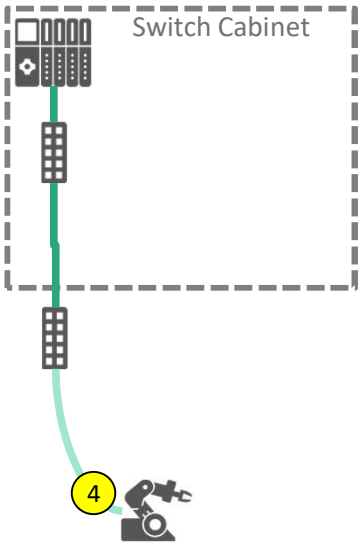
Use Case: Direct Connection of Sensors/Actors



	Usecase	Benefit
3a	Sensors/Actuators in Cabinet - PoDL	Direct Connection of new Sensors/Actors - .. - Small/smart Devices additional in the field - …
3b	Sensors/Actuators in the Field – PoDL	

Used SPE feature set	To be checked
10M, 100M, 1G …	.. Function/Feature: Simpliest IO … Cloud Connect ..

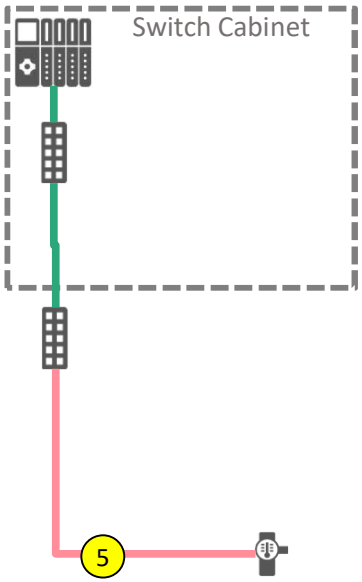
Use Case: Flexible Wire Applications



	Usecase	Benefit
4	Flexible Wire Applications	Higher cable flexibility

Used SPE feature set	To be checked
10M, 100M, 1G …	.. Fast Start Up ..

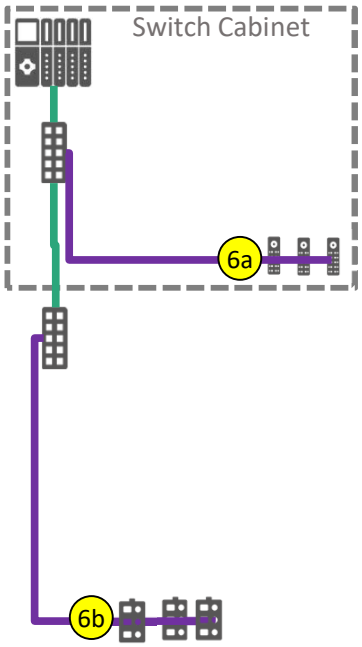
Use Case: Flexible Wire Applications



	Usecase	Benefit
5	Long distance applications	Replace FO

Used SPE feature set	To be checked
10M, 100M, 1G …	.. Cabling (existing) ..

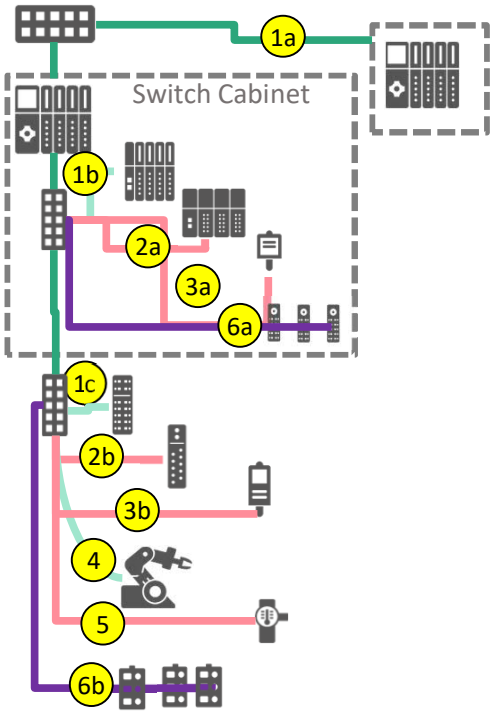
Use Case: Direct Connection of Sensors/Actors

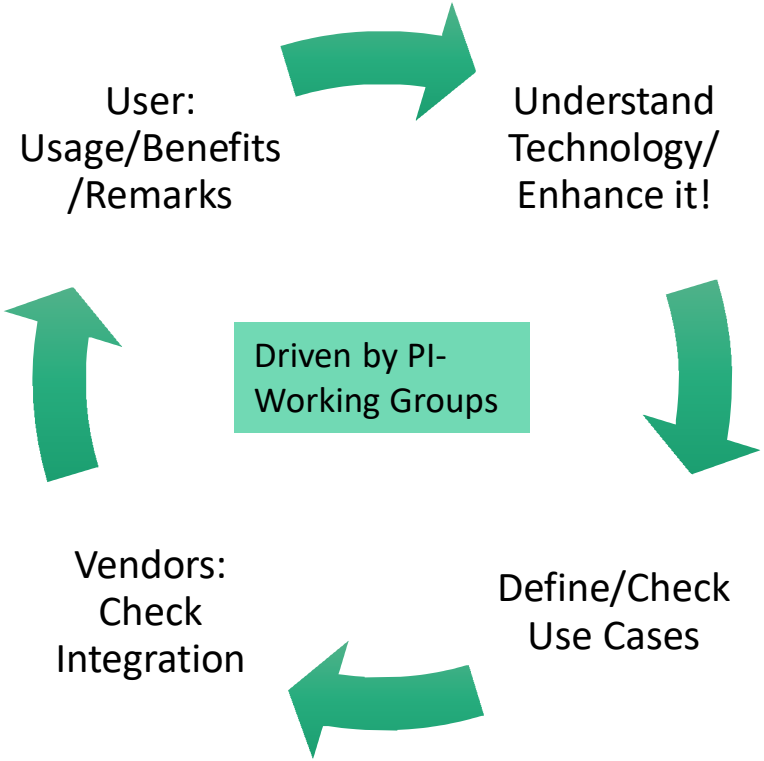


	Usecase	Benefit
6a	Multidrop in Cabinet	New device class - No switches required - Cost reduction - …
6b	Multidrop in Field	

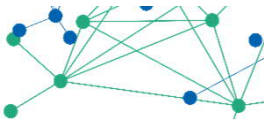
Used SPE feature set	To be checked
10M, Multidroop …	.. New device Class Transition New wiring concepts ..

Multiple Use Cases ➔ Rating





More ToDo´s



Well defined Use Cases

Standardization

IO:
- MAU Type
- Diagnosis

GSD:

Connection:
- Cable
- Connector

Certification

Diagnosis

Physics!?

Connector

…

Guidelines

Commissioning

Installation

Validation

…

Marketing

Documents

Web

Workshops

…

Coordination with other organizations

Works well

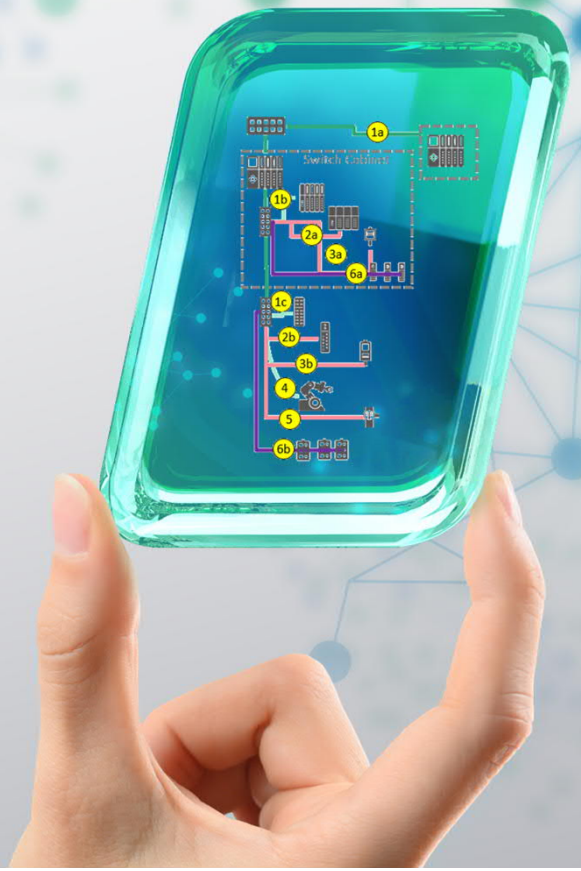
and is a success

Summary

- SPE improves and complements existing applications
- SPE is an enabling technology for new applications
- We will and must make a useful and successful implementation on the basis of use cases and technical evaluations

Go digital. Go PROFINET.

Thank you for your Attention



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