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IN THE ARAB COUNTRIES

UNDER THE THEME
"MANAGING MAINTENANCE WITHIN INDUSTRY 4.0"
CONICIDE WITH THE 16TH ARAB MAINTENANCE EXHIBITION

Study on Process Bus Effect on the Performance of Protection IED in High Voltage Substations

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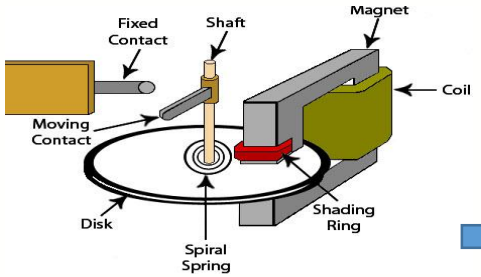
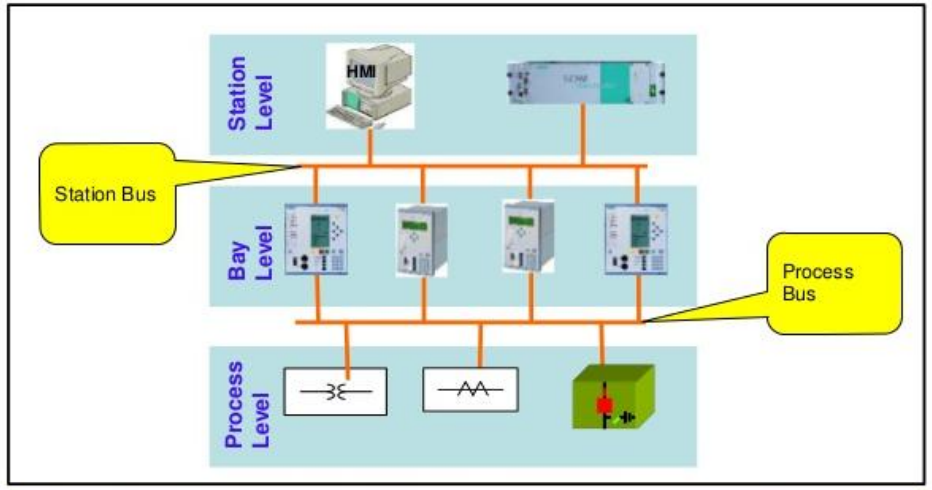


Electro-Mechanical Relay

Static Relay

Numerical Relay (IED)

➢Network Communication Development :



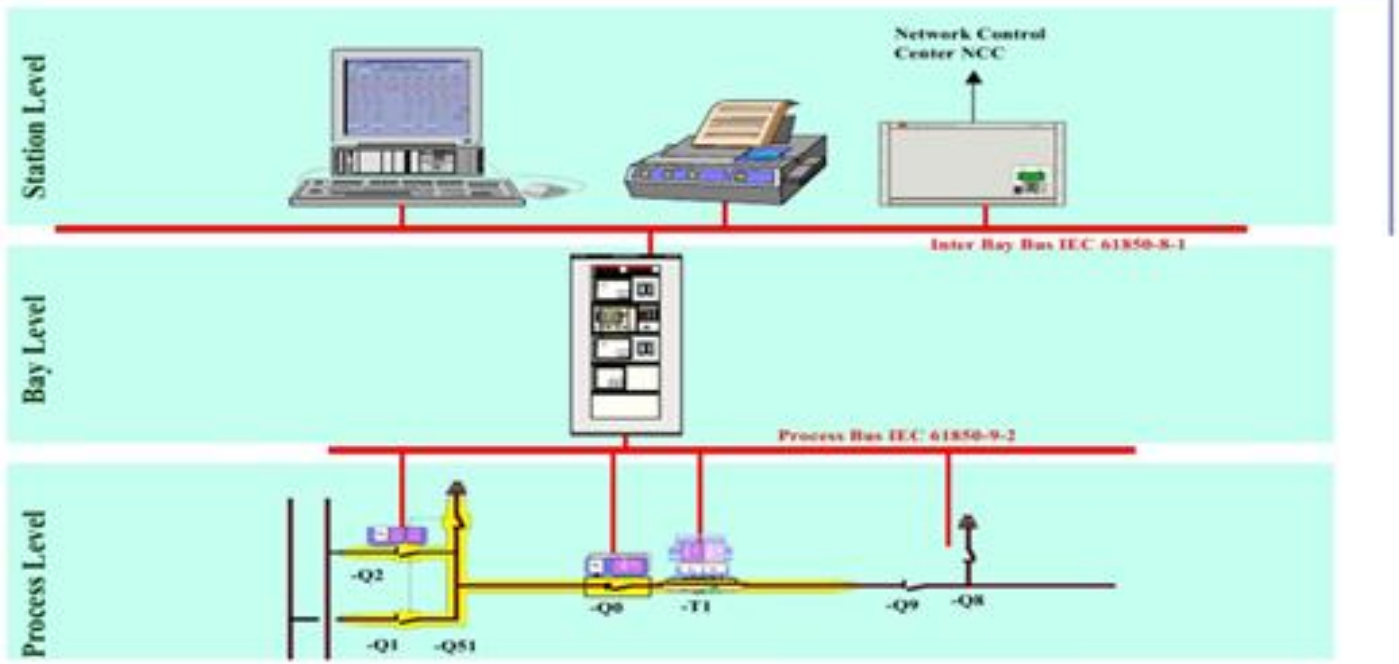
IEC 61850 is more than a protocol, it's an architecture

❑Introduction:

❑ Substation Architecture Development :

- ➢ Conventional Substation
- ➢ Modern Automated Substation.
- ➢ Digital Substation .

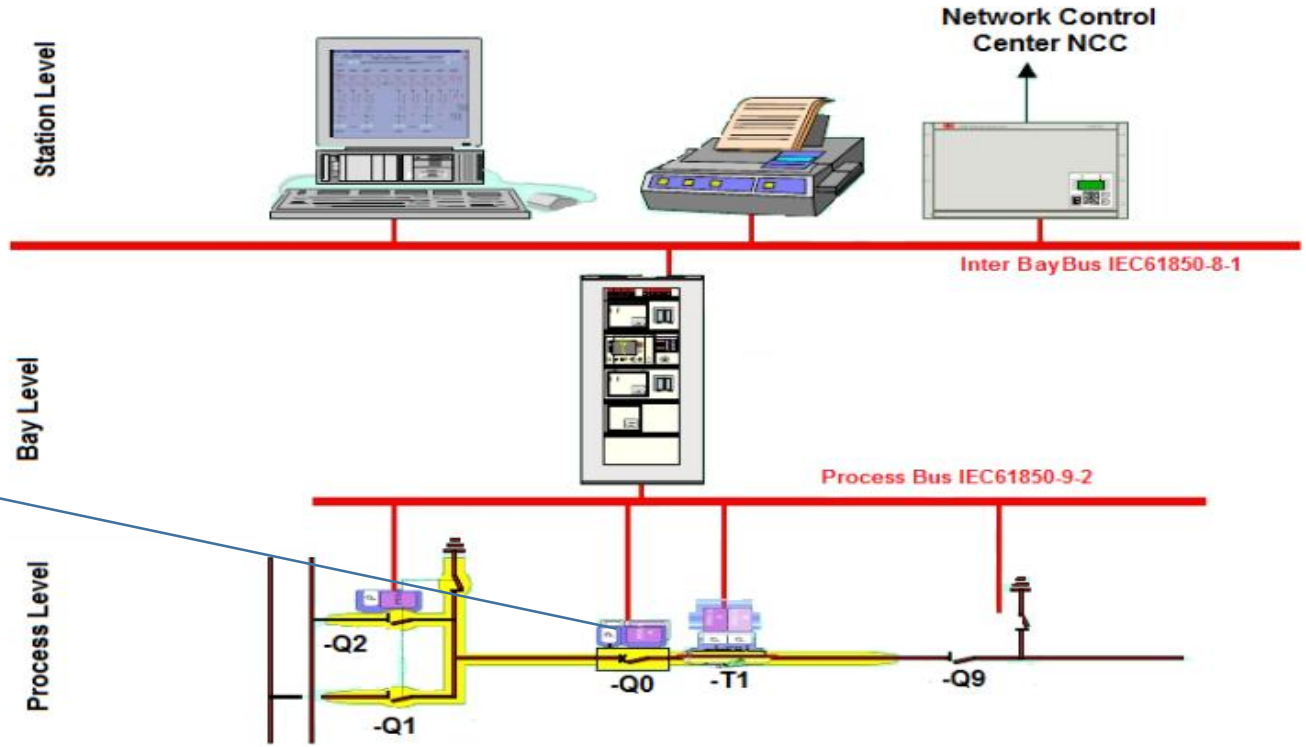
Process Bus Based Substation (Digital Substation)



Structure of the process bus

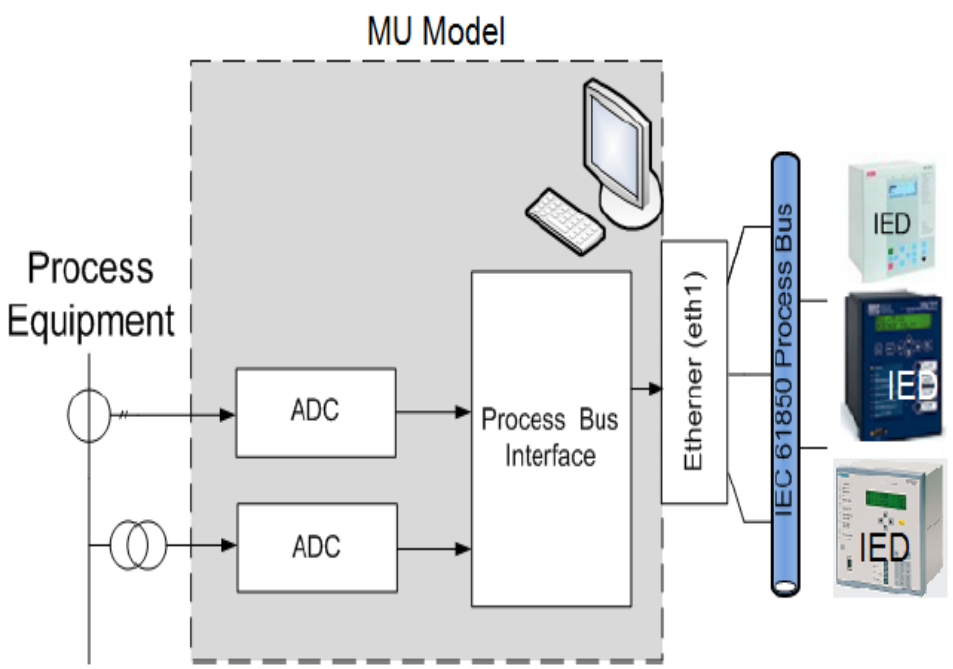
- Structure of the Digital substation:
  - Substation Level.
  - Bay/Unit Level.
  - Process Level.

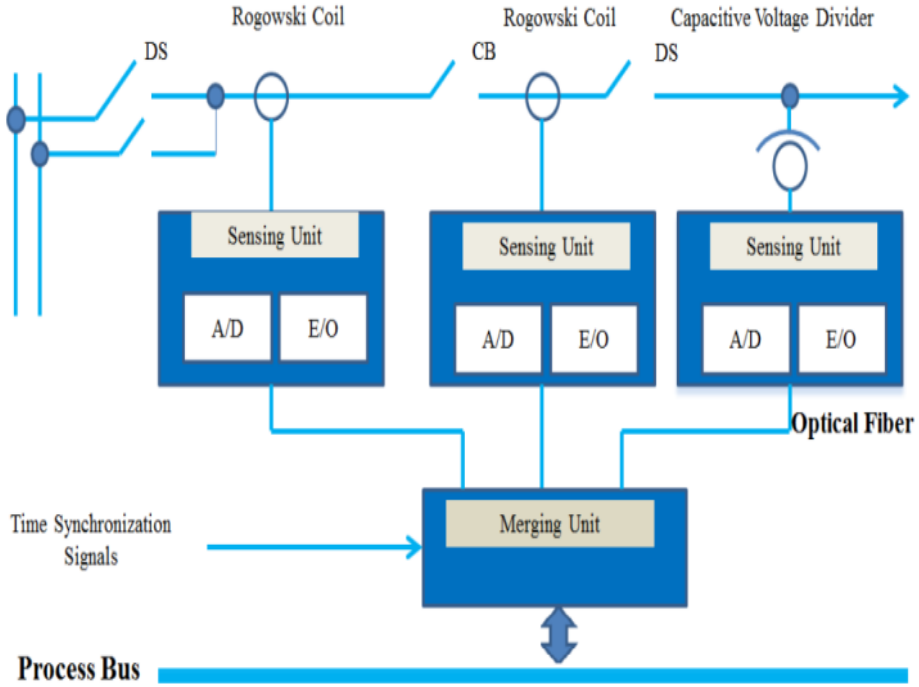
Merging Unit



Structure of the process bus

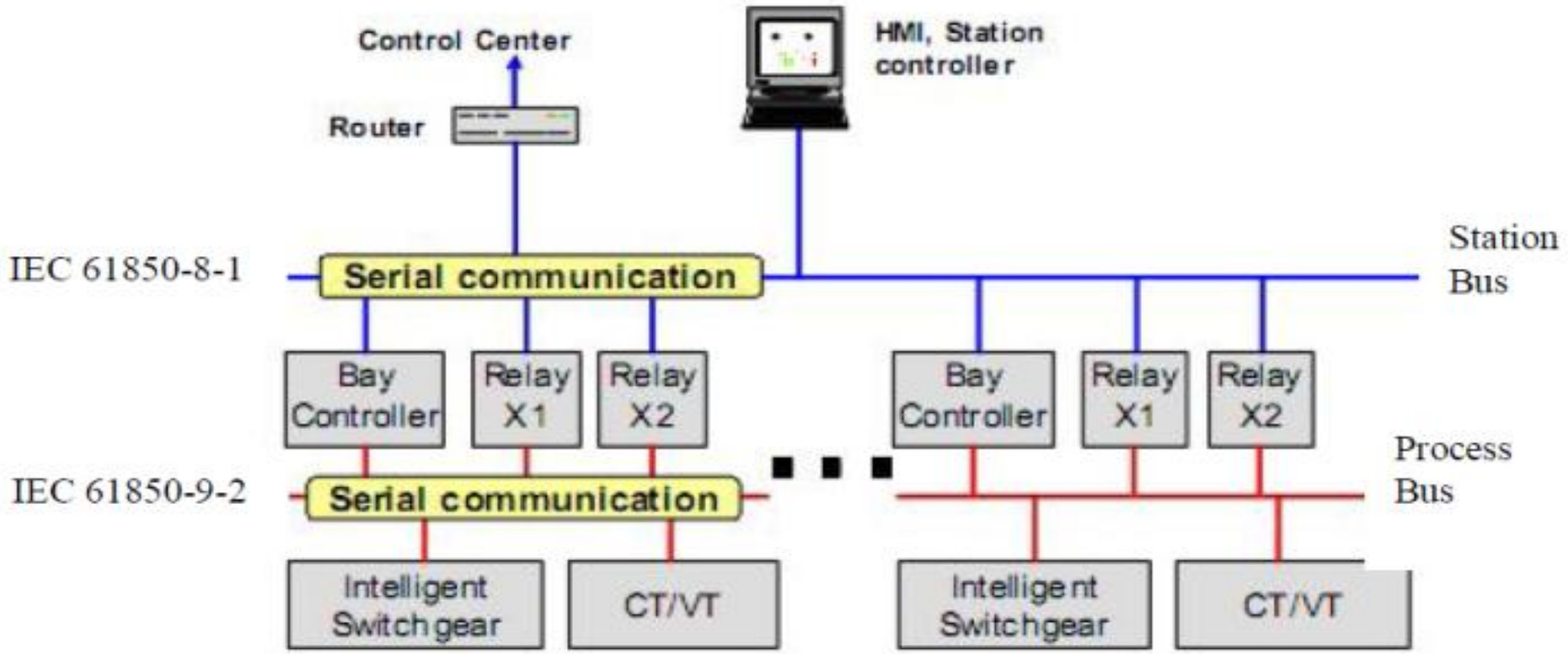
- Merging Unit:





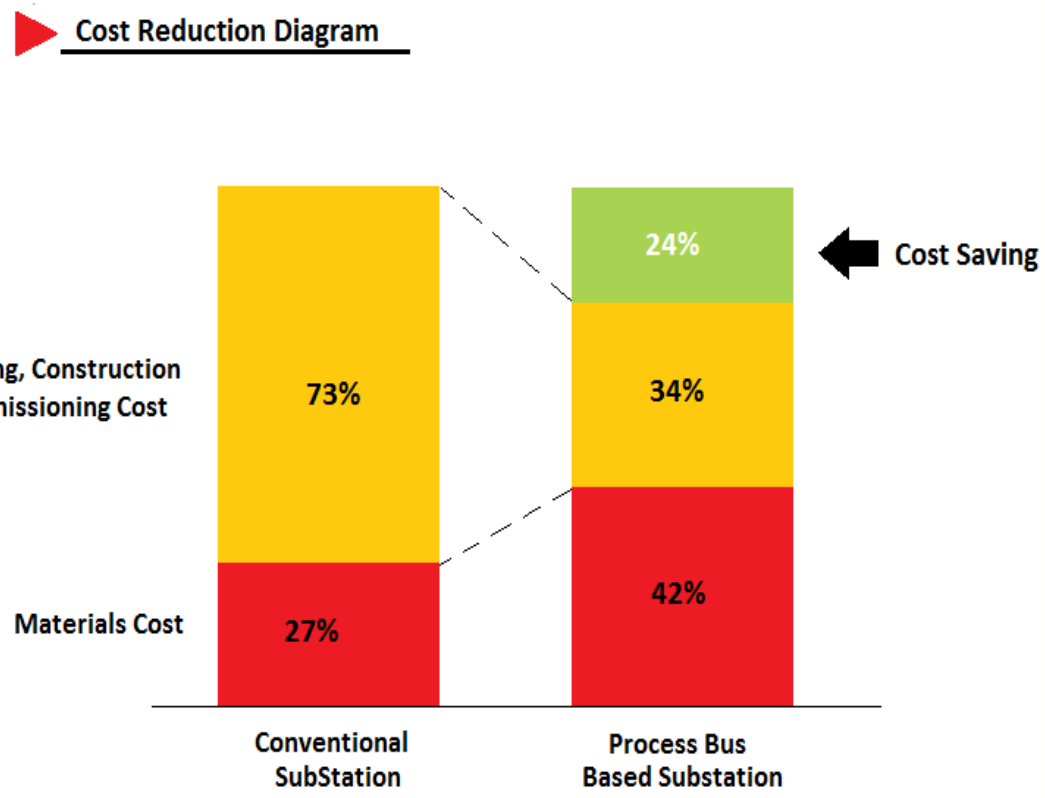
Why Applying Process Bus Technique?

- Simple Wiring and Flexible :



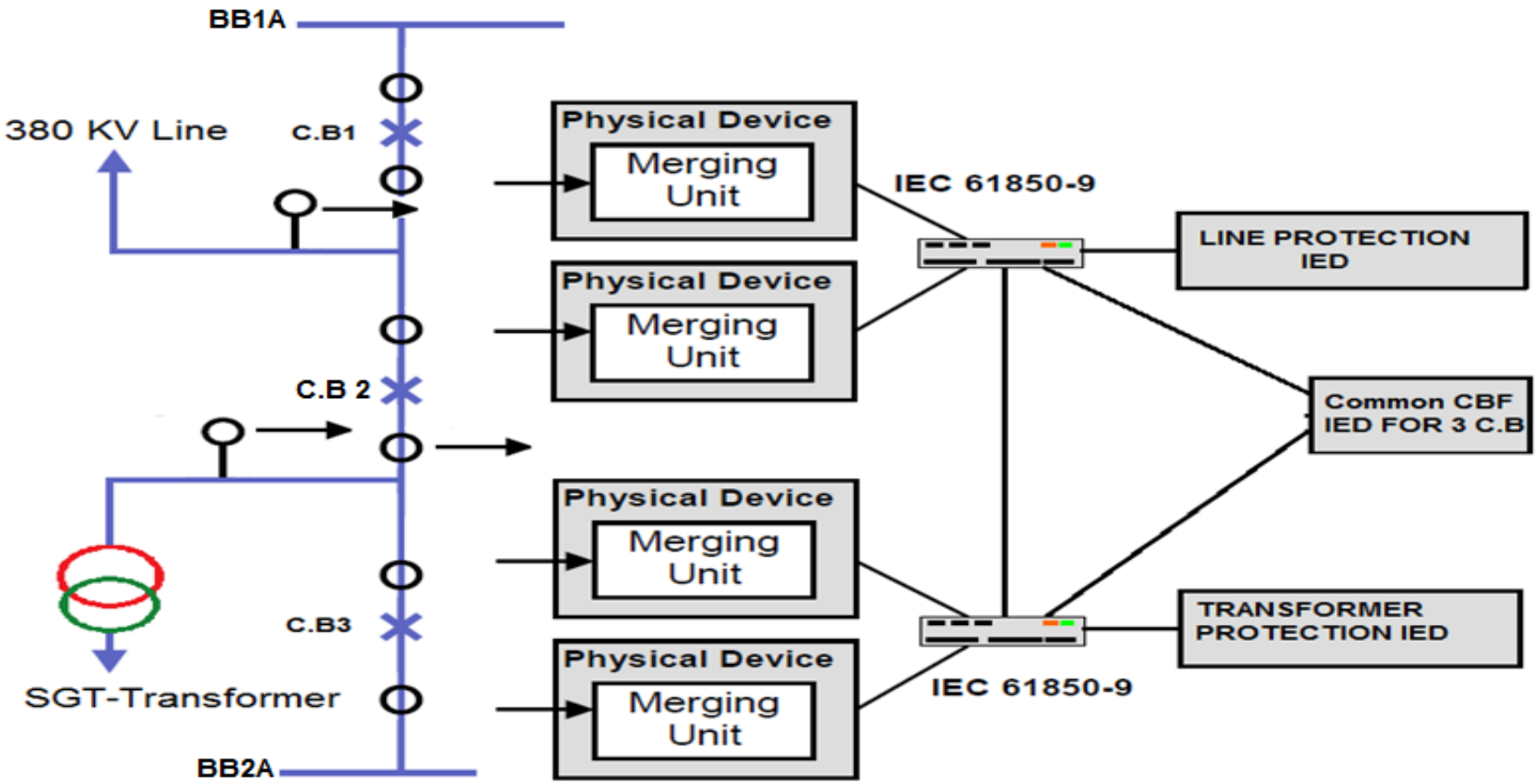
Why Applying Process Bus Technique?

- Cost Savings.
  - Cost Types:
    - Engineering
    - Construction
    - Commissioning
    - Materials Cost



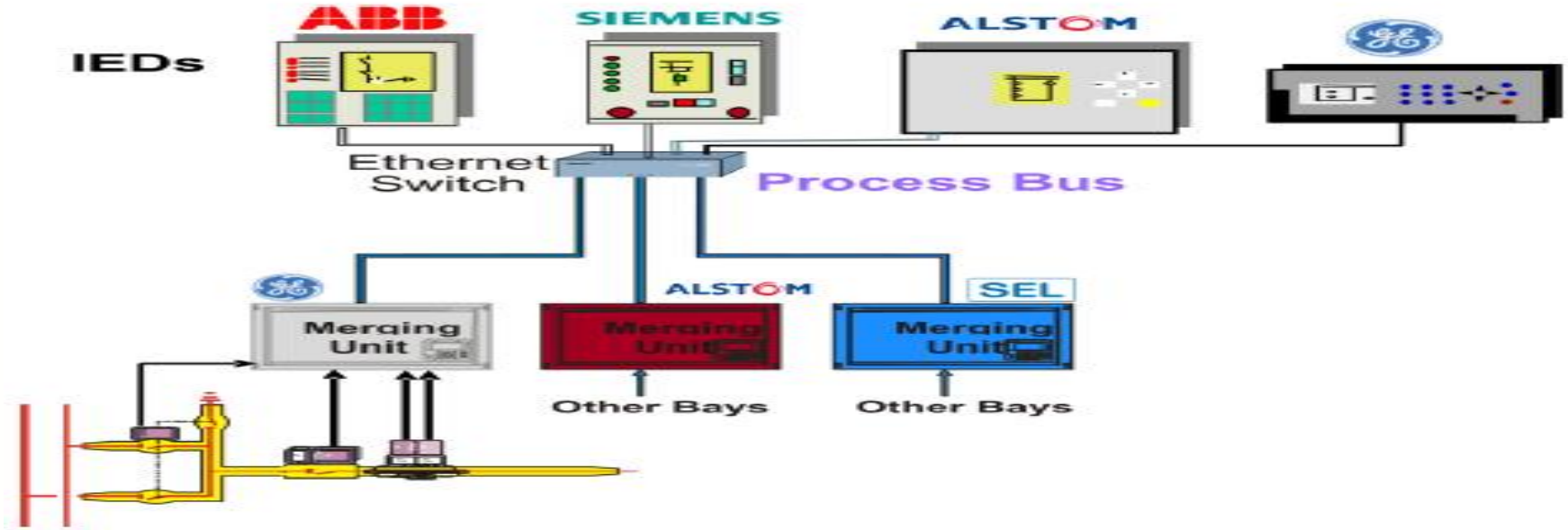
Why Applying Process Bus Technique?

- Enhancements Of Protection Functions.



Why Applying Process Bus Technique?

- Interoperability.

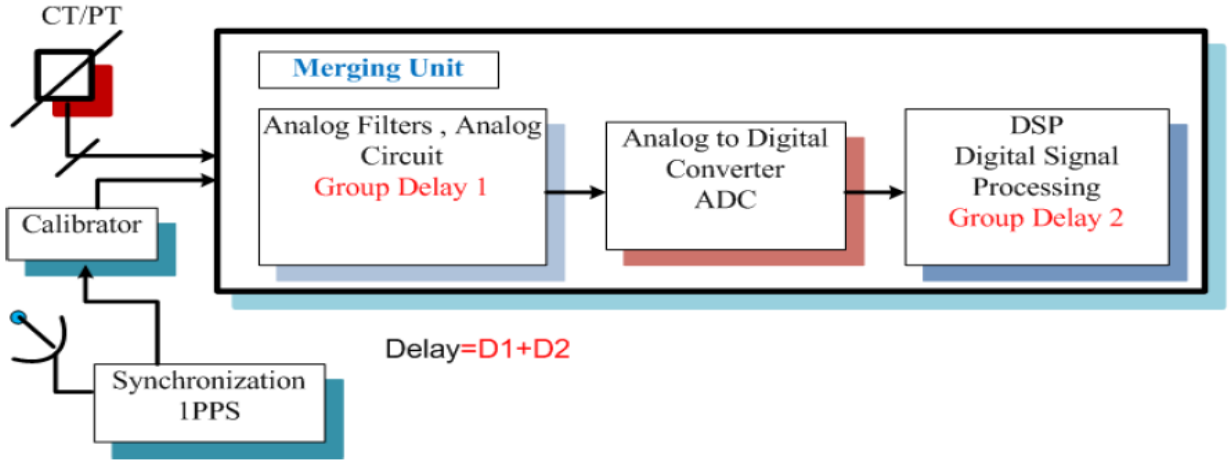


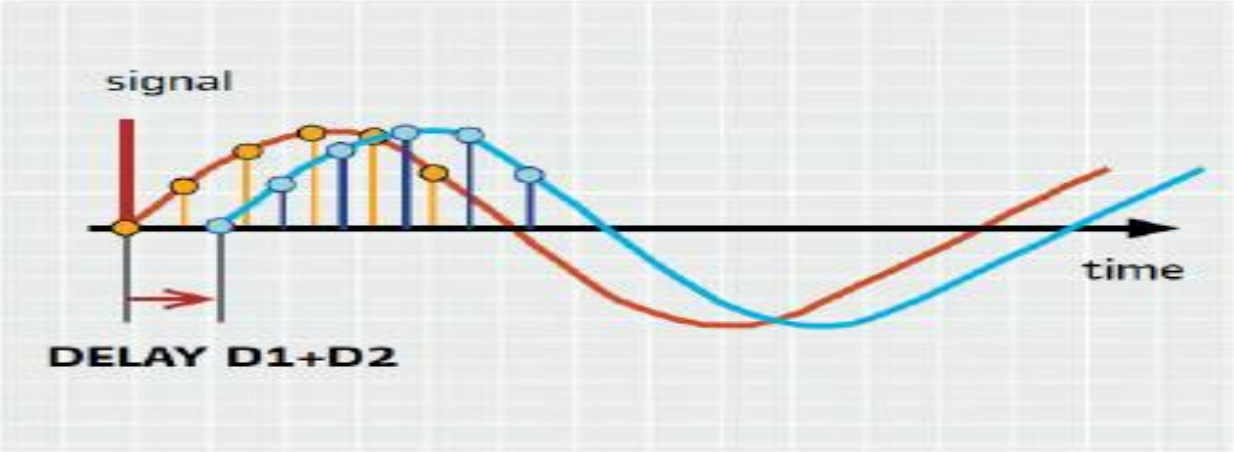
Why Applying Process Bus Technique?

- Personal Safety.
  - Limited dealing with CT and VT Secondary wiring.
  - Expansion without any cable pulling and termination.
  - Limit the dealing with the power equipment.

What are the Impacts on Protection IED and Challenges?

- Loss/Delay Of Time Critical Protection Messages:
  - Filtering Time delay
  - Digital signal Processing Time Delay.
  - TCP/IP Time Delay .

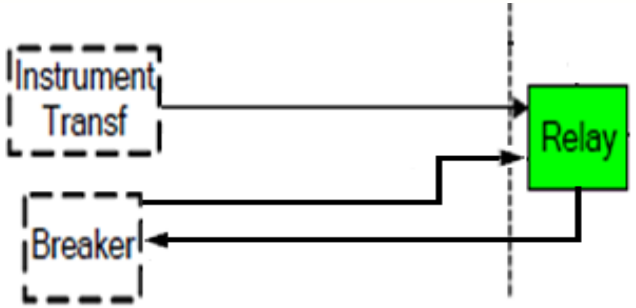




What are the Impacts on Protection IED and Challenges?

- Reliability of IEC 61850 Based Ethernet Architectures.

- Modern System *MTBF:*



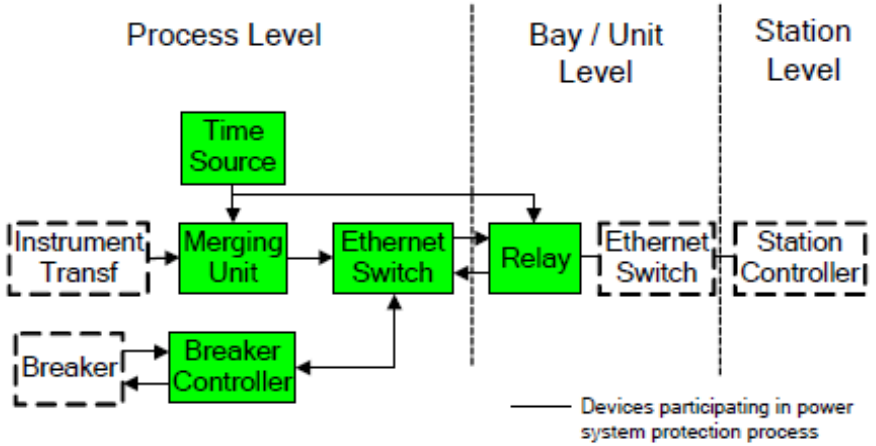
$$\frac{1}{MTBF} = \sum_{n=1}^{N} \frac{1}{MTBF_n} \qquad \text{Eq. 1}$$

In our simplified example, with all MTBFs assumed to be equal to 300 years, the calculation for N devices simply reduces to:

$$systemMTBF = \frac{deviceMTBF}{N}$$

$$systemMTBF = 300/1 = \text{300 Years} \qquad \text{Eq. 2}$$

- Process Bus *MTBF:*



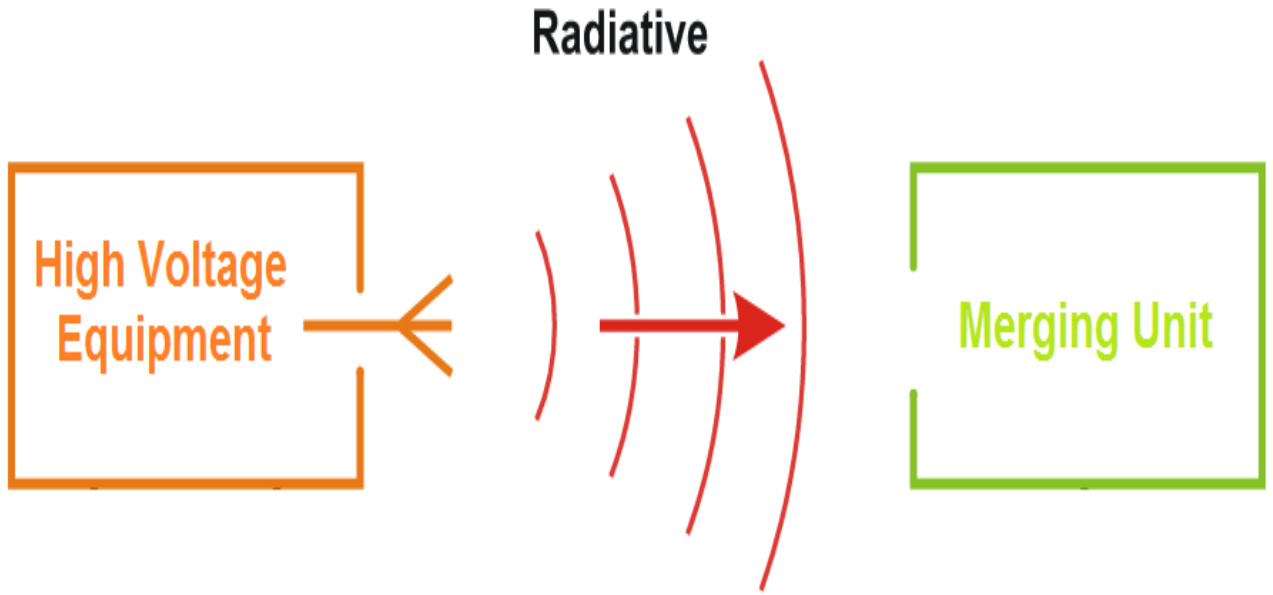
$$\frac{1}{MTBF} = \sum_{n=1}^{N} \frac{1}{MTBF_n} \qquad \text{Eq. 3}$$

$$systemMTBF = \frac{deviceMTBF}{N}$$

$$systemMTBF = 300/5 = \text{60 Years} \qquad \text{Eq. 4}$$

What are the Impacts on Protection IED and Challenges?

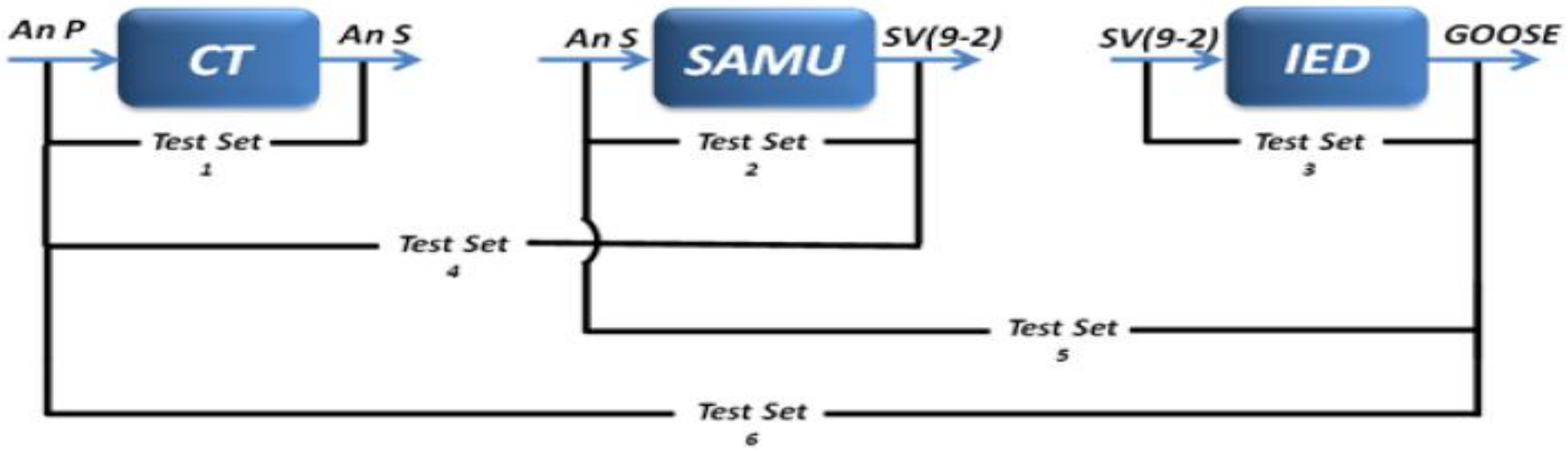
- EMI immunity:
  - Lightning strikes.
  - Switching surges.
  - Electrostatic discharges.



What are the Impacts on Protection IED and Challenges?

- **Digital skills:** Respondents clearly defined three key areas of digital skill where shortages are already being experienced: digital production expertise, digital maintenance capabilities and operating and strategic analytics. .
- **Creating a culture of collaboration:** Whereas historically there has been a clear demarcation of roles and responsibilities, Digital substation creates an interconnected environment where multiple perspectives can be combined and viewed.
- **Data and cyber security:** Security concerns are likely to give rise to a future market in specialized secure data sharing and Network services.

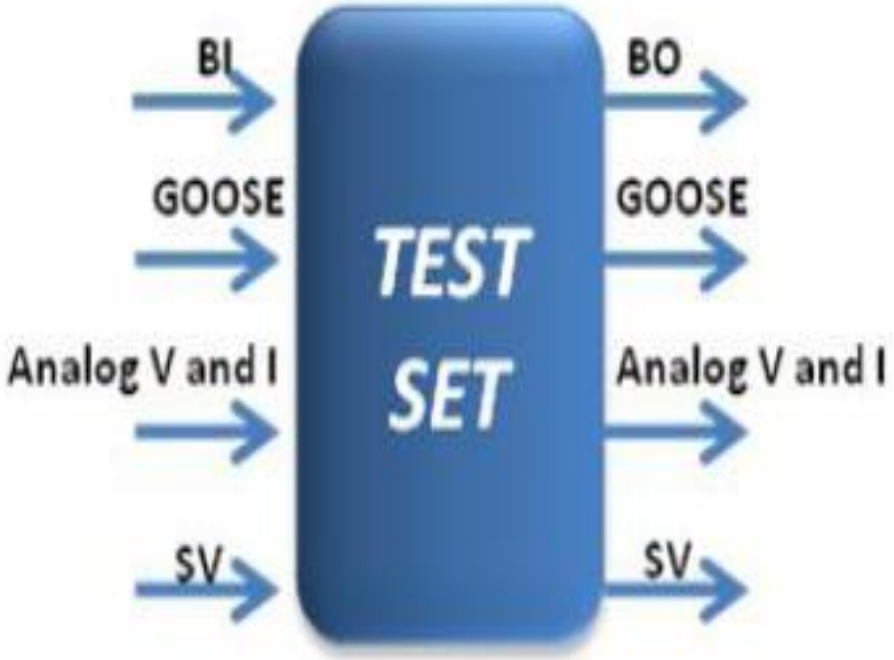
Testing Techniques



	Object Under Test	Inject	Measure
1	CT	Primary Current	Secondary Current
2	SAMU	Several secondary currents and voltages	SV (9-2)
3	IED	SV (9-2)	GOOSE
4	CT + SAMU	Primary Current	SV (9-2)
5	SAMU + IED	Several secondary currents and voltages	GOOSE
6	CT+ SAMU + IED	Primary Current	GOOSE

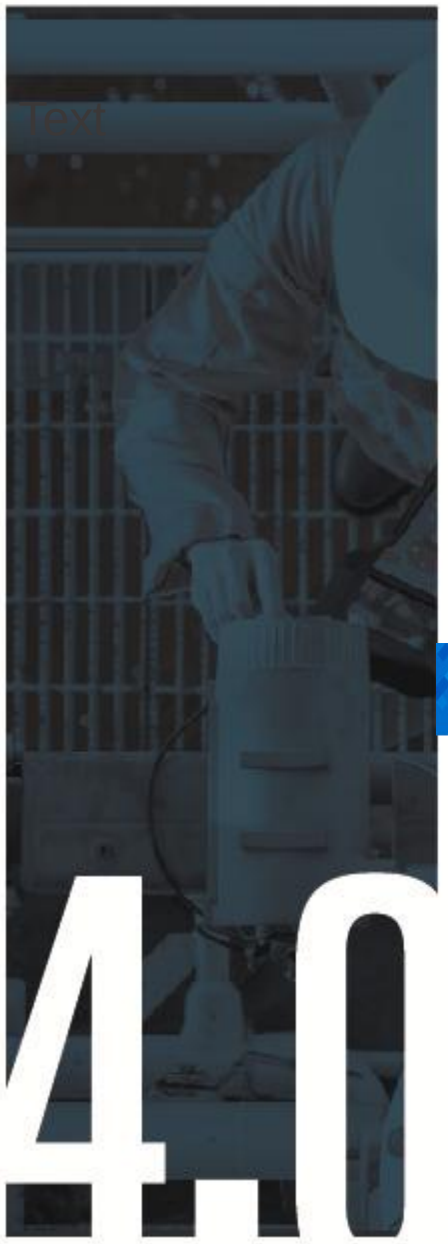
Testing Techniques

- Structure for proposed Process Bus test set



Conclusion and Recommendation :

- Process Bus technology offers a variety of new and exciting possibilities in control and protection systems .
- Like any New technology , Process Bus approach raises a distinct set of issues that have to be overcome in order to achieve wide acceptance of this technology .
- Further technical and practical studies should be conducted to be prepare the power sector for the next revolutionary step in the fully digitalizing of Power Substations.



THANK YOU