

74<sup>th</sup> Annual Conference for Protective Relay Engineers  
Texas A&M University  
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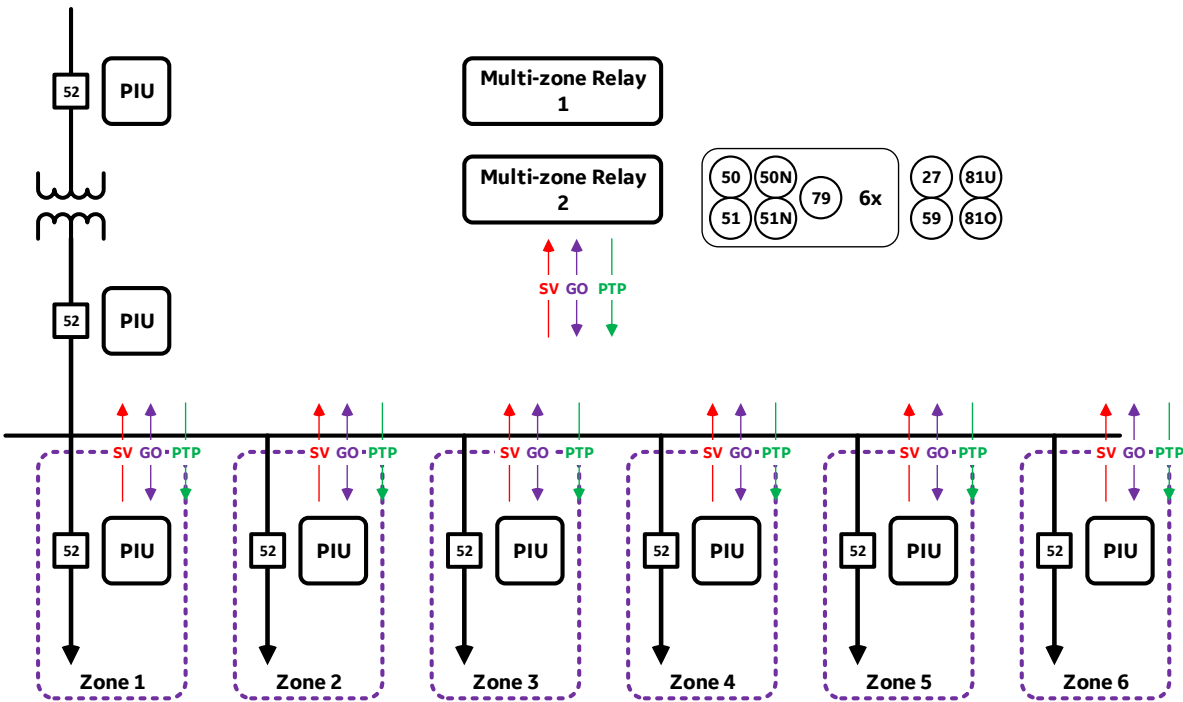
## Testing a Process Bus Based Multi Zone Protection Relay

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GE Grid Solutions

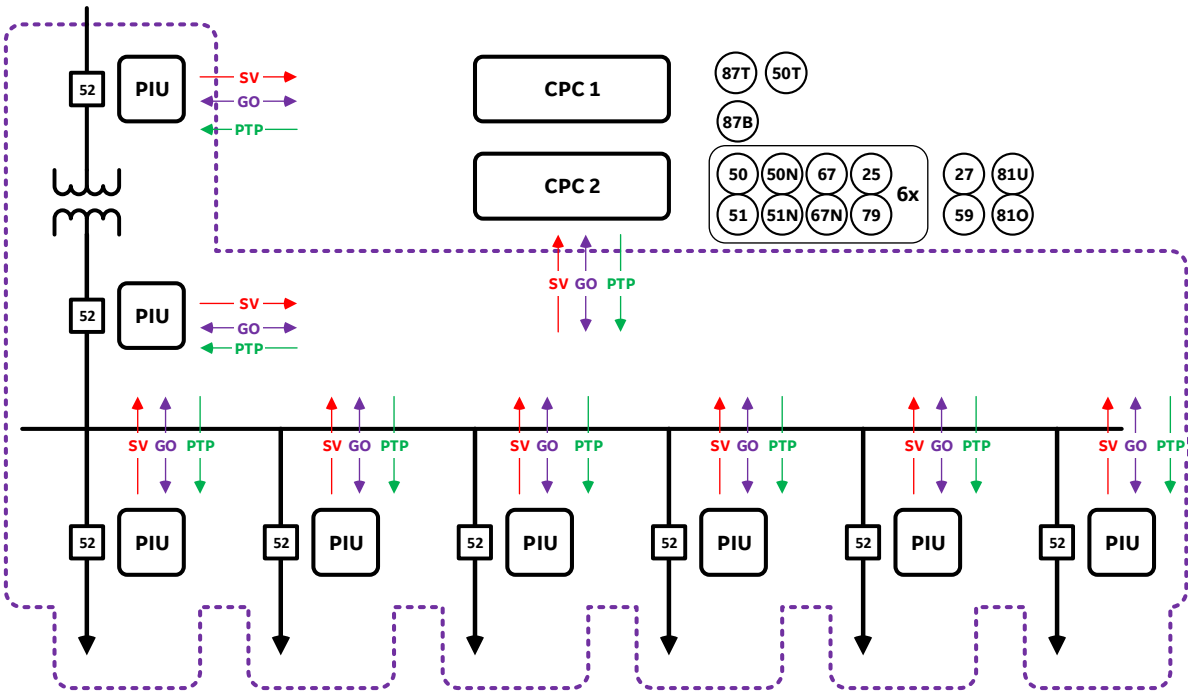


# Typical distribution

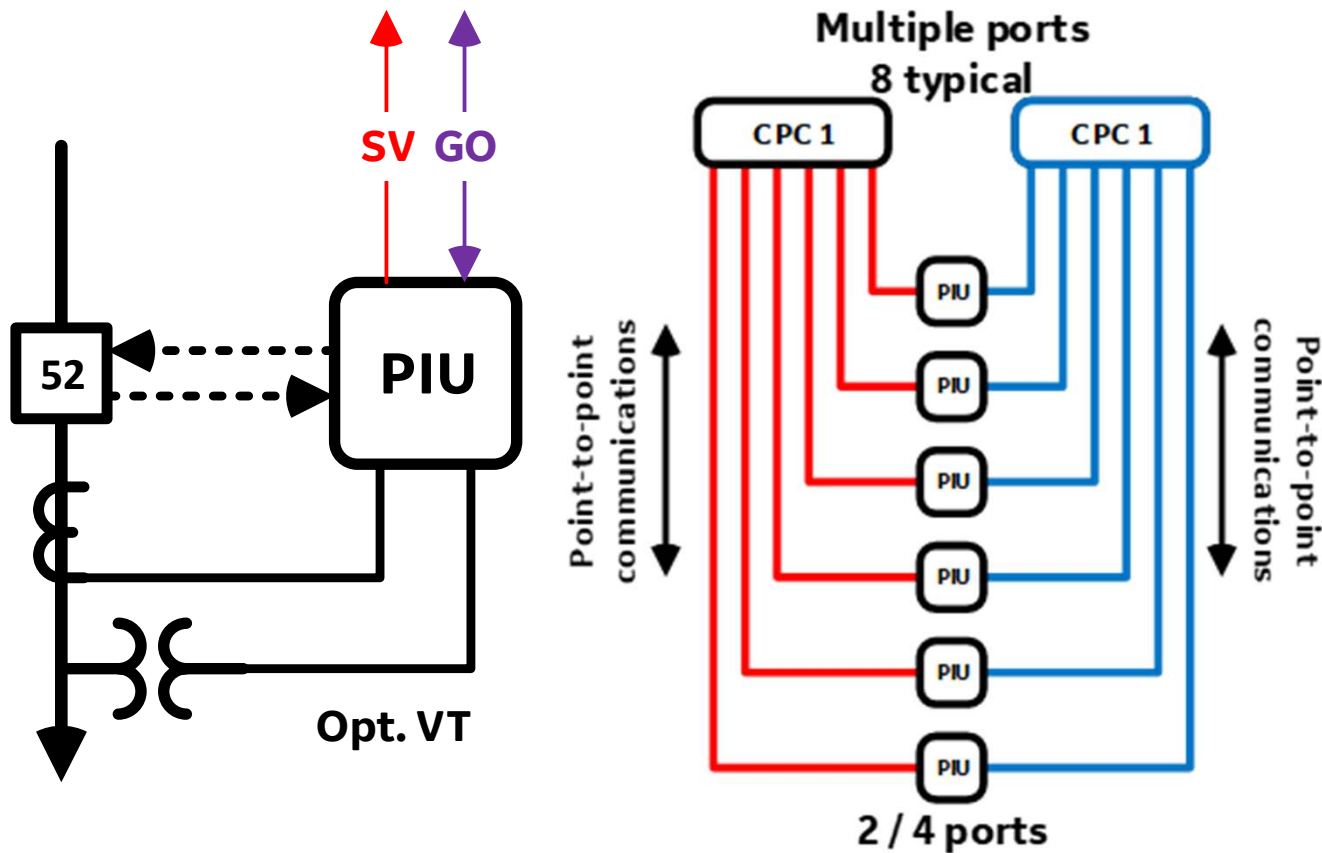
Multi-Zone Feeder Protection



CPC: Centralized Protection and Control



# Background



PIUs: all analog to digital at circuit breakers

- SV for analog measurements
- GOOSE for status and control

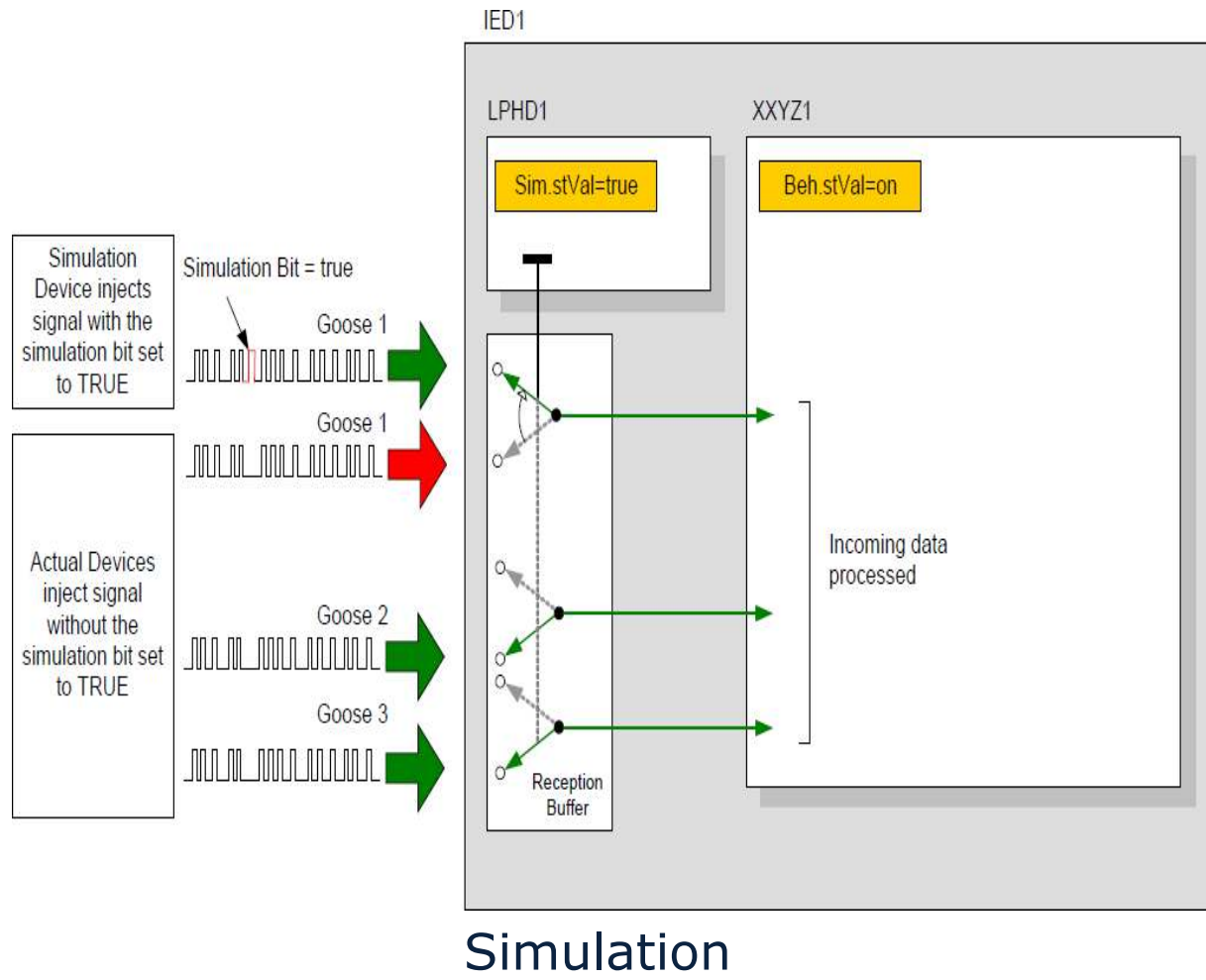
Some process bus network architecture is applied

- Beyond the scope of this paper

# Translating testing to IEC 61850

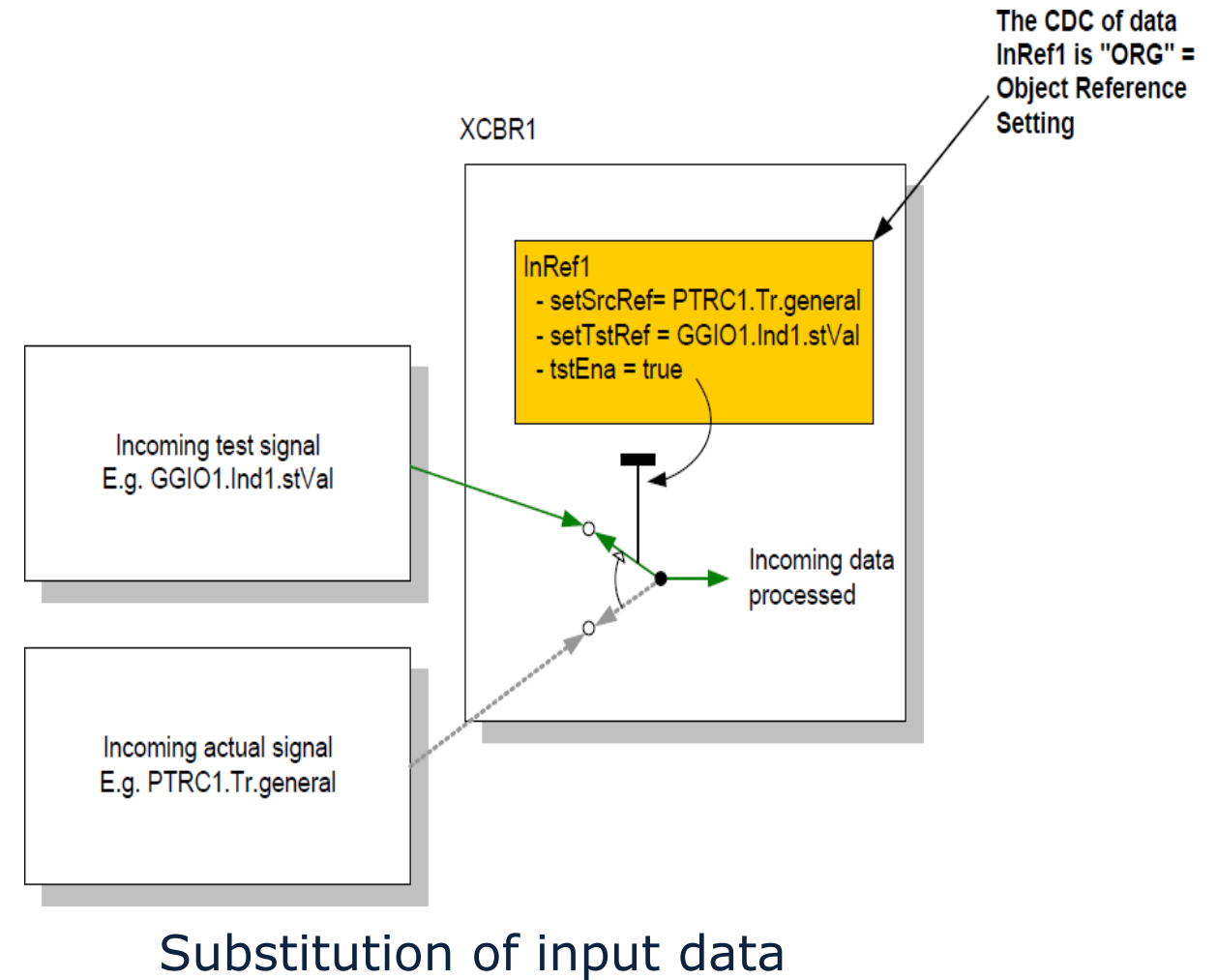
## Isolation

- TEST mode (at device, LD, LN level)



## Controlled data for testing

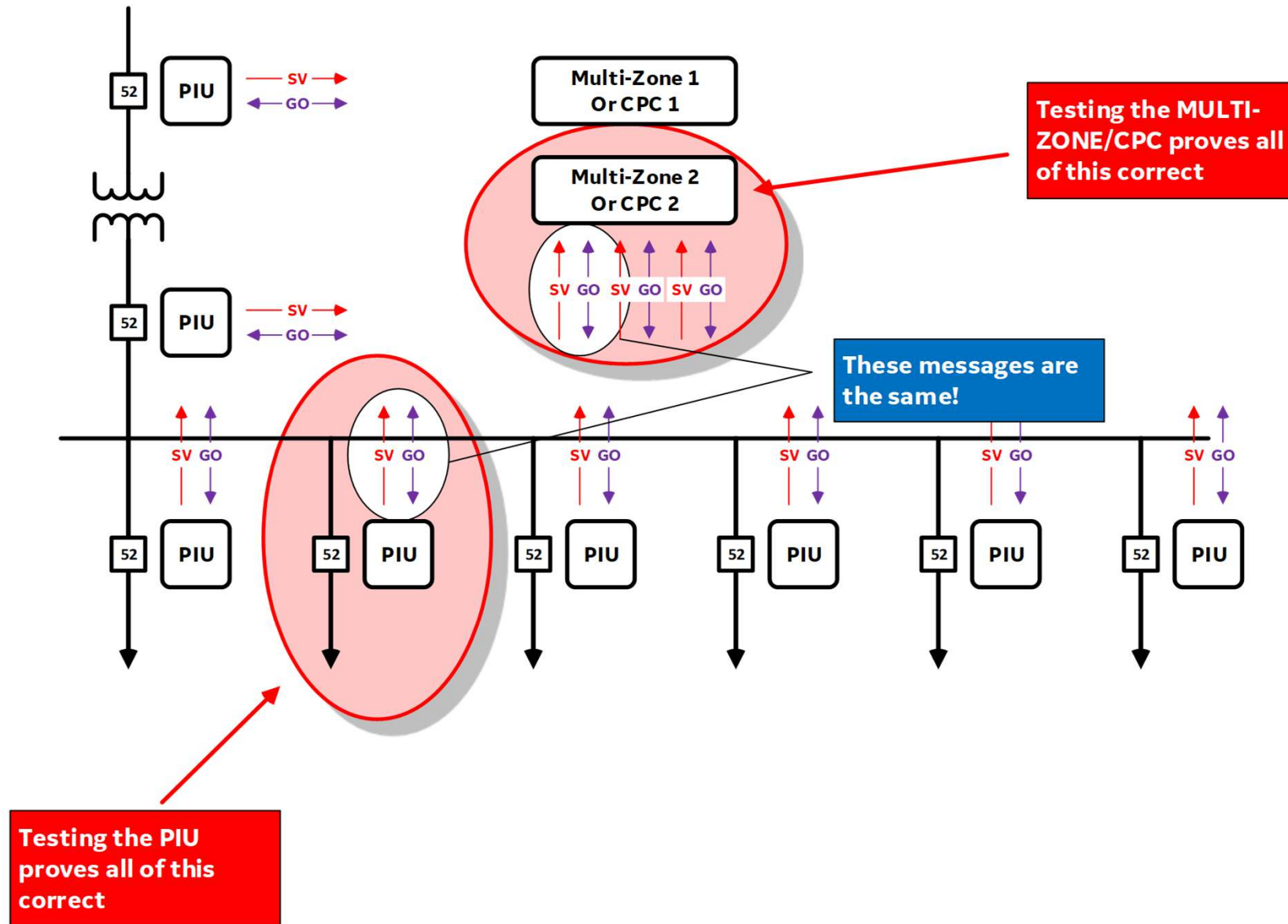
- SV, GOOSE



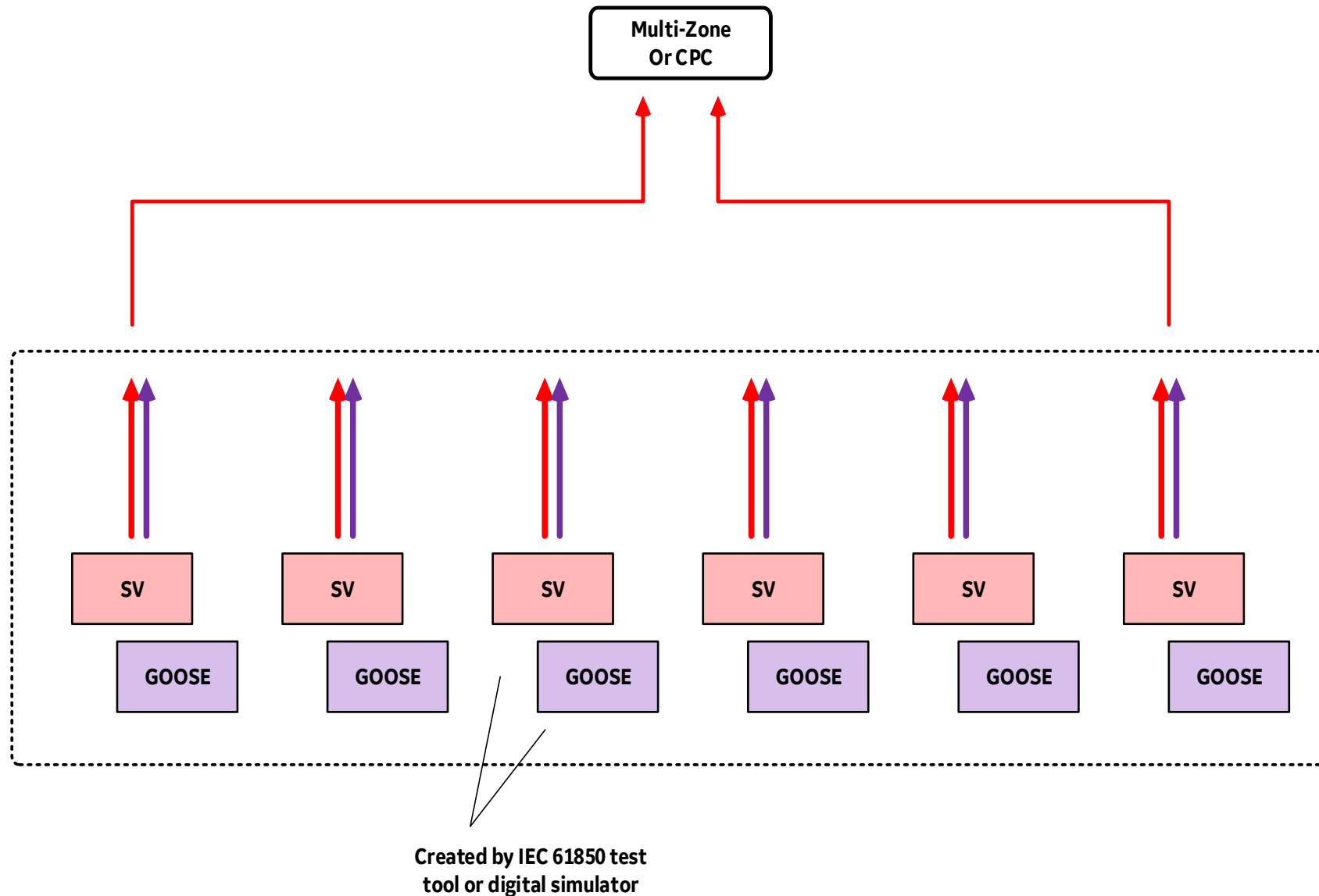
# So how do you test?

- CIGRE Technical Bulletin 760 “Test strategy for Protection, Automation and Control (PAC) functions in a fully digital substation based on IEC 61850 applications”
  - ✓ Also the latest version of IEC 61850-10
- Think:
  - Subsystems
  - FAT/lab testing
  - Redundancy of the multi-zone relay/CPC unit

# Test as subsystems

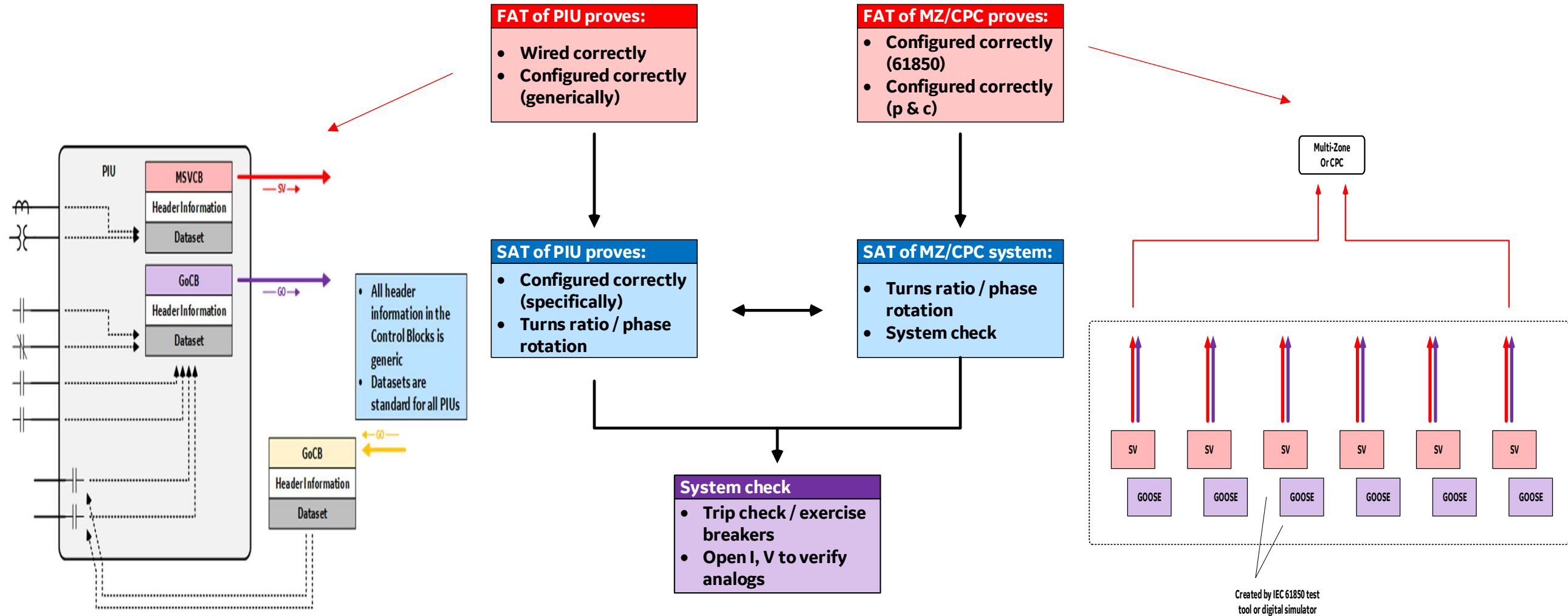


# Testing a multi-zone relay/CPC unit





# Commissioning

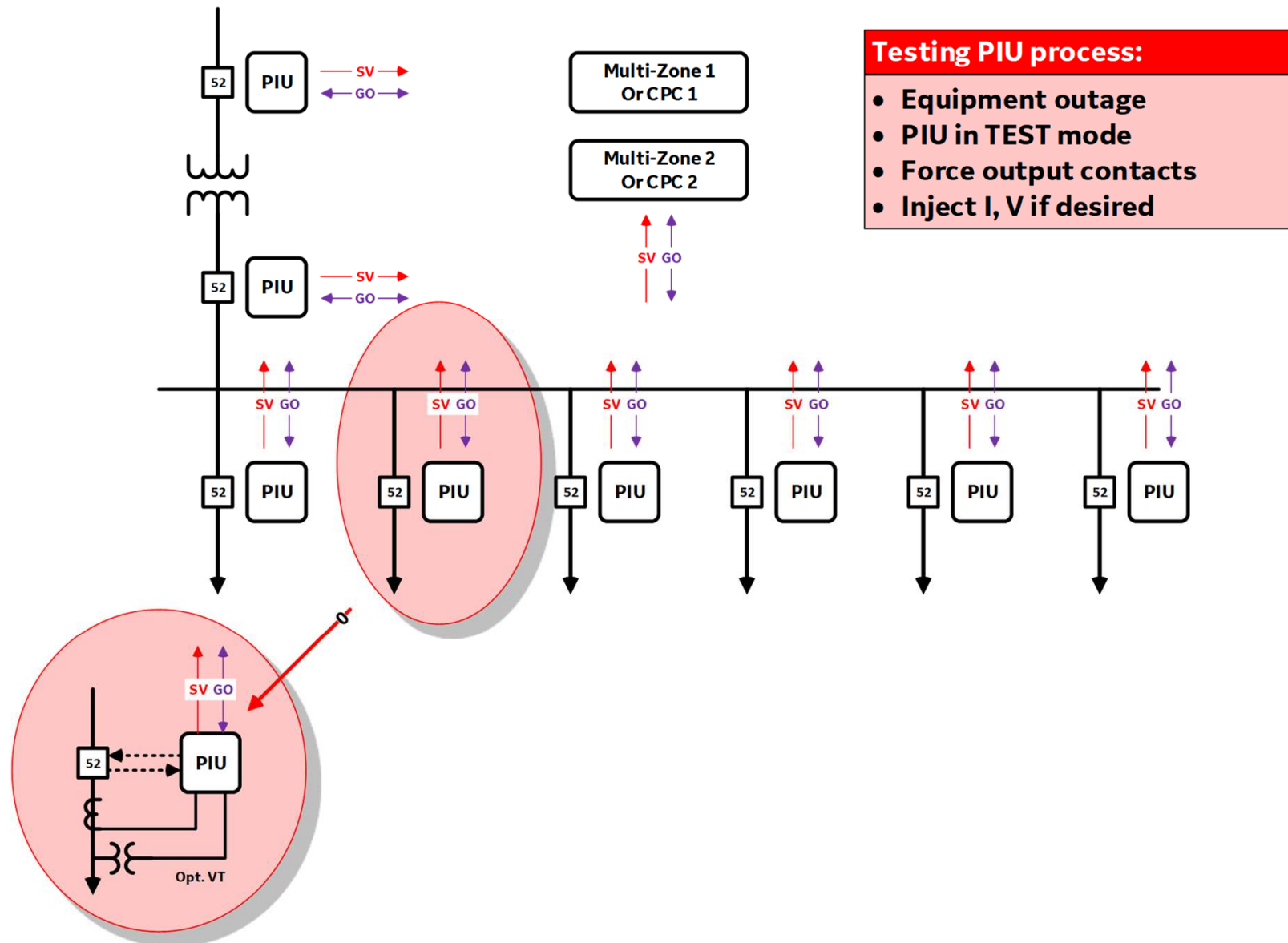




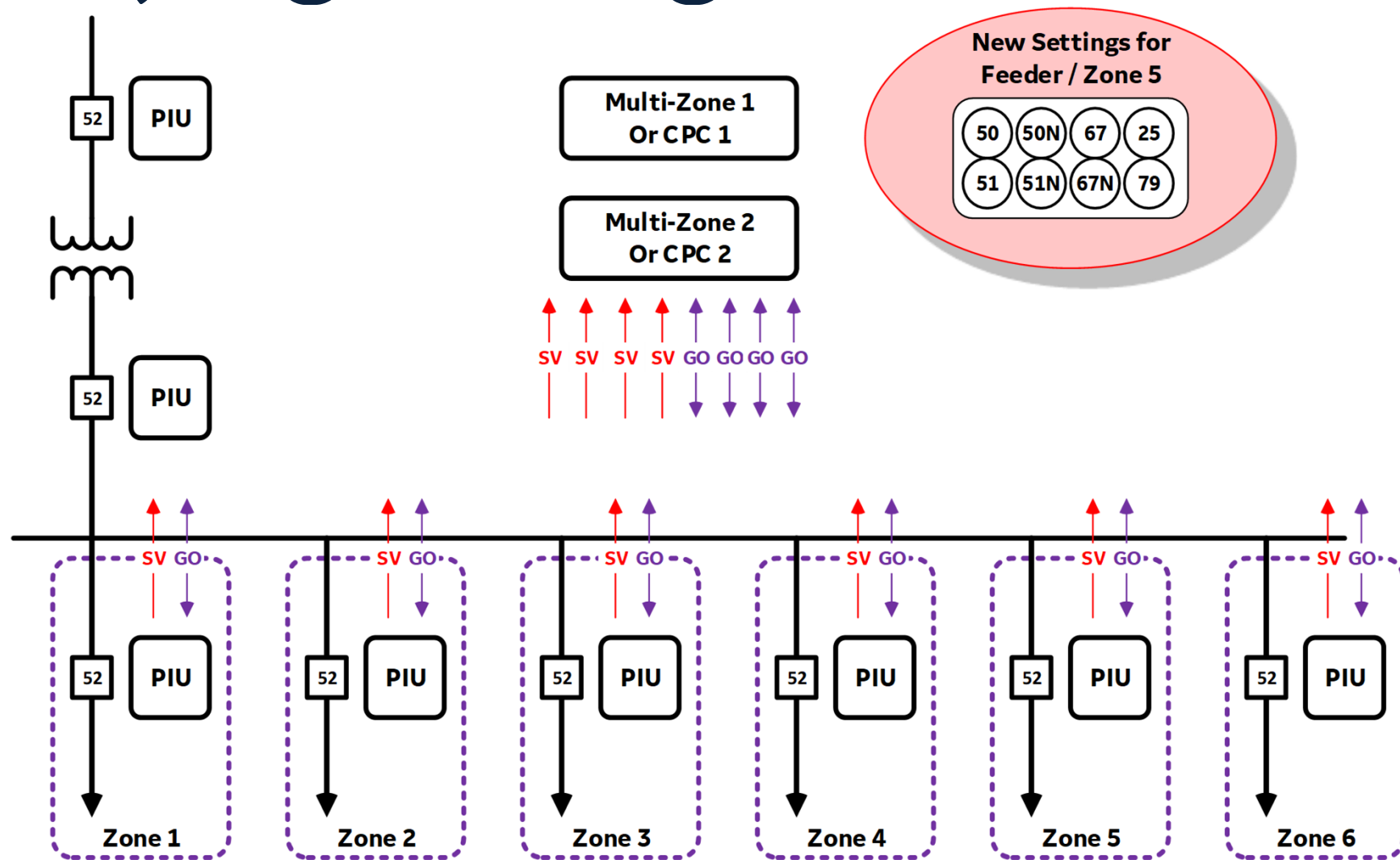
# Maintenance Testing

- Maintenance testing is limited to verifying PIU performance
  - ✓ Multi-Zone / CPC is fully digital / self-monitored
  - ✓ Must at least verify output contacts on PIU
- Multi-Zone / CPC testing only required when configuration changes
  - ✓ Example: New feeder protection settings
  - ✓ Redundancy of Multi-Zone / CPC units simplifies this testing

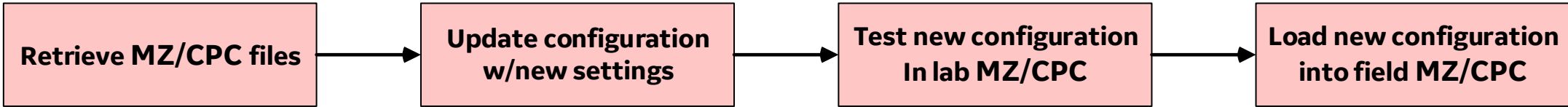
# Maintenance Testing - PIUs



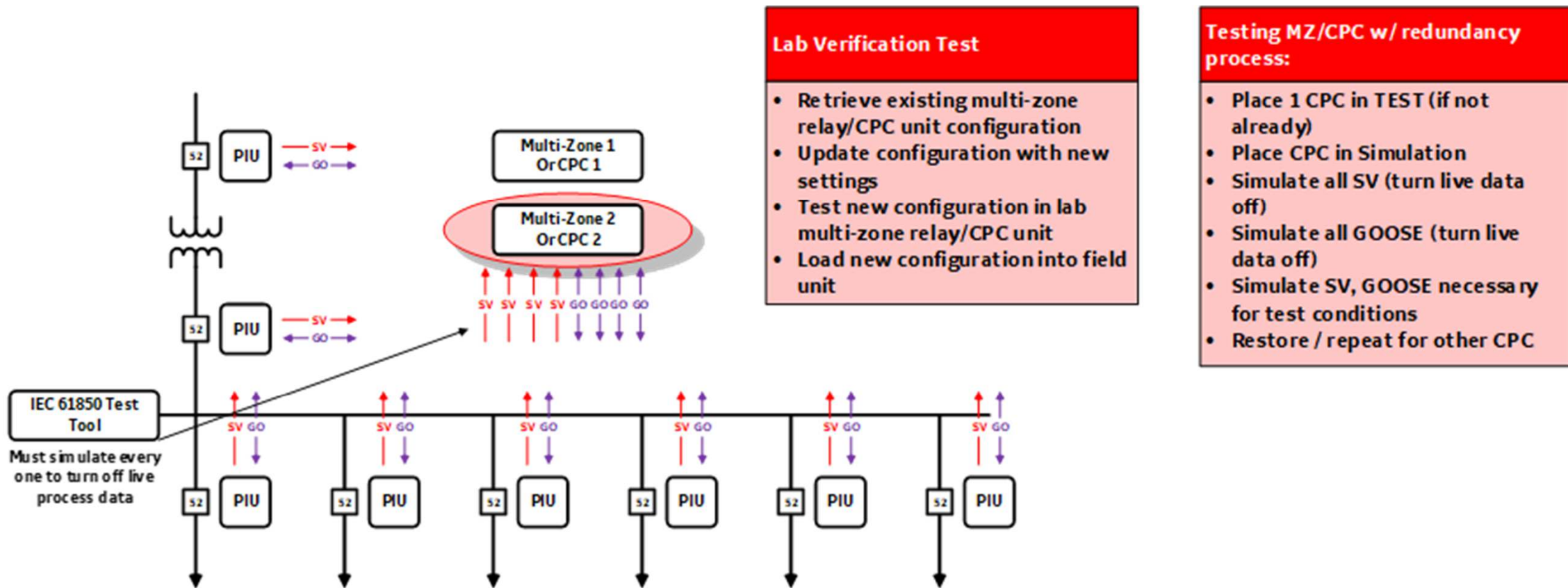
# Verifying settings



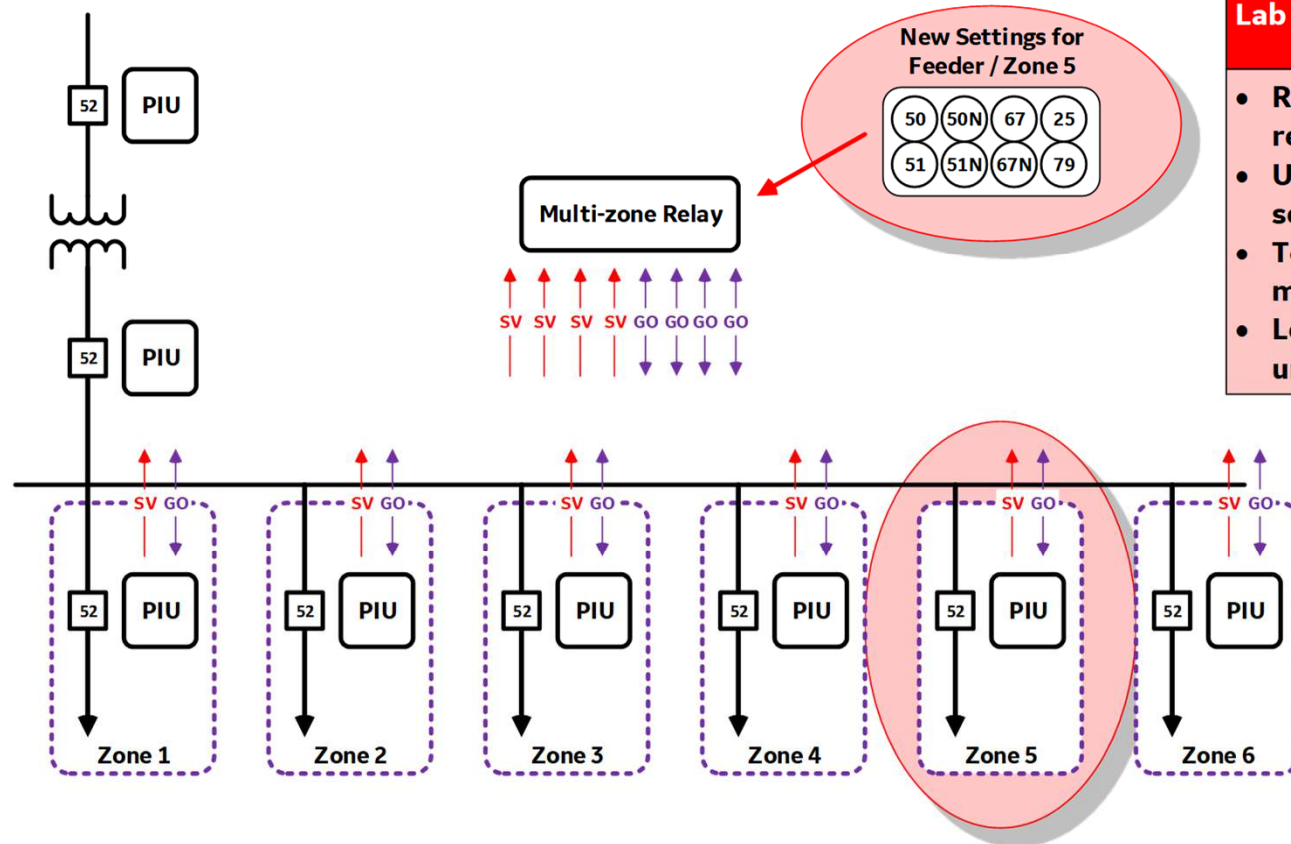
**Do this in a lab environment**



# Field test w/redundant



# Field Testing single Relay /CPC



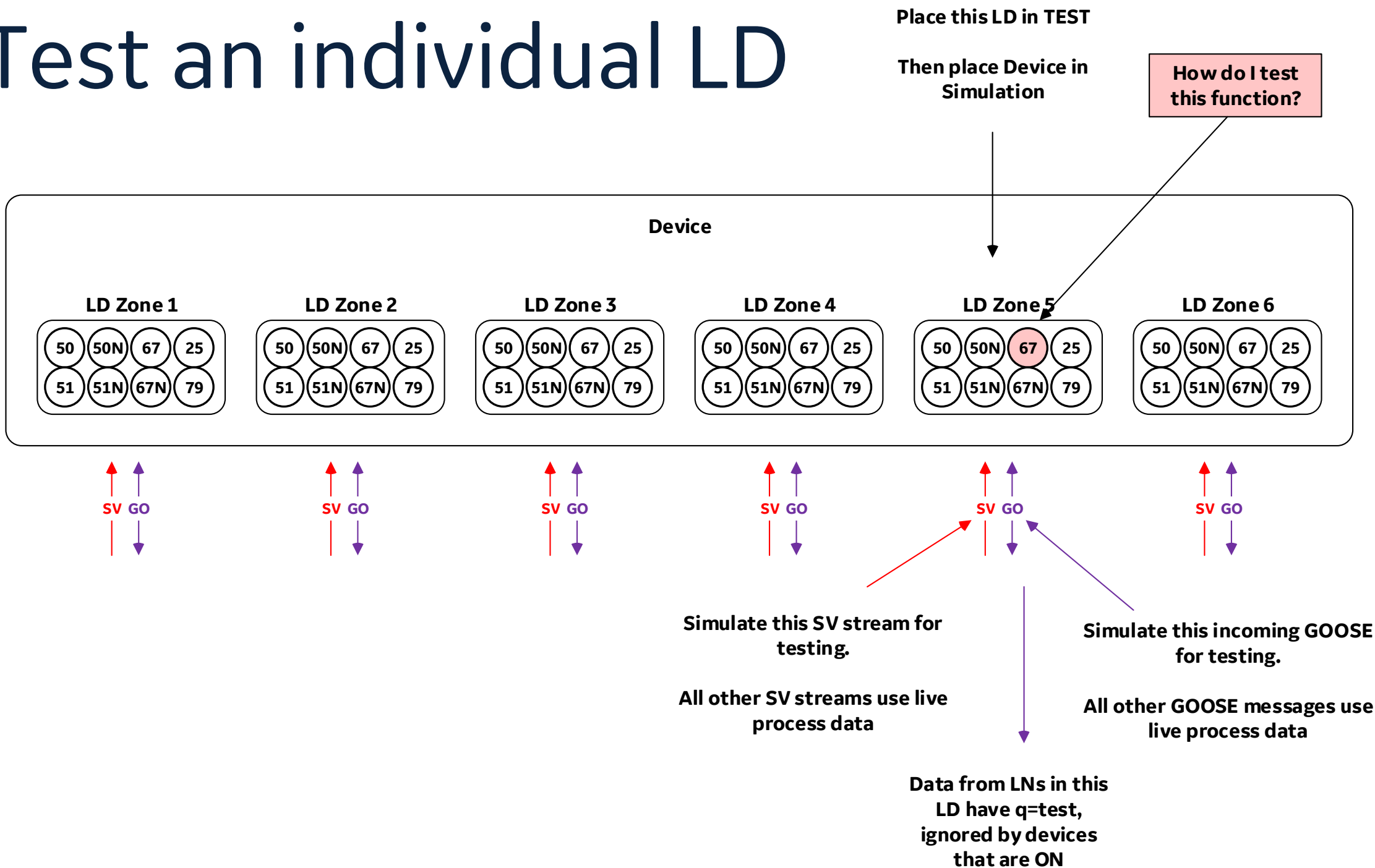
## Lab Verification Test

- Retrieve existing multi-zone relay/CPC unit configuration
- Update configuration with new settings
- Test new configuration in lab multi-zone relay/CPC unit
- Load new configuration into field unit

## Testing MZ/CPC w/o redundancy process:

- Requires equipment outage
- Place LD to test in TEST mode
- Place MZ/CPC in Simulation
- Place associated PIU in TEST mode
- Simulate SV, GOOSE necessary for test conditions
- Restore device: turn Simulation off, turn LD ON
- But....

# Test an individual LD

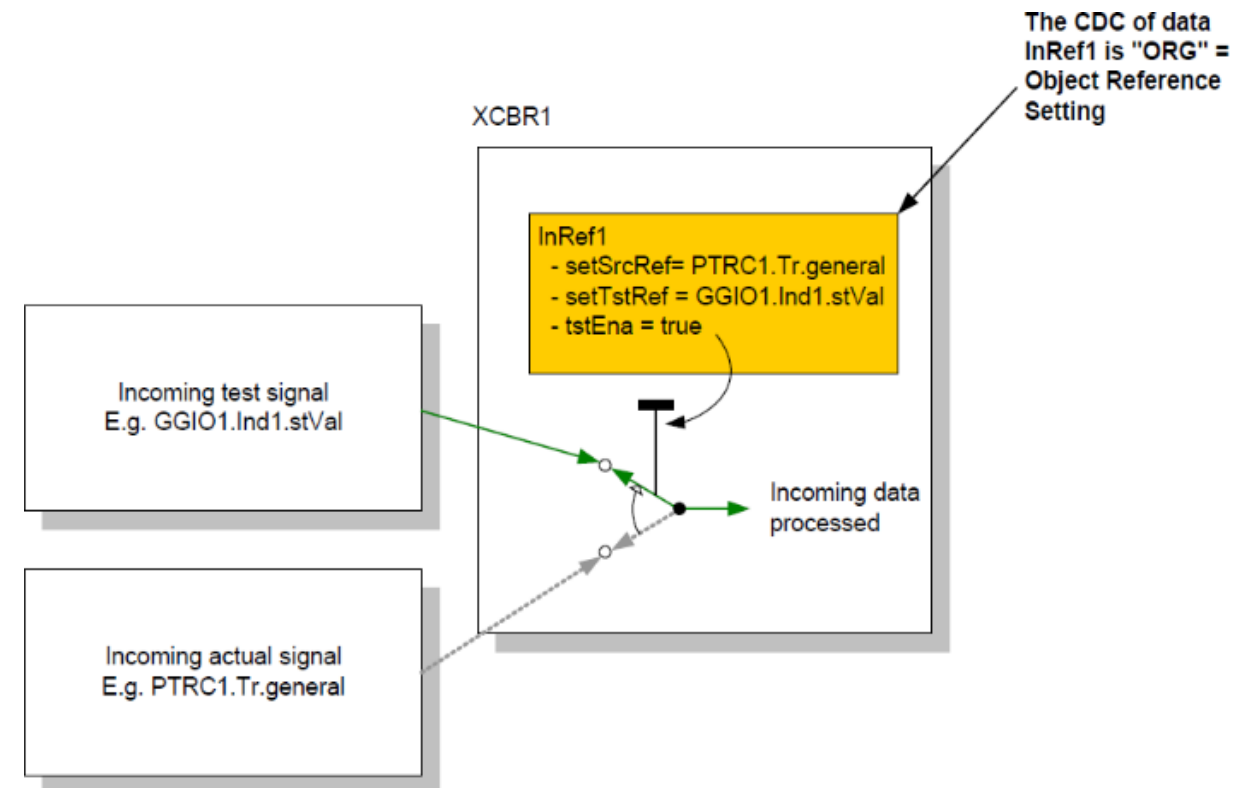


# Testing the 67 function (PTOC/RDIR)

The 61850 answer: substitution of test data

- Define setTestref attribute for every SV InRef for every LN. Every SV InRef is controllable
- Not supported in most device today

Simple solution: Redundant devices





# Conclusion

For Multi-zone / CPC:

- Test as subsystems
- FAT/lab test as much as possible
- Commissioning is better than conventional (much of the work is done during FAT)
- Redundancy of Multi-Zone / CPC units simplifies testing

Thanks for the time

