

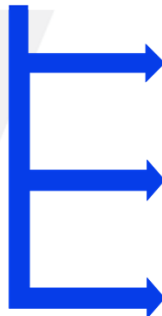


IEC 61850 Standard Reference IEC Committees for relay protection applications

Andrea Bonetti

TC 57 Power systems management and associated information exchange

Scope [Structure](#) [Projects / Publications](#) [Documents](#) [Votes](#) [Meetings](#) [Collaboration Tools](#)



TC 38 Instrument transformers

Scope [Structure](#) [Projects / Publications](#) [Documents](#) [Votes](#) [Meetings](#) [Collaboration Tools](#)

TC 95 Measuring relays and protection equipment

Scope [Structure](#) [Projects / Publications](#) [Documents](#) [Votes](#) [Meetings](#) [Collaboration Tools](#)

TC 17 High-voltage switchgear and controlgear

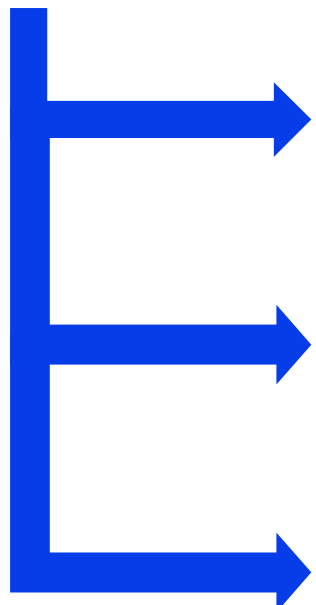
Scope [Structure](#) [Projects / Publications](#) [Documents](#) [Votes](#) [Meetings](#) [Collaboration Tools](#)

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RELEVANT IEC COMMITTEES FOR IEC 61850 SA APPLICATIONS

TC 57 Power systems management and associated information exchange

Scope Structure Projects / Publications Documents Votes Meetings Collaboration Tools



TC 38 Instrument transformers

Scope Structure Projects / Publications Documents Votes Meetings Collaboration Tools

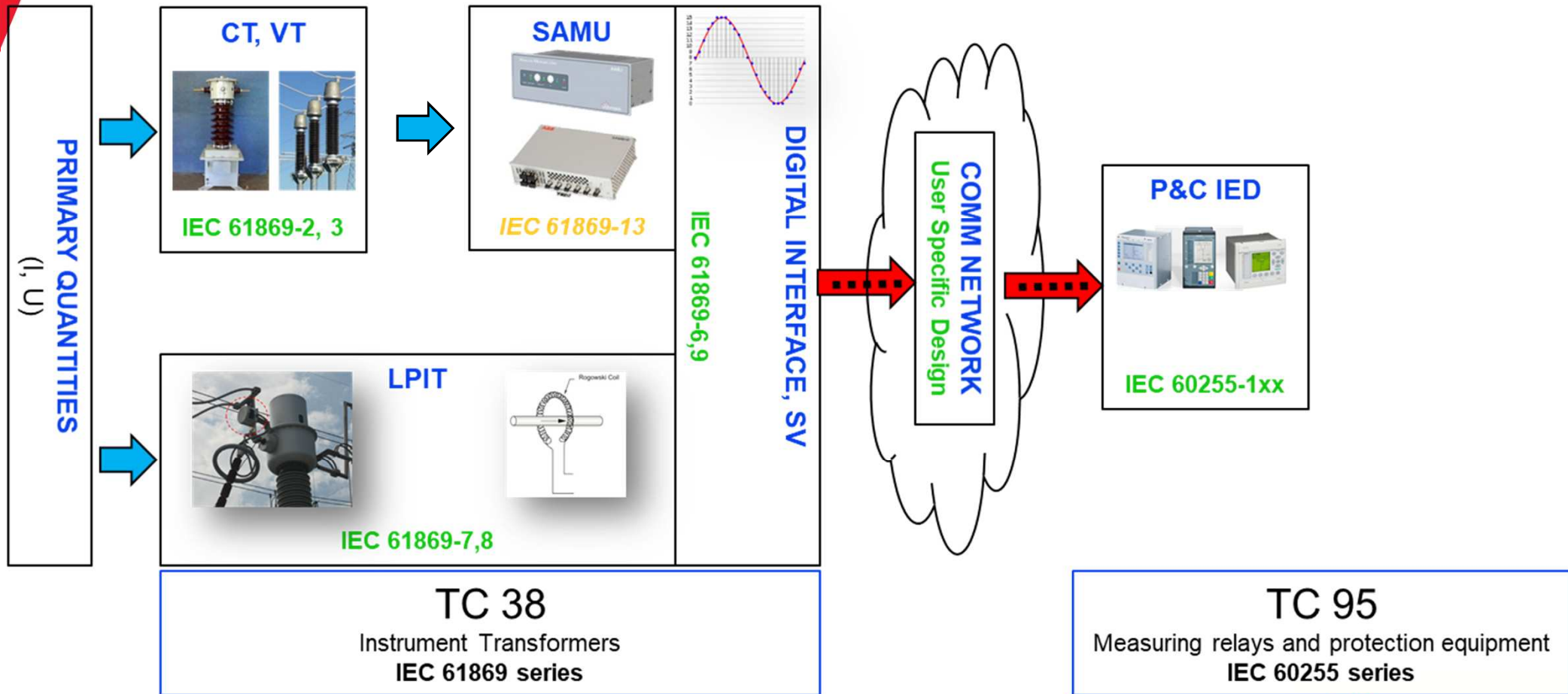
TC 95 Measuring relays and protection equipment

Scope Structure Projects / Publications Documents Votes Meetings Collaboration Tools

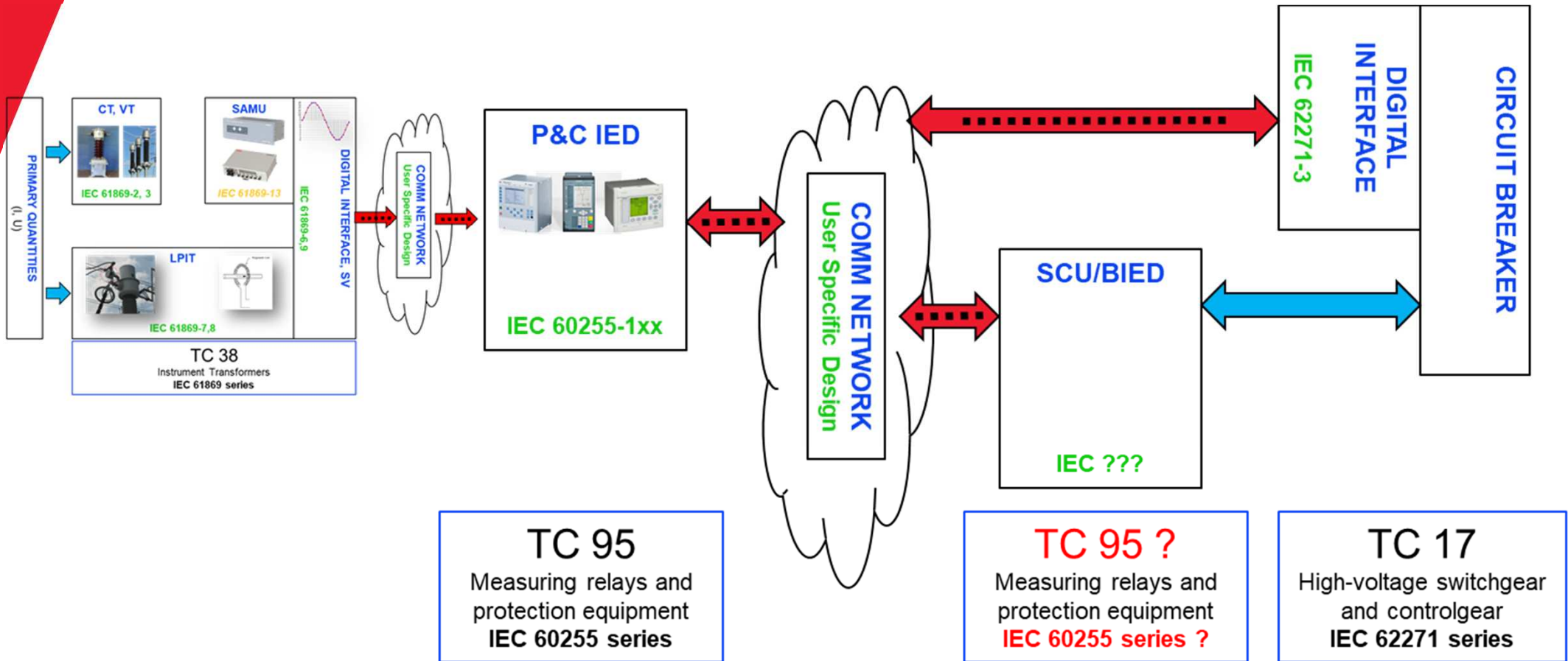
TC 17 High-voltage switchgear and controlgear

Scope Structure Projects / Publications Documents Votes Meetings Collaboration Tools

The "IEC Protection System"

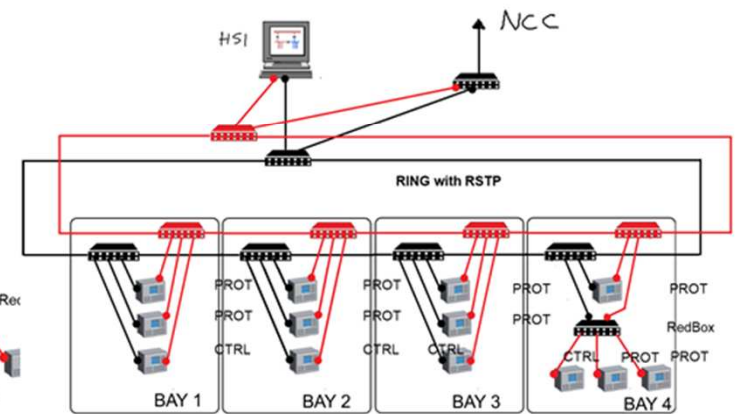
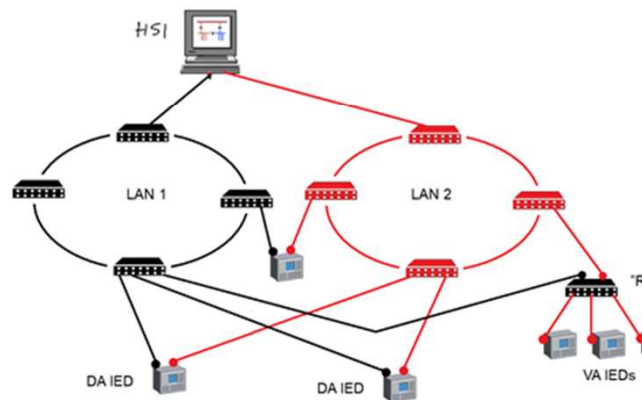
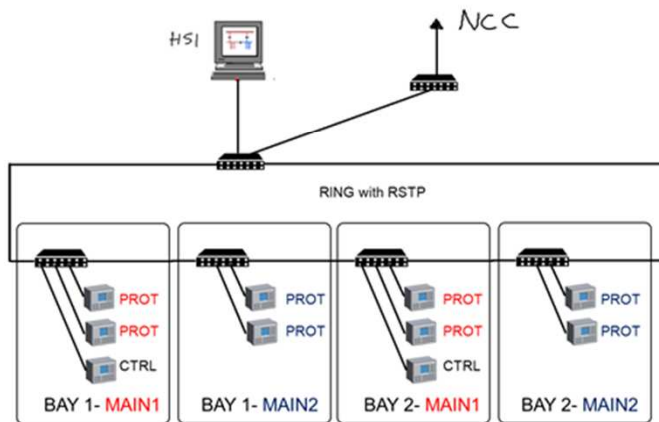


The "IEC Protection System"



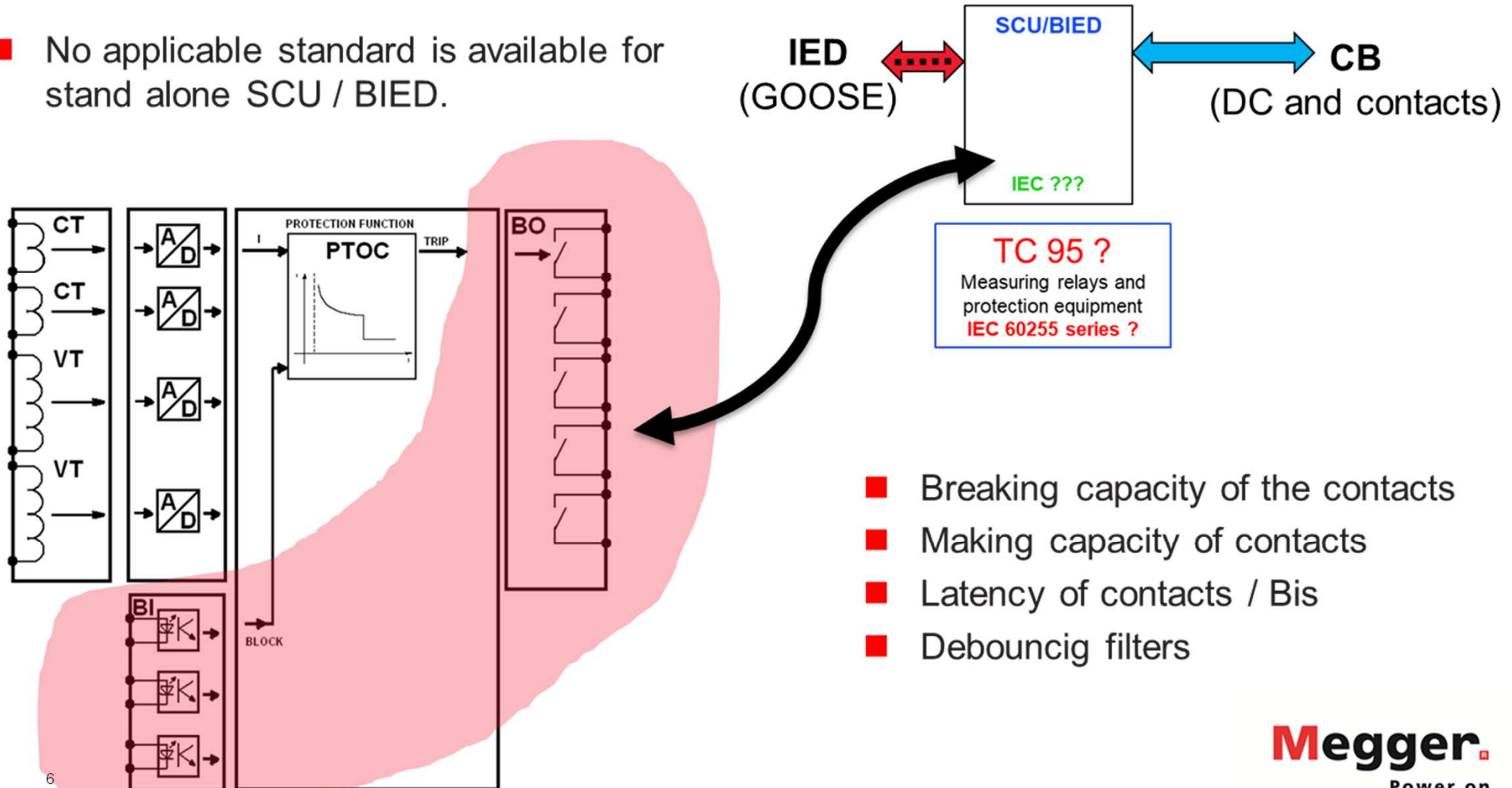
The Communication Network

- Only partially covered by IEC 61850 standards: technical reports, guidelines, best practices
- No general statements over performances are possible as they are very much depending on the application
- Responsibility is on the user/ system integrator (customer requirements, engineering solutions)



SCU / BIED Binary Inputs and Outputs Interface

- No applicable standard is available for stand alone SCU / BIED.



- Breaking capacity of the contacts
- Making capacity of contacts
- Latency of contacts / Bis
- Debouncig filters

TC 38 and IEC 61869 Series

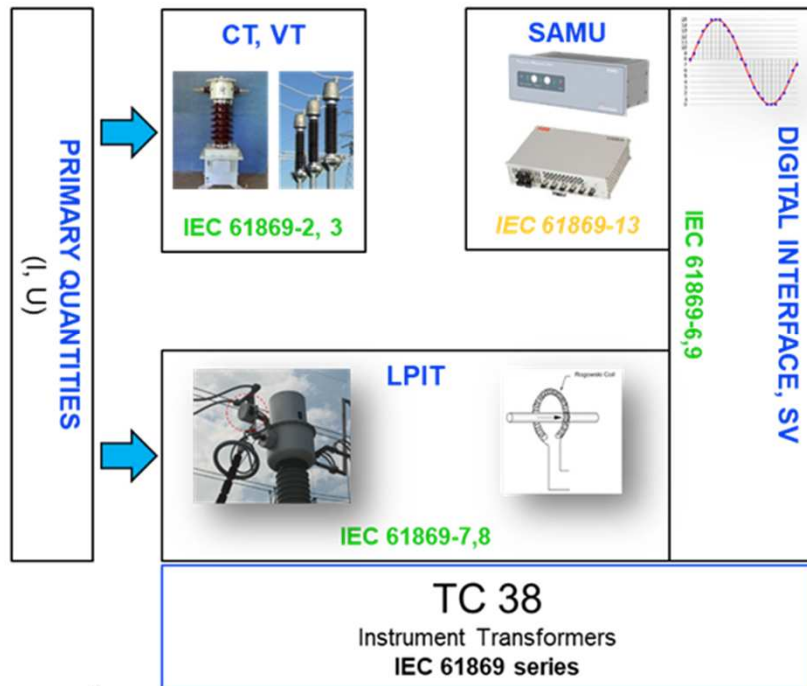
IEC Committee TC 38 M

Definition of CTs and VTs

Definition of SV protocols
("profiles" from IEC 61850 standard)

Definition of Transient Performances of Merging Units
(LPIT, SAMU..)

Project number Numéro de projet	IEC 61869-9 Ed.1.0
IEC/TC or SC: 38 CEI/CE ou SC:	Secretariat / Secrétariat Italy



TC 38 and IEC 61869 Series

IEC 61869-9: Instrument Transformers - Part 9: Digital interface for instrument transformers

**Approved
May 2016**

Project number Numéro de projet	IEC 61869-9 Ed.1.0
IEC/TC or SC: 38 CEI/CE ou SC:	Secretariat / Secrétariat Italy

6.903.3 Digital Output Sample Rates

The standard sample rates (f in the variant notation) are as follows:

Table 901 – Standard sample rates

	Digital output sample rates [Hz]	Number of ASDUs per frame	Digital output publishing rate [frames/s]	Notes
"LE" - PROT	4 000	1 or 2	4 000 or 2 000	Legacy, for use on 50 Hz systems.
	4 800	1	4 800	Legacy, for use on 60 Hz systems, or 50 Hz systems with 96 samples per nominal system frequency cycle
"LE" - PQ	4 800	2	2 400	Preferred rate for general measuring and protective accuracy classes, regardless of the power system frequency
	5 760	1 or 2	5 760 or 2 880	Legacy, for applications on 60 Hz systems with 96 samples per nominal system frequency cycle
"LE" - PQ	12 800	8	1 600	Deprecated, only for use on 50 Hz systems
	14 400	6	2 400	Preferred rate for quality metering accuracy class, regardless of the power system frequency
"LE" - PQ	15 360	8	1 920	Deprecated, only for use on 60 Hz systems
	96 000	1	96 000	Preferred rate for DC instrument transformer applications

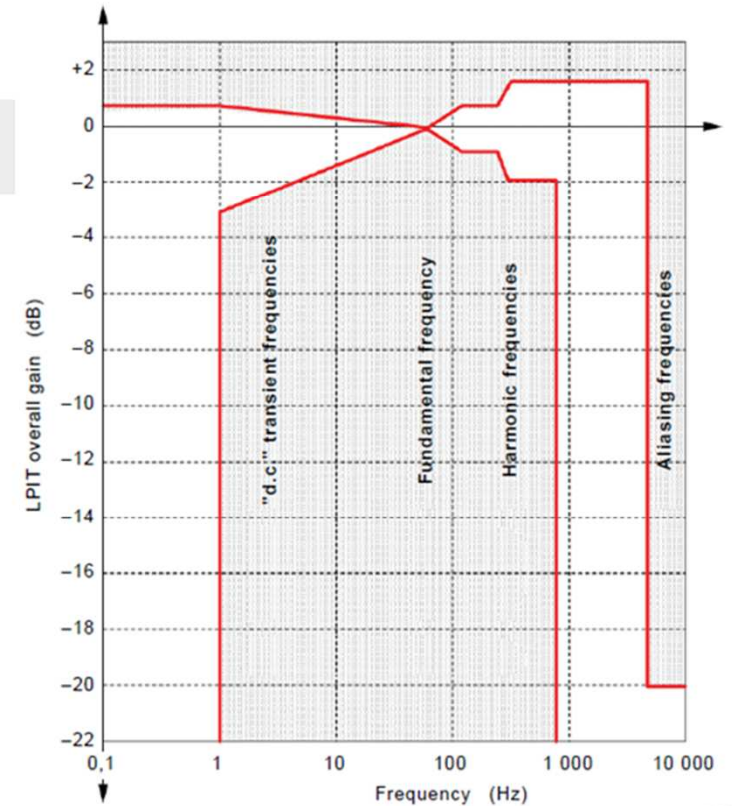
TC 38 and IEC 61869 Series

IEC 61869-6

Edition 1.0 2016-04

Instrument transformers – Part 6: Additional general requirements for low-power instrument transformers

- Defines the transient response (transfer function) of LPIT / Merging Units.
NOT for SAMU! (**IEC 61869-13, not released yet, 2018**)
- Defines the requirements for **ratio error and phase error** in case of harmonics and sub harmonics for protective purposes.



TC 38 and IEC 61869 Series

IEC 61869-6:2016

Instrument transformers - Part 6: Additional general requirements for low-power instrument transformers

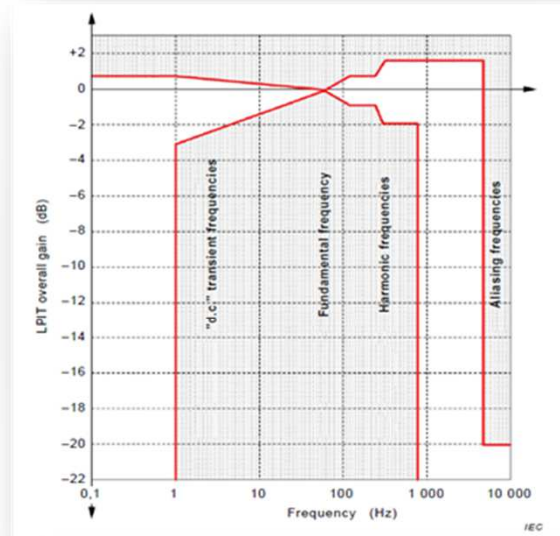
TC 38 | [Additional information](#)

TC 38 Instrument transformers

IEC 61869-9:2016

Instrument transformers - Part 9: Digital interface for instrument transformers

TC 38 | [Additional information](#)



Digital output sample rates Hz	Number of ASDUs per frame	Digital output publishing rate frames	Remarks
4 000	1	4 000	For use on 50 Hz systems backward compatible with 9-2LE guideline.
4 800	1	4 800	For use on 60 Hz systems backward compatible with 9-2LE guideline, or 50 Hz systems backward compatible with 96 samples per nominal system frequency cycle.
4 800	2	2 400	Preferred rate for general measuring and protective applications, regardless of the power system frequency.
5 760	1	5 760	For applications on 60 Hz systems backward compatible with 96 samples per nominal system frequency cycle.
12 800	8	1 600	Deprecated, only for use on 50 Hz systems.
14 400	6	2 400	Preferred rate for quality metering applications, regardless of the power system frequency including instrument transformers for time critical low bandwidth d.c. control applications.
15 360	8	1 920	Deprecated, only for use on 60 Hz systems.
96 000	1	96 000	Preferred rate for instrument transformers for high bandwidth d.c. control applications.

Protection Applications
according to AHG3
Nov 2017

TC 17 and IEC 62217 Series

TC 17 High-voltage switchgear and controlgear

Scope Structure Projects / Publications Documents Votes Meetings Collaboration Tools

IEC 62271-3:2015

High-voltage switchgear and controlgear - Part 3: Digital interfaces based on IEC 61850

TC 17 | [Additional information](#)

- IEC 61850 modelling (LNs) for XCBR, XSWI
- Timing requirements
- Restrictions for GOOSE
- Communication access points

TC 95 and IEC 60255 Series

- Relay standard is under the series IEC 60255-1xx

 **IEC 60255-121:2014**
Edition 1.0 (2014-03-07)
Measuring relays and protection equipment - Part 121: Functional requirements for distance protection

 **IEC 60255-127:2010**
Edition 1.0 (2010-04-27)
Measuring relays and protection equipment - Part 127: Functional requirements for over/under voltage protection

 **IEC 60255-149:2013**
Edition 1.0 (2013-07-30)
Measuring relays and protection equipment - Part 149: Functional requirements for thermal electrical relays

IEC Committee TC 95 MT4 

Definition of relay performances

Standardized tests to assess relay performance

Standardized methods to report the results

Minimum requirements for type testing

Mandatory manufacturer declaration of CT dimensioning formulae

Consider impact of IEC 61850 on relay behavior

TC 95, IEC 60255 Series and IEC 61850

What IEC 60255-1xx series covers about IEC 61850:

- The Operate Time shall be declared with “contact” and with “IEC 61850 GOOSE”

– 74 –

60255-121/FDIS © IEC

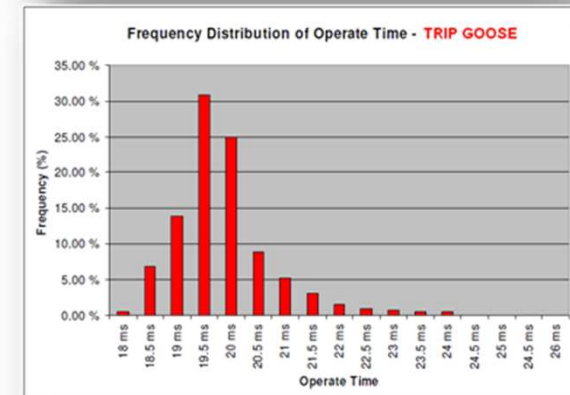
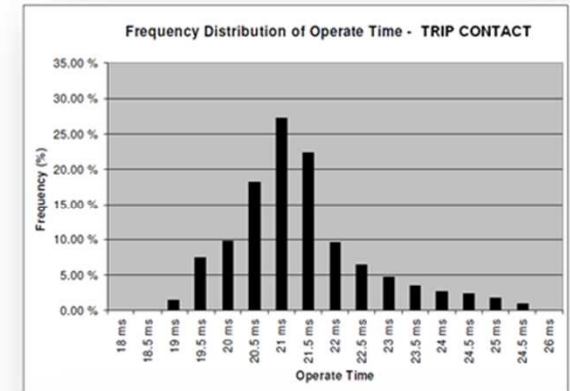
6.3.5.4 Reporting of typical operate times

The manufacturer shall report the histograms and the calculated mode, median and mean, when stating the typical operate time of the distance protection function.

The typical operate times shall be published for the selected frequency and selected rated current of the protection relay.

Operate media (trip media)

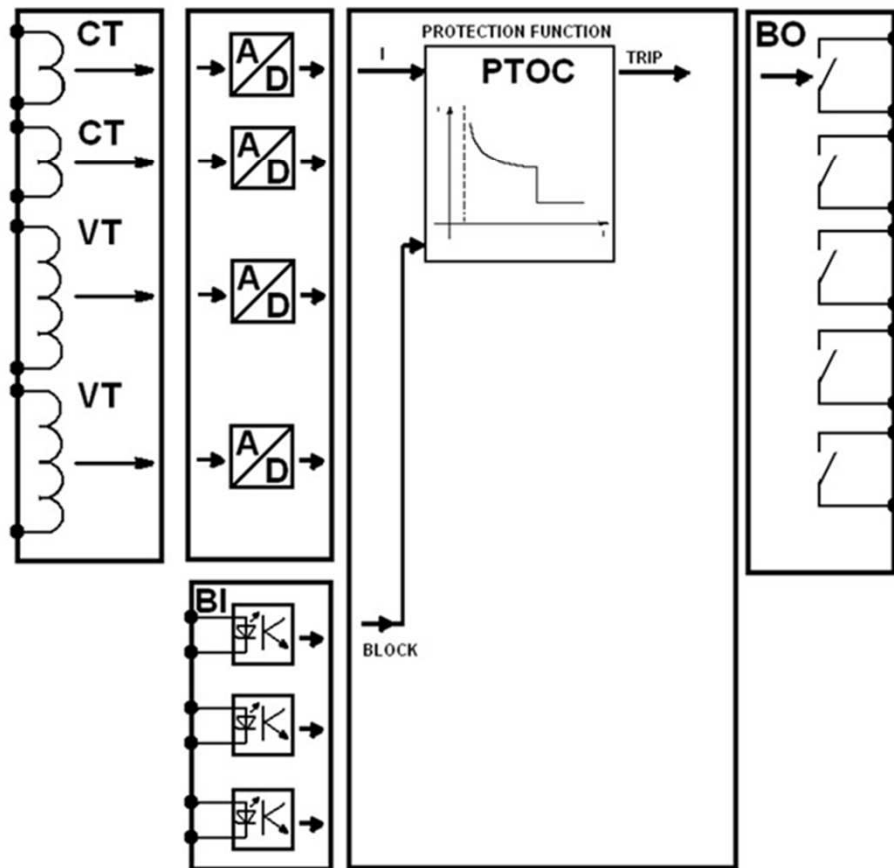
The manufacturer shall declare with which output the operate time has been measured (trip binary output contact, or solid state output, or GOOSE message of the IEC 61850 series). If the relay can provide different output media, then the manufacturer shall declare how the SIR diagrams are affected.



TC 95, IEC 60255 Series and IEC 61850

What is the principle of the testing in **today's** 60255-1xx series?

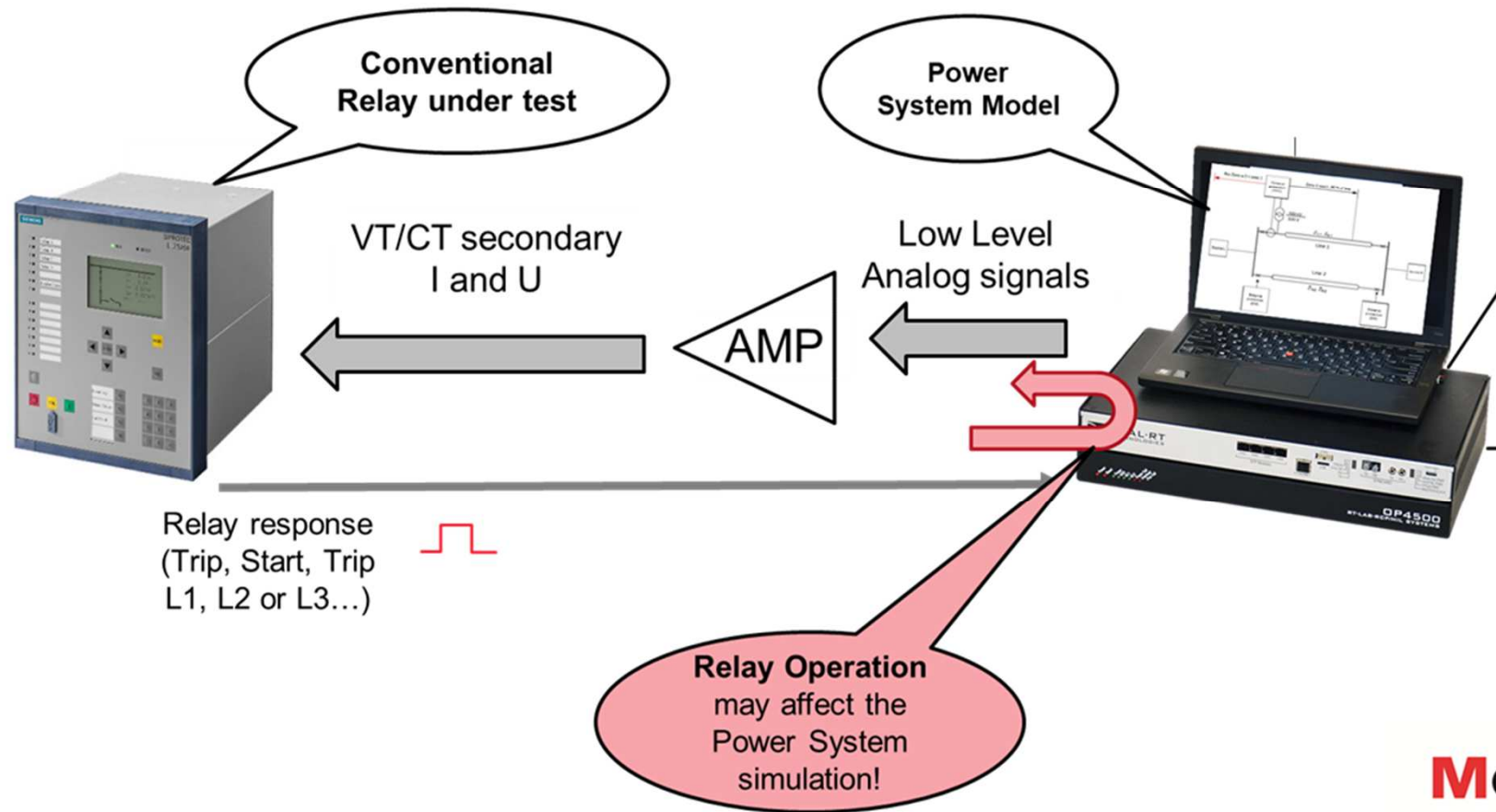
- The tests are mainly referred to this generic representation of the protection relay:



- The tests described are made for **applications when conventional current transformers** are directly connected to the protection relay. **For process bus applications**, these tests should be adapted by mutual agreement of all of the parties involved.

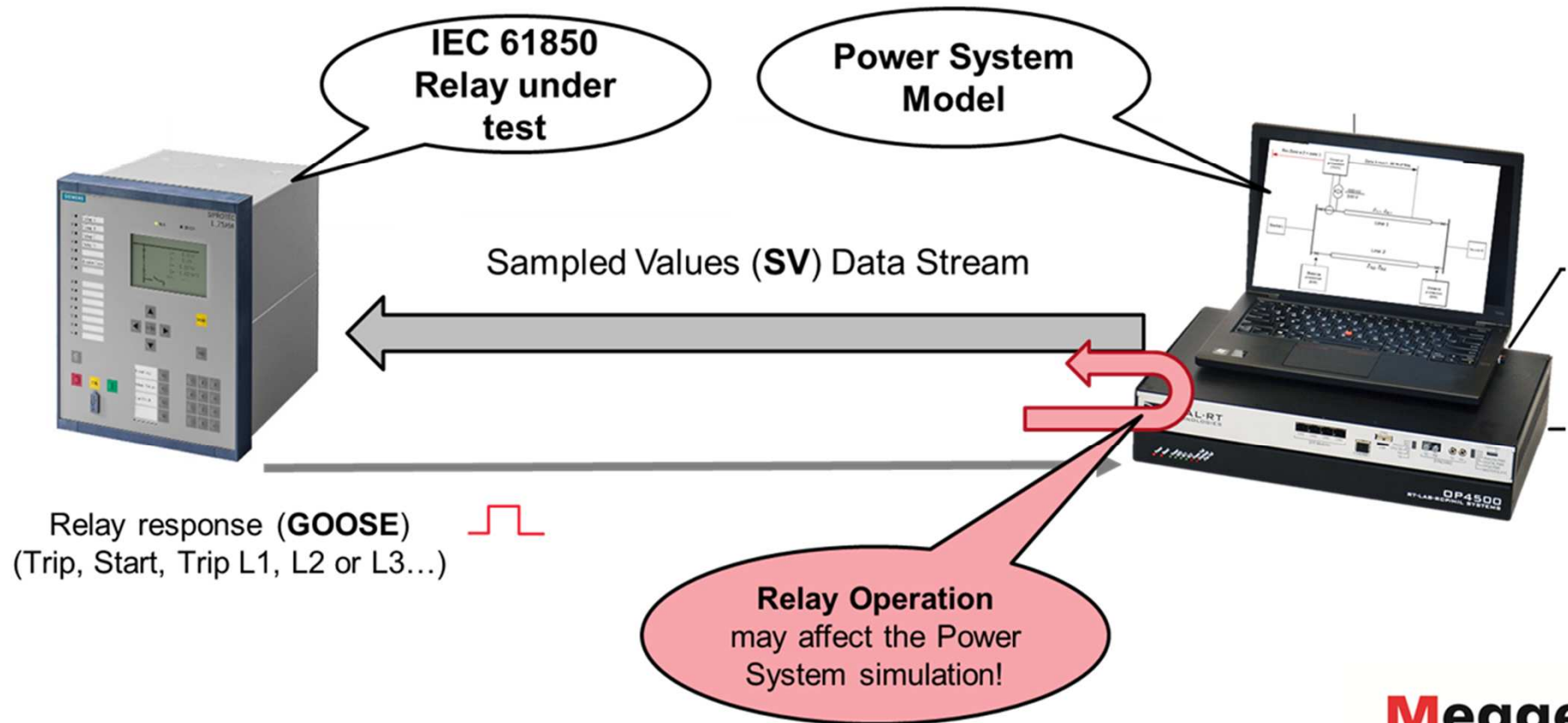
TC 95, IEC 60255 Series and IEC 61850

What is the principle of the testing in today's 60255-1xx series?



TC 95, IEC 60255 Series and IEC 61850

How would it be done with IEC 61850?



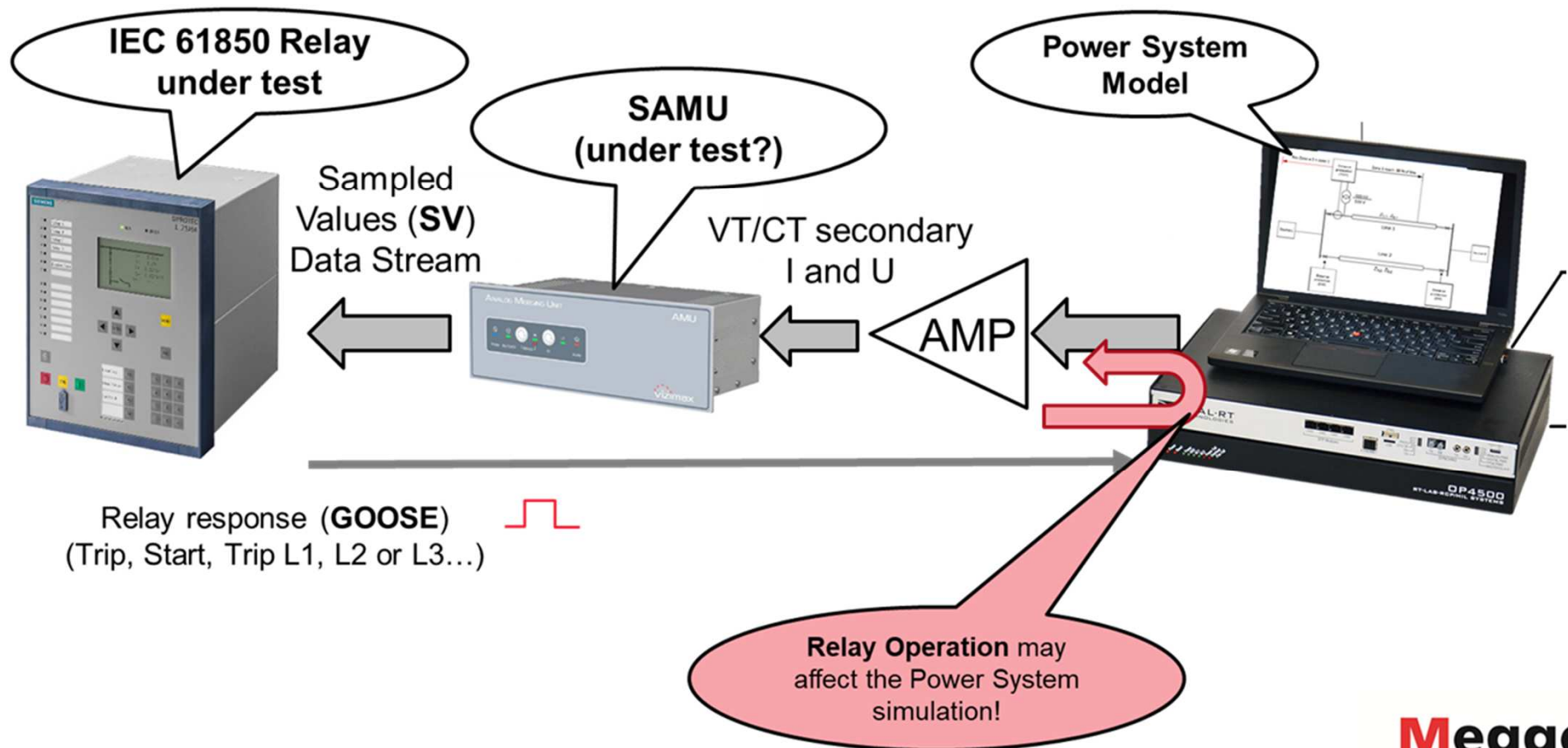
Relay response (GOOSE)
(Trip, Start, Trip L1, L2 or L3...)



Relay Operation
may affect the Power
System simulation!

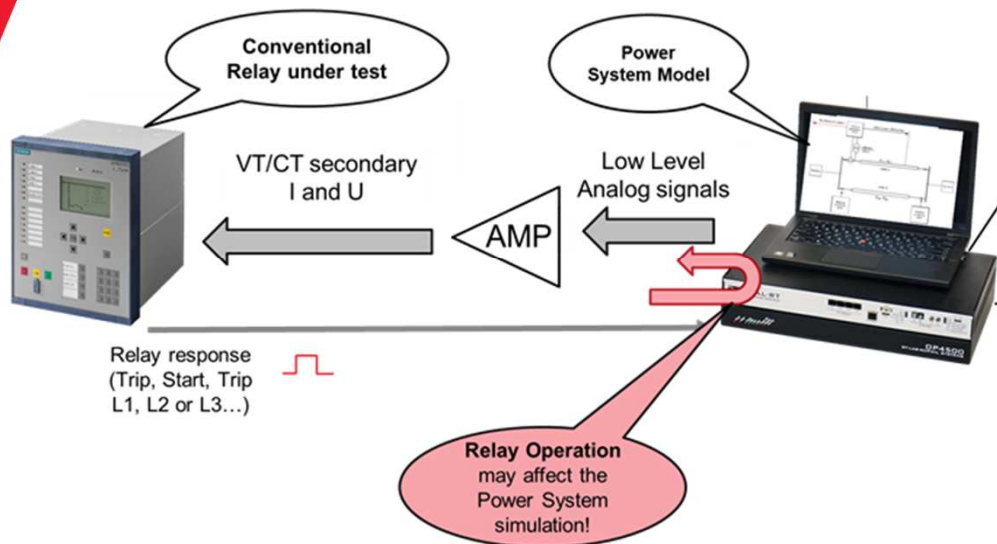
TC 95, IEC 60255 Series and IEC 61850

How would it be done with IEC 61850?



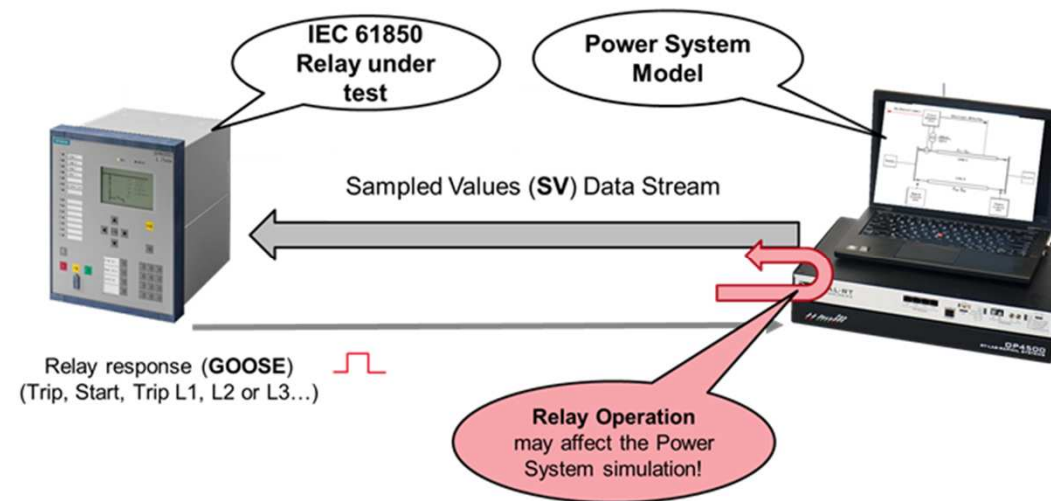
TC 95, IEC 60255 Series and IEC 61850

Are we testing the same thing?



All the A/D conversion chain of the relay is included in the test.

CT/VT behavior is simulated in the Power System Simulator. We have reasonable models for them.



The "A/D conversion chain" is in the MU that **must be simulated in the Power System Simulator!**

Models for MUs to be created.

TC 95, IEC 60255 Series and IEC 61850

CT Requirements in IEC 60255-1xx series

- The 60255-1xx series details **how relay manufacturers shall declare the requirements for the CT sizing**
- Users are **able to verify that the used CTs are ok** for the given application, or are able to size them in the initial project phase (from IEC 60255-121).

$$E_{alreq} = \frac{I_f}{I_{pr}} \cdot K_{tot} \cdot I_{sr} (R_{ct} + R_{ba})$$

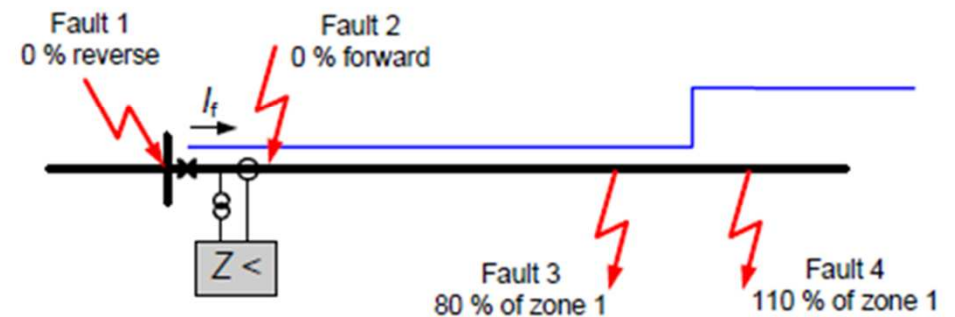


Figure F.1 – Fault positions to be considered

TC 95, IEC 60255 Series and IEC 61850

MU Requirements in IEC 60255-1xx series ?

- TC 95 may require manufacturers to declare “formulae” to “select the correct Merging Unit” from the application, as today it is done for CTs. Definition of accepted pattern of the Transfer Function? (see IEC 61869-6, TC 38)
- What about the protocol? Manufacturer shall also describe the protocols it accepts (see IEC 61869-9, TC 38)



TC 95, IEC 60255 Series and IEC 61850

How to handle the “quality”?

- GOOSE and SV signals have a “**quality declaration**” from the publisher.
What to do if the quality is “not good” in the receiving protection IED?
 - TRIP ORDER (invalid, failure)
 - OVERCURRENT SIGNAL (out of range)
 - Reversed current (not time synchronized)



Who will answer all these questions?



INTERNATIONAL ELECTROTECHNICAL COMMISSION

TECHNICAL COMMITTEE 95: MEASURING RELAYS AND PROTECTION EQUIPMENT

Creation of a new Ad hoc Group (AHG 3), "Use case of digital sampled values instead of analog input", in response to the decision taken at the TC 95 plenary meeting in Paris (2016-10-21)



AHG 3

Convener: Leitloff Volker (FR)

Kick-off Meeting June 2017

Second Meeting October 2017

Third Meeting April 2018

Report to TC95 for Autumn 2018

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Outcome from the Ad Hoc Group 3:

- **Some definitions** applicable for protections with analog inputs will **need to be adapted/modified**:
 - effective range, operative range, accuracy, rated quantities...
- **New notions and requirements** will be defined:
 - behavior in case of missing GOOSE / SV
 - behavior in case of "non good" quality for published data
 - behavior in case of lack of time synchronization
- Inputs to TC 95 for **new requirements in the existing parts** of IEC 60255 series
- Inputs to TC 95 for **new general parts** to the IEC 60255 series:
 - accuracy and ranges definitions
 - requirement for a new part for SCU / BIED
- Inputs for TC 38 (IEC 61869 series)
- Inputs for TC 17 (IEC 62271 series)
- **Final Technical Report**



Thank you!

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