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Monitoring of Power System and Communication Infrastructures based on IEC 61850 and IEC 61400-25

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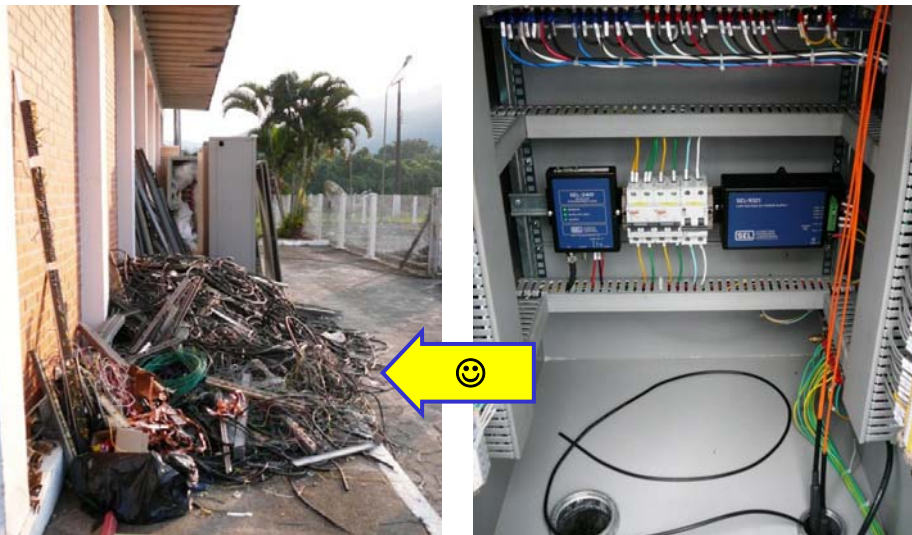
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Content

- ▶ The problem to solve
- ▶ Title and Scope IEC 61850 and 61400-25
- ▶ Model of 3-phase electrical system
- ▶ Object Models for Monitoring
- ▶ First example: Overview IEC 61850
- ▶ What is the difference compared to DNP3?
- ▶ Examples of models
- ▶ RWE Pilot project
- ▶ Model for Ethernet switch
- ▶ Summary

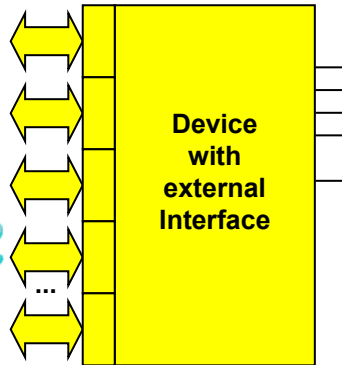
Substation (high costs for copper and work)



Source: Sergio Kimura et al, RottaElektroEletricidadee ServicosS.A., Brazil; SEL

Which standard should I use?

- IEC 60870-5-101/104
- IEC 61850-8-1
- IEC 60870-6 TASE.2
- ...
- DNP3.0
- ProfiNet
- EthernetIP
- Modbus TCP
- ...
- OPC DA
- OPC DX
- OPC XML-DA
- XML, SOAP
- Web Services, ...
- and and ...

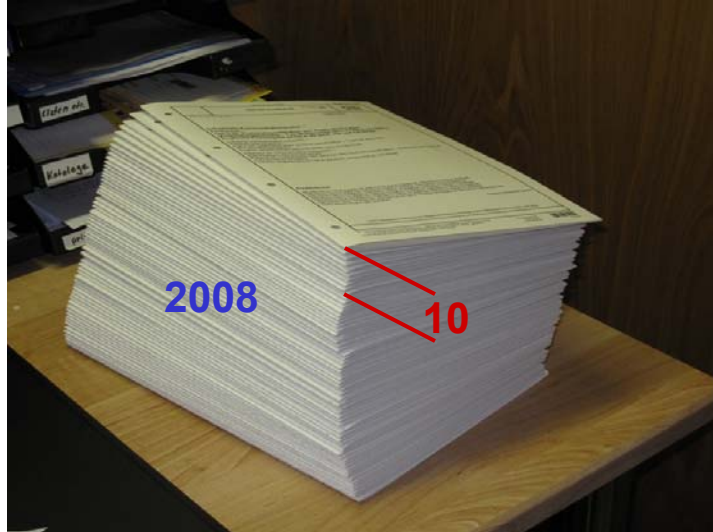


100+

Which bus ?

- | | | |
|-----------------------|--------------|----------------|
| • A-bus | • IEEE 1118 | • Partnerbus |
| • Arcnet | • Instabus | • P-net |
| • Arinc 625 | • Interbus-S | • Profibus-FMS |
| • ASI | • ISA SP50 | • Profibus-PA |
| • Batibus | • IsiBus | • Profibus-DP |
| • Bitbus | • IHS | • PDV |
| • CAN | • ISP | • SERCOS |
| • ControlNet | • J-1708 | • SDS |
| • DeviceNet | • J-1850 | • Sigma-i |
| • DIN V 43322 | • LAC | • Sinec H1 |
| • DIN 66348 | • LON | • Sinec L1 |
| • FAIS | • MAP | • Spabus |
| • EIB | • Master FB | • Suconet |
| • Ethernet | • MB90 | • VAN |
| • Factor | • MIL 1553 | • WorldFIP |
| • Fieldbus Foundation | • MODBUS | • ZB10 |
| • FIP | • MVB | • ... |
| • Hart | • P13/42 | |
| • IEC 61158 | • P14 | |

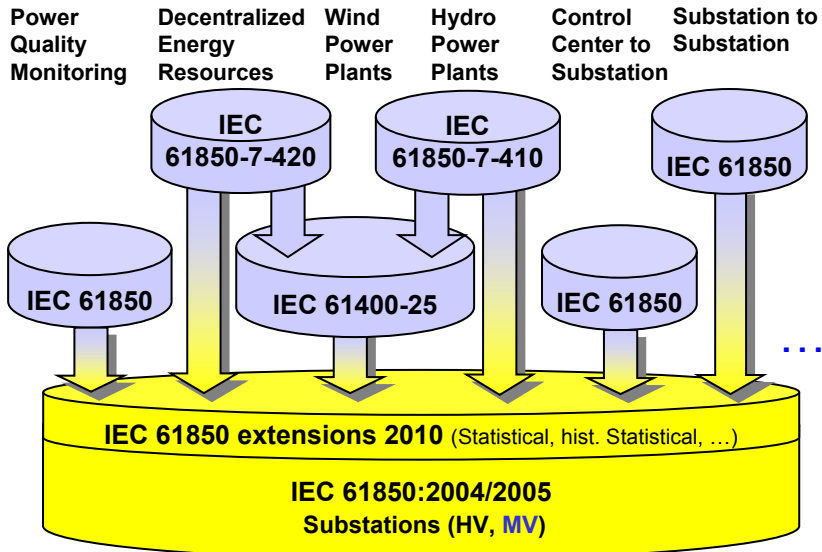
IEC 61158 Edition 2 (International Fieldbus)



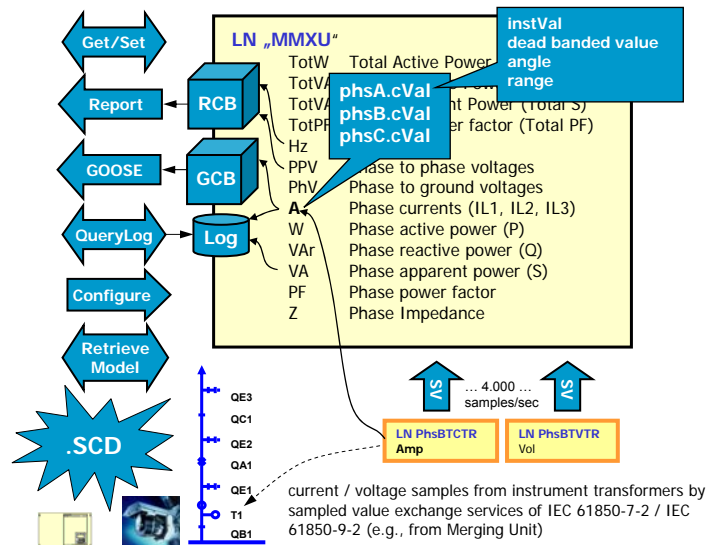
Title and Scope IEC 61850

- ▶ Old title:
Communication networks and systems in **substations**
- ▶ New title:
Communication networks and systems for **power utility automation**
- ▶ Standard has 17 (6 wind) parts; 7+ new parts
- ▶ Project started in 1995

Re-use of IEC 61850



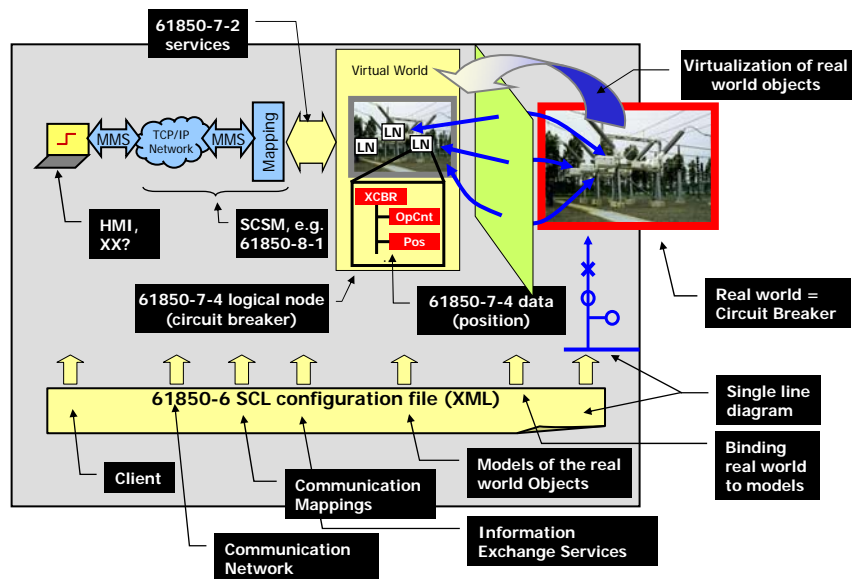
Model of 3-phase electrical system



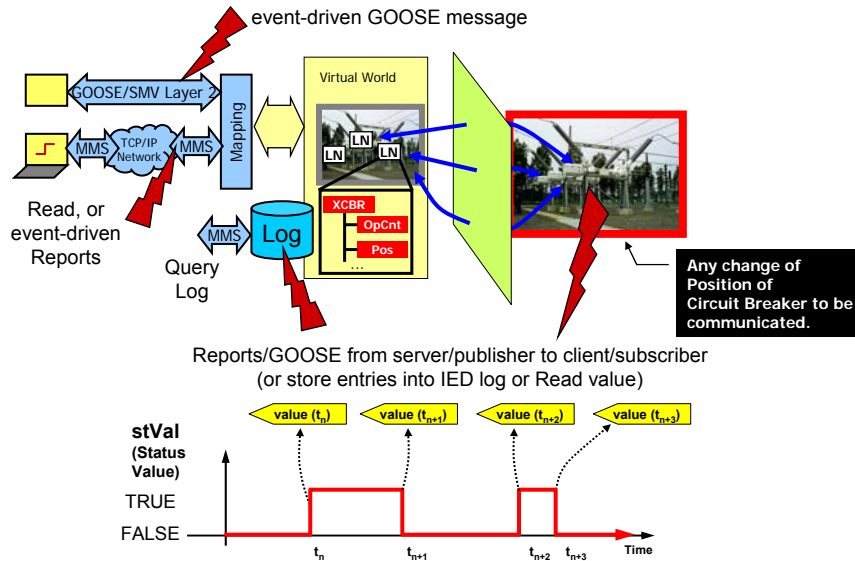
Parts with Object Models for Monitoring

- ▶ IEC 61850-7-4 (Object Models, Core, 150 LNs)
- ▶ IEC 61850-7-410 (Object Models, Hydro, 60 LNs)
- ▶ IEC 61850-7-420 (Object Models, DER, 50 LNs)
- ▶ IEC 61400-25-2 (Object Models, Wind, 16 LNs)
- ▶ IEC 61850-25-6 (Object Models, Wind, CMS, 1 LN)

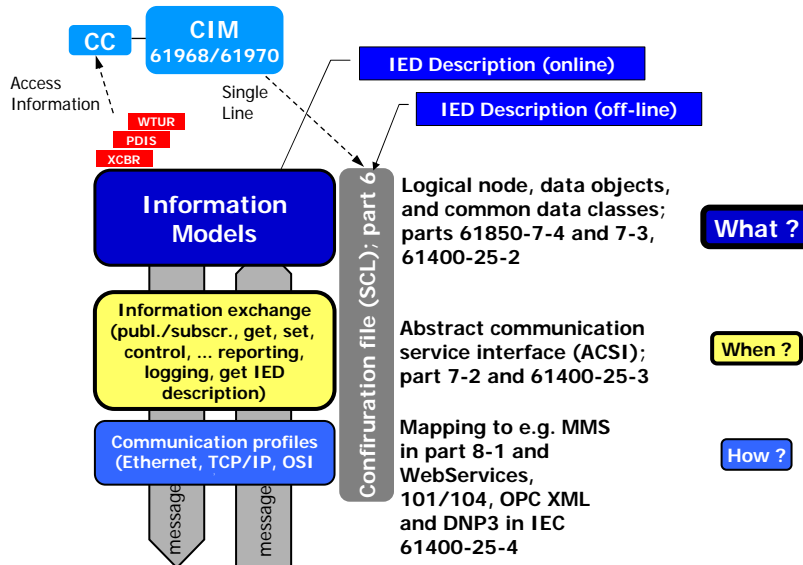
First example of application: modeling



First example of application: communication



„Layer model“ of IEC 61850



What is the difference compared to DNP3?

IEC 61850

- Communication protocols
 - SCADA
 - Real-time
 - Selfdescription
- Information models
- Configuration language

DNP3/101/104

- Communication protocol
 - SCADA



IEC 61850-7-4 Supervision LNs

- ▶ Monitoring and diagnostics for arcs – SARC
- ▶ Circuit breaker supervision – SCBR (new) → [see next slides](#)
- ▶ Insulation medium supervision (gas) – SIMG
- ▶ Insulation medium supervision (liquid) – SIML
- ▶ Tap changer Supervision – SLTC (new)
- ▶ Supervision of Operating Mechanism – SOPM (new)
- ▶ Monitoring and diagnostics for partial discharges – SPDC (new)
- ▶ Power Transformer Supervision – SPTR (new)
- ▶ Circuit Switch Supervision – SSWI (new)
- ▶ Temperature supervision – STMP (new)
- ▶ Vibration supervision – SVBR (new)
- ▶ **LNs for Cable, Tower, etc are under development**



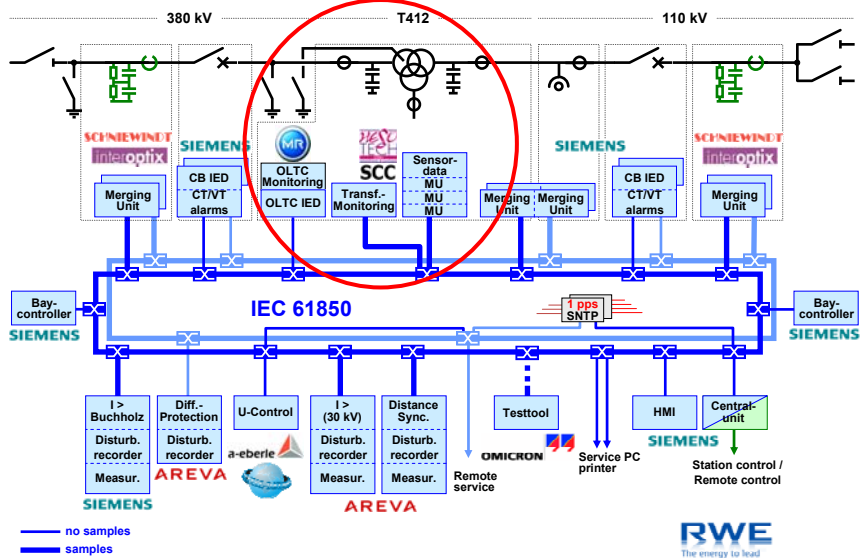
LN SCBR (status)

Status information	
OpCntRs	Resettable Operation Counter
ColOpn	Open command of trip coil
AbrAlm	Contact abrasion alarm
AbrWrn	Contact abrasion warning
MechHealth	Mechanical behavior alarm
OpTmAlm	Switch operating time exceeded
ColAlm	Coil alarm
OpCntAlm	Number of operations (modeled in the XCBR) has exceeded the alarm level for number of operations
OpCntWrn	Number of operations (modeled in the XCBR) exceeds the warning limit
OpTmWrn	Warning when operation time reaches the warning level
OpTmh	Time since installation or last maintenance in hours

LN SCBR (measurements)

Measured values	
AccAbr	Cumulated abrasion
SwA	Current that was interrupted during last open operation
ActAbr	Abrasion of last open operation
AuxSwTmOpn	Auxiliary switches timing Open
AuxSwTmCls	Auxiliary switches timing Close
RctTmOpn	Reaction time measurement Open
RctTmCls	Reaction time measurement
OpSpdOpn	Operation speed Open
OpSpdCls	Operation speed Close
OpTmOpn	Operation time Open
OpTmCls	Operation time Close
Stk	Contact Stroke
OvStkOpn	Overstroke Open
OvStkCls	Overstroke Close
ColA	Coil current
Tmp	Temperature e.g. inside drive mechanism

RWE Pilot project (in operation 2010)



LN LCCH (Ethernet Switch)

Measured values	
RxCnt	Number of received messages; MIB 1.3.6.1.2.1.2.2.1.10.x, x = port number; number of received octets.
RedRxCnt	Number of received messages on redundant channel; not used for switches
TxCnt	Number of sent messages; MIB 1.3.6.1.2.1.2.2.1.16.x, x = port number; number of sent octets.
Settings	
ApNam	Access point name to which this channel belongs; only needed, if more than one access point and more than one physical channel exist. Not used for pure switches; might be used on application IEDs with additional switch functionality.
ChLivTms	Timeout time for channel live supervision; default 5s

Summary

- ▶ IEC 61850 is **THE** international accepted and used standard for **information, information exchange and system and device configuration** in electric power systems
- ▶ The standard IEC 61850 and related standards will be **extended** by many new **information models** inside and outside the electrical world (gas, ...)
- ▶ The main focus was on **protection and control**
- ▶ In the future **Monitoring Information** will be a crucial focus
- ▶ Products are available

Additional information

- ▶ Contact: schwarz@scc-online.de
- ▶ <http://www.nettedautomation.com>
- ▶ These slides:
<http://www.nettedautomation.com/news>
- ▶ <http://iec61850-news.blogspot.com>
- ▶ Visit UCA IUG booth 1932