

Quality Assurance requirements and experiences for GOOSE/SV configuration

Paper Reference 123

Author	Company	Email	Presenter
Rodney Hughes	Rod Hughes Consulting Pty Ltd	rg@rodhughesconsulting.com	✓
Alexey Anoshin	TEKVEL Ltd.	aao@tekvel.com	
Aleksandr Golovin	TEKVEL Ltd.	gav@tekvel.com	

Some experiences



- Incorrect incomer/feeder subscriptions
 - Only detected at site commissioning
 - Large multicolumn/row spreadsheets difficult to validate
- All publishing to one Multicast MAC address
 - IEDs receiving messages totally irrelevant to their operation
 - Delays in reception of critical messages
- Only 3 (!!) out of the 90 elements in the datasets used by other IEDs
 - Wasted bandwidth
 - Delays in reception of critical messages and data

SCL designed to be human-readable

```

<Header id="My Project Id" nameStructure="IEDName" r
<History>
  <Hitem revision="1" version="1" what="created" v
</History>
</Header>
<Communication>
  <SubNetwork name="Communication">
    <ConnectedAP apName="AP1" iedName="P1W01A1">
      <Address>
        <P type="IP" xsi:type="tP_IP">191.0.1.1</P>
        <P type="IP-SUBNET" xsi:type="tP_IP-SUBNET">
        <P type="IP-GATEWAY" xsi:type="tP_IP-GATEWAY">
        <P type="OSI-PSEL" xsi:type="tP_OSI-PSEL">00
        <P type="OSI-SSEL" xsi:type="tP_OSI-SSEL">00
        <P type="OSI-TSEL" xsi:type="tP_OSI-TSEL">00
      </Address>
      <GSE cbName="TRIP" ldInst="LD0">
        <Address>
          <P type="MAC-Address" xsi:type="tP_MAC-Add
          <P type="APPID" xsi:type="tP_APPID">0011</P>
          <P type="VLAN-ID" xsi:type="tP_VLAN-ID">01
          <P type="VLAN-PRIORITY" xsi:type="tP_VLAN-
        </Address>
        <MinTime multiplier="m" unit="s">8</MinTime>
        <MaxTime multiplier="m" unit="s">5000</MaxTi
      </GSE>
    </ConnectedAP>
  </SubNetwork>
</Communication>

```

Are you ready to read and understand this?

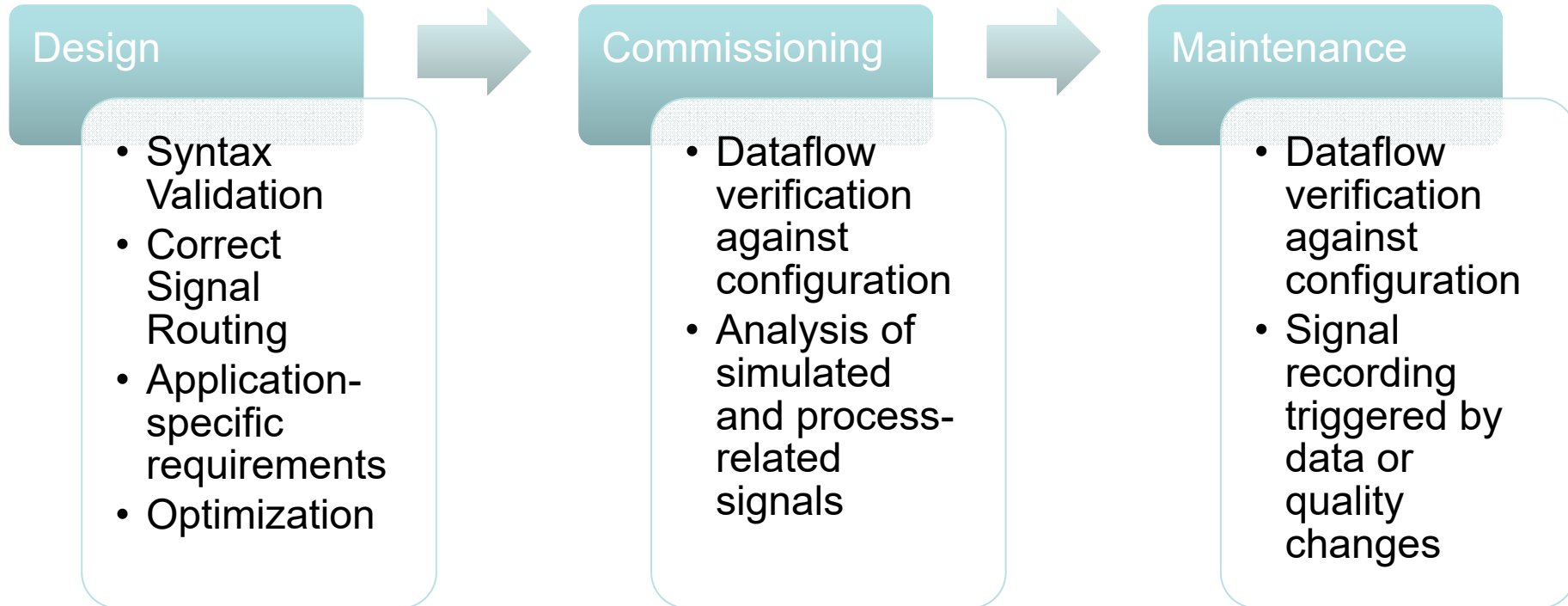
- Human-readable, **but hardly understandable.**
- Project files analyzed contained **over 1'000'000 lines** of text
- Typically **SCD accompanied with human-written Excel** publisher/subscriber matrix
- Existing tools hardly help verification of **communications from the application point of view**
- **Problems** not discovered at the configuration phase **shall arise during FAT, SAT or commissioning.**

Are there proper tools?

	System Configuration Tool	IED Configuration Tool
Visualization of communications	+	-
Multi-vendor	+/-	-
Analyze project	+/-	-
Vendor-specific analysis	-	+
Application-specific analysis	-	+/-
Trace changes in the project	-	-

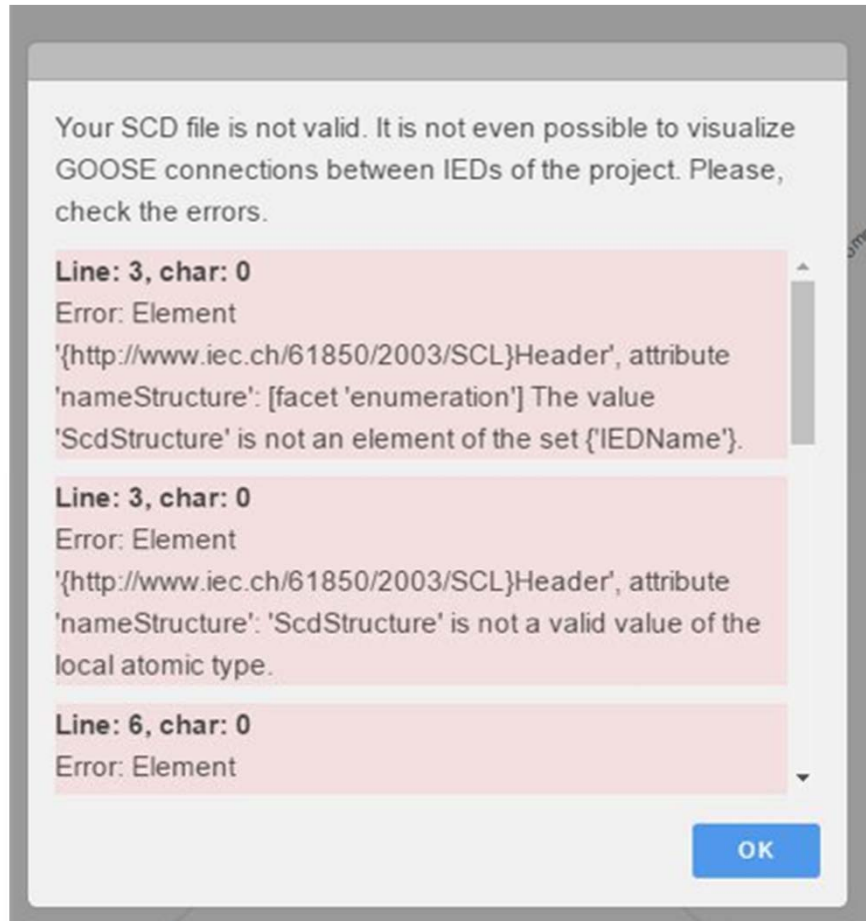
SCT and ICT are mainly designed for configuration purposes, which generally makes them hard-to-use for visualization and analysis purposes

Required Quality Assurance on different stages



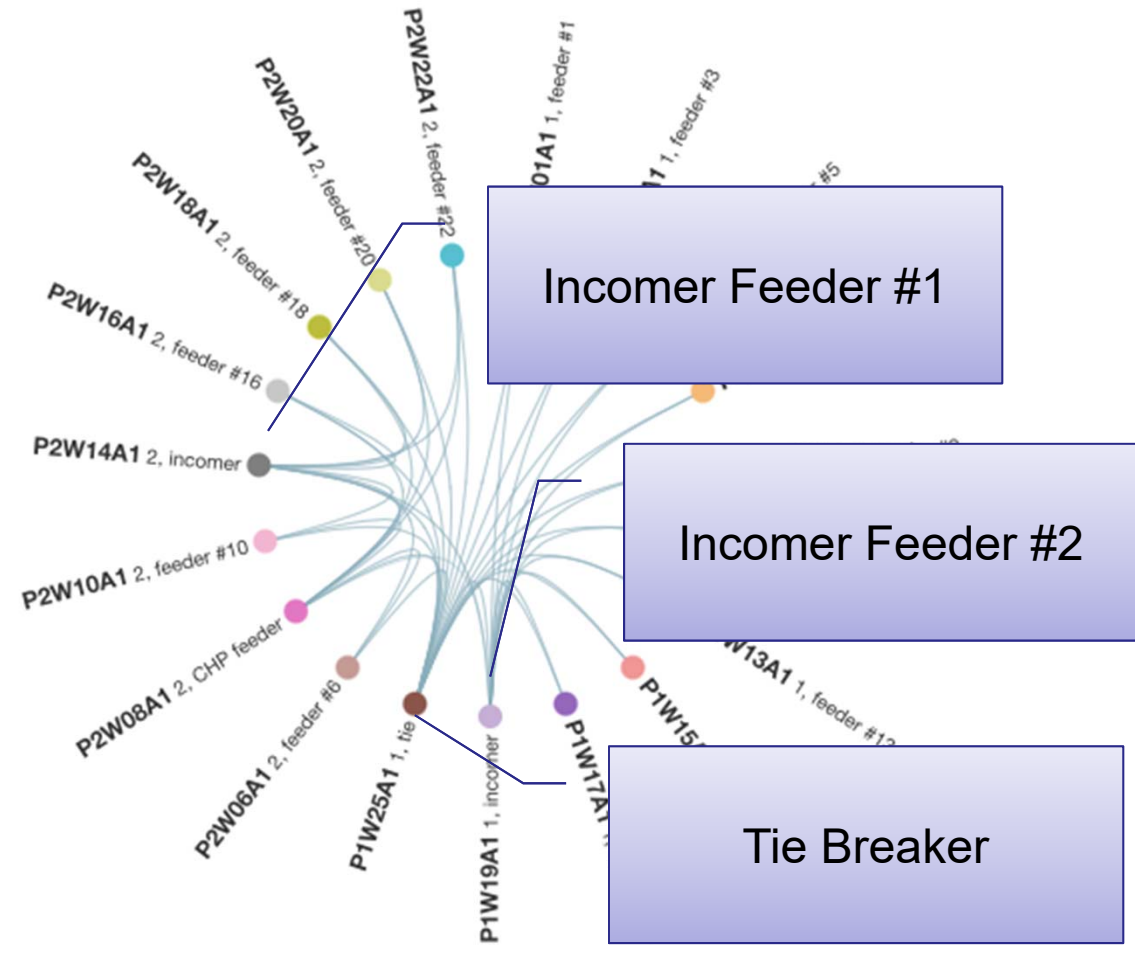
IMPORTANT: There shall be only one configuration file (SCD) for the entire project and changes shall be traced in case of any changes made.

SCL Schema Validation



- Vendor-specific tools in some cases use outdated SCL Schemas not including latest changes to the standard.
- Invalid SCL-file in most cases would be refused by another vendor's tools calling for some "magic" to be able to configure communications.
- Schema validation does not guaranty quality of configuration itself but puts mandatory rools on SCL-file syntax.

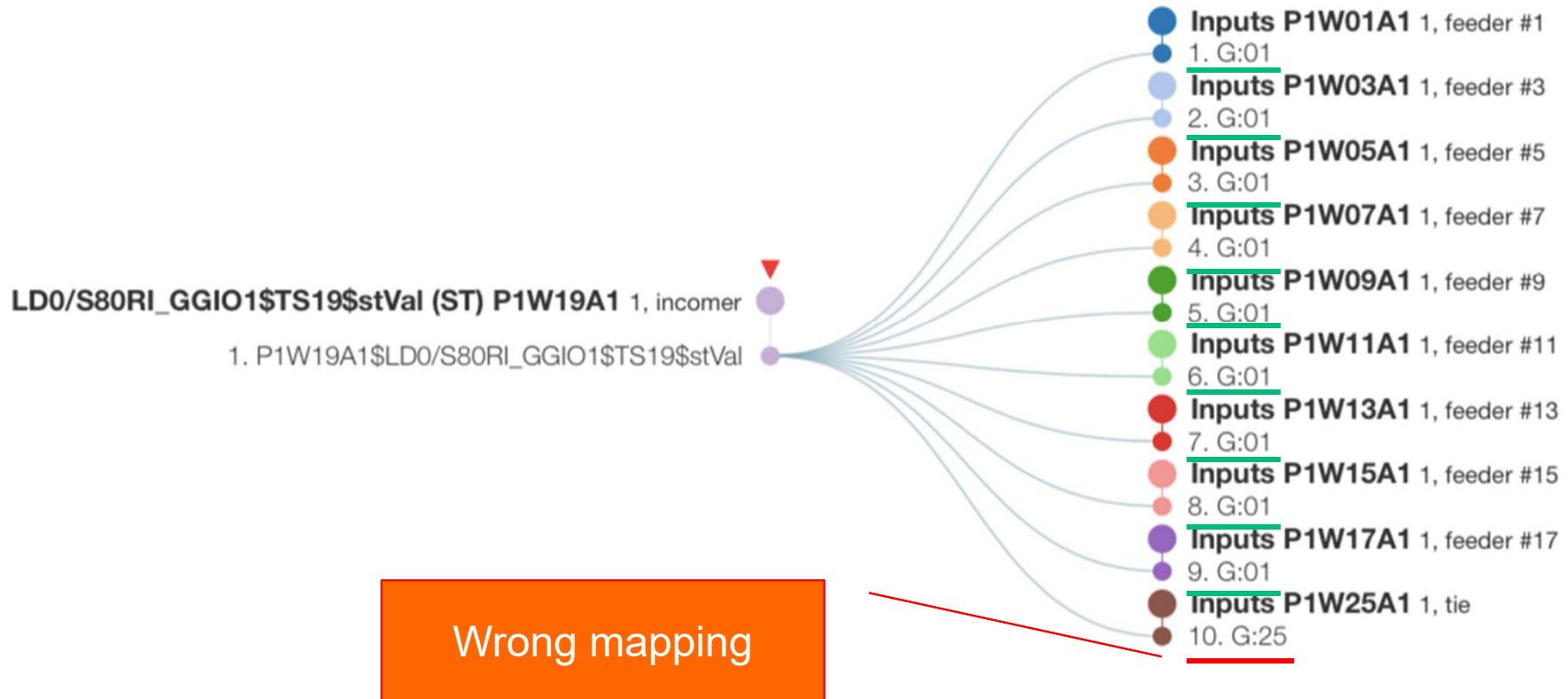
Viewing GOOSE Communications



Visualization of GOOSE communications as “cables” makes application-specific dataflow absolutely obvious and traceable.

In case of any misconfiguration a designer shall see it in a glance.

Visual Analysis for Template Matching



Detailed Analysis for SCD

Statistics

SCL file has **1924** minor and **0** critical error(s). Check the table below for details

Detailed information

Element	Element Type	Warn level	Description
PI_PROT/PTRC8\$Tr\$general ST	FCDA	Minor	Dataset includes FCDAs not subscribed by any IEDs. May be there is a room for dataset optimization
PI_PROT/PTRC9\$Tr\$general ST	FCDA	Minor	Dataset includes FCDAs not subscribed by any IEDs. May be there is a room for dataset optimization
PI_PROT/PTRC10\$Tr\$general ST	FCDA	Minor	Dataset includes FCDAs not subscribed by any IEDs. May be there is a room for dataset optimization
PI_PROT/PTRC11\$Tr\$general ST	FCDA	Minor	Dataset includes FCDAs not subscribed by any IEDs. May be there is a room for dataset optimization
PI_PROT/PTRC12\$Tr\$general ST	FCDA	Minor	Dataset includes FCDAs not subscribed by any IEDs. May be there is a room for dataset optimization
PI_PROT/PTRC13\$Tr\$general ST	FCDA	Minor	Dataset includes FCDAs not subscribed by any IEDs. May be there is a room for dataset optimization
PI_PROT/PTRC14\$Tr\$general ST	FCDA	Minor	Dataset includes FCDAs not subscribed by any IEDs. May be there is a room for dataset optimization

TOP checks to be performed

#	Error	Description
1	GOOSE is not subscribed by any IEDs	Indicates either error in configuration, when certain IED (or IEDs) have never been subscribed to the GOOSE, or excessive GOOSE configured.
2	Dataset contains attributes not subscribed by any IED	Might be an error in configuration: IED won't receive desired information or dataflow is not optimized.
3	Quality flag is not transmitted or not subscribed by any IEDs	Not using quality flags might lead to incorrect operation of the system in "bad-quality" conditions
4	Duplicate GOOSE/SV destination MAC-address	System performance might be poor due to inability of hardware mac-filtering
...

Conclusions



- Visualization of GOOSE and SV communications provides means to discover and eliminate up to 70% of configuration errors at the design stage
- Automated system configuration analysis provides means to optimize communication flow up to 30%



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Thank You