

We have reduced the Complexity of IEC 61850 to a Beautiful Simplicity



com.tom WEB-PLC for

IEC 60870-5-104 Server (slave),

IEC 61850 Server,

Gateway IEC 60870-5-104 Server to IEC 61850 Client, and

Gateway IEC 61850 Server to IEC 61850 Client

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See the Beautiful Simplicity of IEC 61850 Live

See a live demo at the SPS/IPC/Drives
Nuremberg (Germany)
26-28 November 2013

... get a free ticket (click on icon or link below):



http://www.beck-ipc.com/en/download/load.asp?f=/other/guestcard_sps-ipc-drives-2013_de.pdf

See you there!

Content

Situation, Objectives, Summary, Introduction, ...

WEB-PLC for Gateway IEC 61850 to IEC 60870-5-104

Background IEC 61850 Application (architecture, ...)

Former example (first steps) – kept for information

Content

Situation, Objectives, Summary, Introduction, ...

WEB-PLC for Gateway IEC 61850 to IEC 60870-5-104

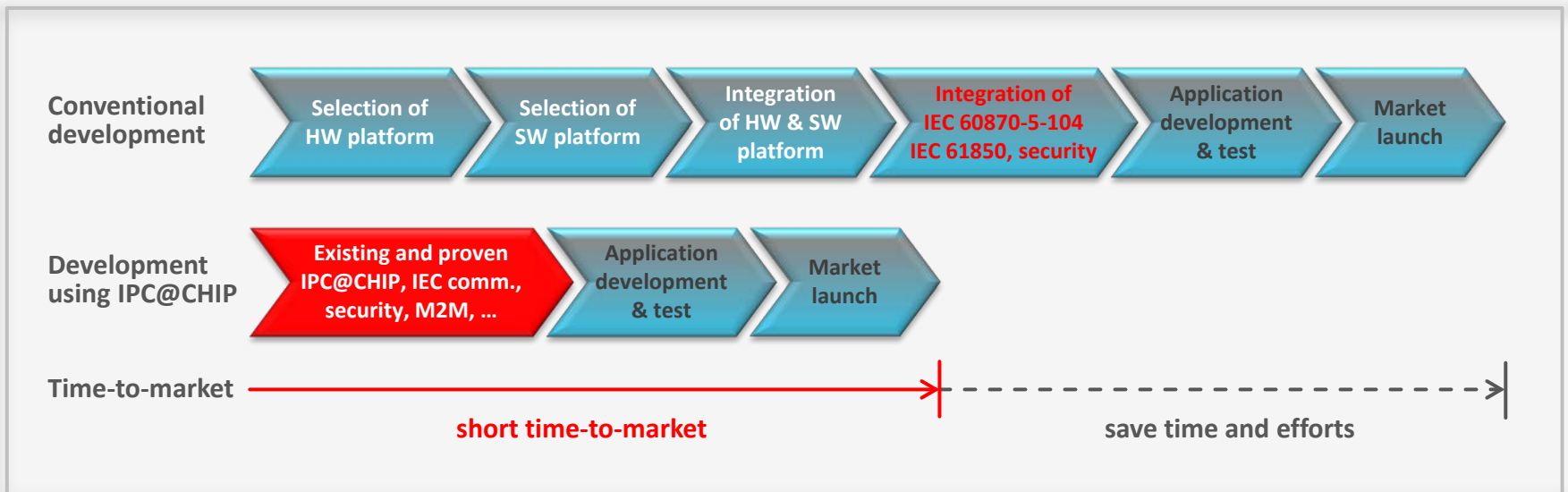
Background IEC 61850 Application (architecture, ...)

Former example (first steps) – kept for information

Situation

- IEC 61850 and IEC 60870-5-104 (DNP3) are well known and used standards for many application domains all over.
- IEC 60870-5-104 and DNP3 are the preferred solutions for Tele-Control and Tele-Monitoring. They provide simple exchange of status, measurements, counters, and control commands.
- These protocols are implemented in most control centers and SCADA systems.
- IEC 61850 is the preferred solution for information management for substation protection, monitoring, and automation.
- The need for collecting more condition monitoring information from process equipment like transformers, switch gears, cable, ... is preferably implemented by IEC 61850.
- One crucial challenge is: How can the huge amount of IEC 61850 based information easily be carried by IEC 60870-5-104 (DNP3)?
- **The following slides show the beauty of a very simple and powerful gateway.**

Short time-to-market with com.tom



Use IEC 61850 and IEC 60870-5-104 ... while others are still struggling to integrate tons of IEC 61850 and IEC 60870-5-104 software

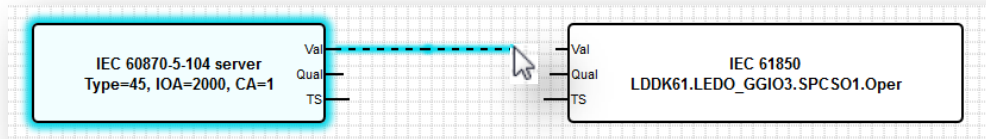
Objectives

- The main objective of this presentation is to provide the basic concept of using the Beck IPC **WEB-PLC*** (that is implemented on the RADIO com.tom 2.1 device) for implementing a gateway of signals from (to) an underlying IEC 61850 server device to (from) a control center using IEC 60870-5-104.
- The **WEB-PLC is used to graphically marshal** the signals between various protocols in both directions: monitoring and control.
- In addition to the gateway, the concept is applicable for any other use-case of IEC 60870-5-104 and IEC 61850.
- This power point presentation will be posted on:
<http://www.blog.iec61850.com> and other websites.
- Useful links:
 - <http://www.com-tom.de/about.php?l=en>
 - <http://www.com-tom.de/products.php>
 - http://www.com-tom.de/download/datasheet/en/DS_comtom_RADIO_2.1_V04.pdf
 - http://www.beck-ipc.com/files/manual/com.tom_WEB-PLC_GettingStarted_V16.pdf
 - http://www.etz.de/files/e00626zfe_beck.pdf#/etz_0610

* PLC = Programmable Logic Controller

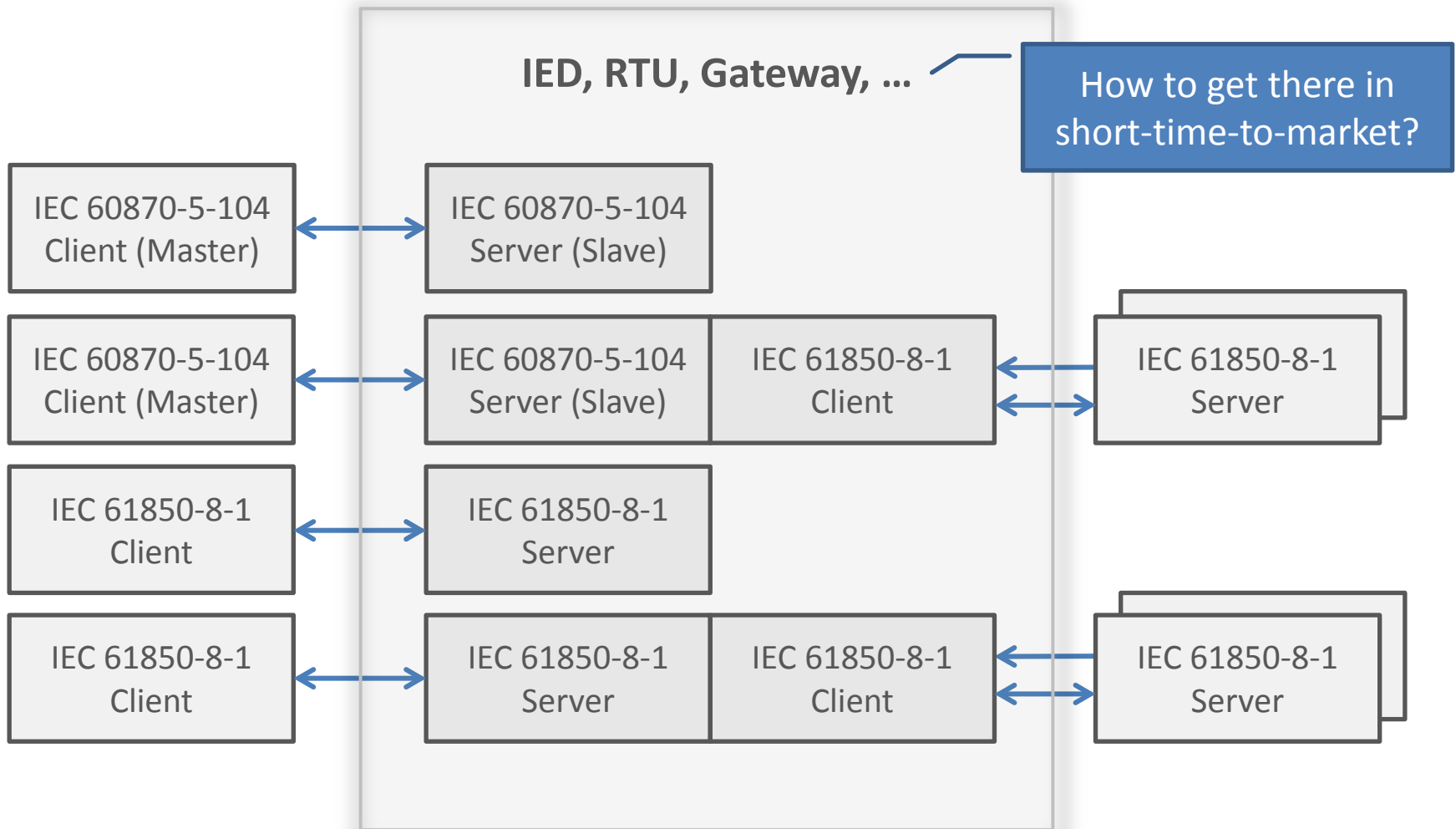
Summary

- The implementation of a gateway of signals from (to) an underlying IEC 61850 server device to (from) a control center using IEC 60870-5-104 is now **available**.
- The various functions like accessing input and output signals, signals from (to) other underlying devices and applying WEB-PLC logic functions like AND, OR, COMPARE, ... are **configured graphically**:



- The configuration of the signal flow is completely based on **Internet Browsers**, e.g., Mozilla Firefox - **No other tool required**.
- Protocols like IEC 60870-5-104, IEC 61850, IEC 61400-25, Modbus, M-Bus, ...
- **No need to work with IEC 61850 or IEC 60870-5-104 API, SCL, DataSets and Report Control Blocks → Complexity of IEC 61850 is HIDDEN !!**
- Build-in tool **maps IEC 61850 common data class attributes** (FC: ST, MX) by rules **automatically to WEB-PLC Inputs and Outputs**.
- The WEB-PLC is appropriate for **very short time-to-market** implementations.

Major protocols in use ...



Content

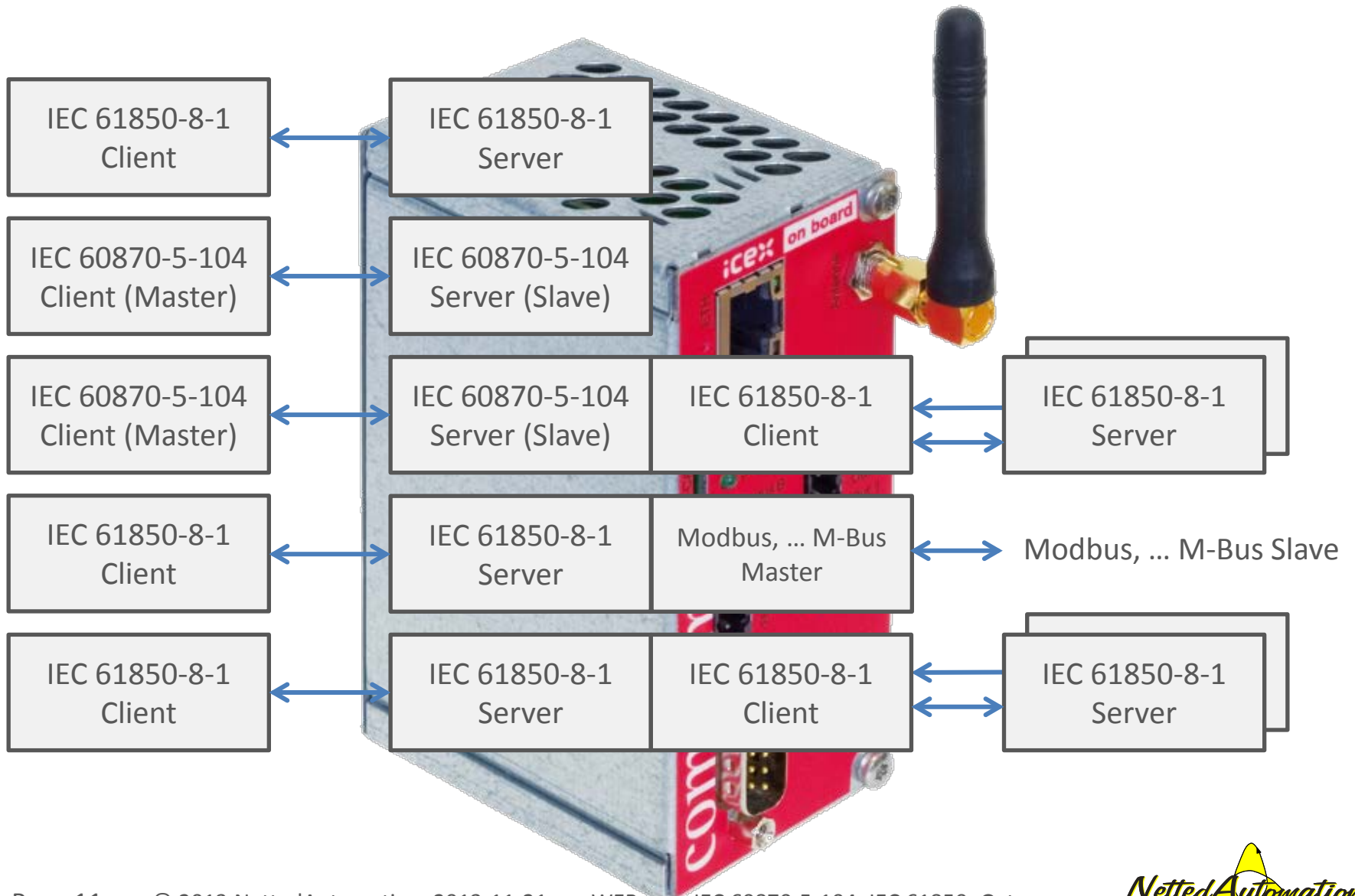
Situation, Objectives, Summary, Introduction, ...

WEB-PLC for Gateway IEC 61850 to IEC 60870-5-104

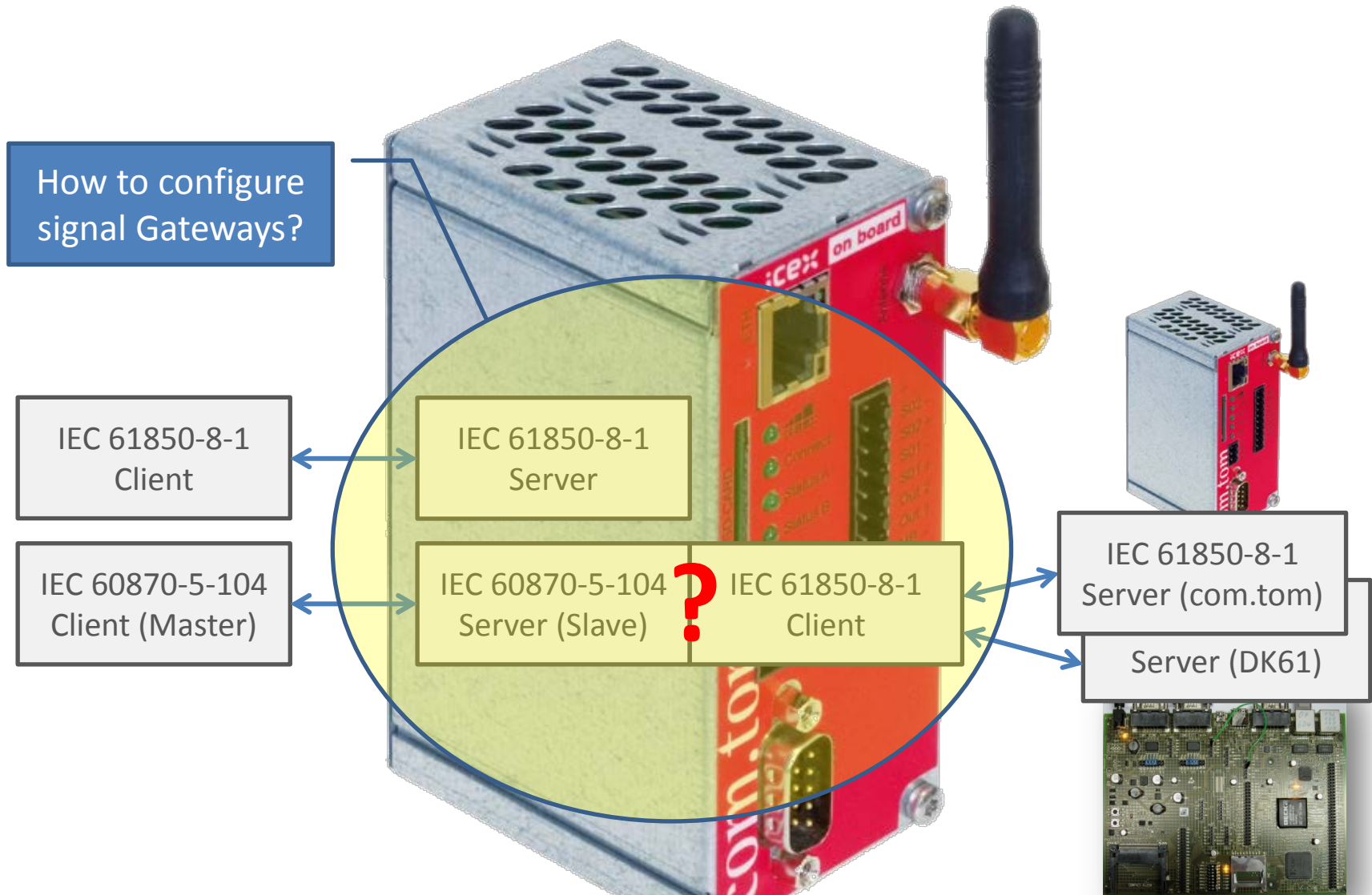
Background IEC 61850 Application (architecture, ...)

Former example (first steps) – kept for information


Use of com.tom as an efficient platform



com.tom RADIO 2.1 and DK61 (used for examples)



Your com.tom for IEC 61850 and IEC 60870-5-104



Find your com.tom for your application.

Select features

17 products found

Programming area ✓

- All
- C/C++
- WEB-PLC
- CODESYS
- GUI Editor und C/C++


Communication ✓

Application


Interfaces

Functions and Protocols ✓


- SMS
- OpenVPN
- com.tom Portal
- IEC 60870-5-104
- IEC 61850 Server
- IEC 61850 Client
- SNMP Client
- DHCP Server
- NAT
- Firewall
- COM Server
- Modbus TCP Slave (Server)
- Modbus RTU Slave (Server)
- Modbus TCP Master (Client)




com.tom BASIC 2.0




com.tom BASIC 3.0




com.tom BASIC 3.0 S



com.tom BASIC 4.0



com.tom BASIC 5.0



com.tom BASIC 5.0 S

<http://com-tom.de/products.php>

Starter Kit com.tom RADIO 2.1

- <http://beck-ipc.com/en/products/shop/index.asp>
- The comprehensive starter kit comprises the WEB-PLC and optionally the IEC 60870-5-104 and IEC 61850:



com.tom RADIO Starterkit

Complete starter kit for com.tom RADIO 2.1.
Consisting of: com.tom RADIO 2.1, Ethernet patch cable, cross over cable, 3-pole connector, 10-pole connector, SD card and power supply unit, packed in a systainer. RoHS compliant.

The Starter Kit includes the setting up, connection and use of the com.tom portal for 1 year.
After that year you have to order the portal connection separately (per unit/month: 9.90 €, minimum period: 24 month).

An M2M 50MB data rate can be ordered for the com.tom RADIO 2.1 for use in Germany if required.
(other European countries on request)

com.tom SIM card, single cost
Order number: 570602
Price per card: 12.50 €

com.tom SIM 50MB connection fees
(minimum period 24 month)
Order Number: 42000001
Price unit/month: 9.90 €

Request and ordering under sales@beck-ipc.com

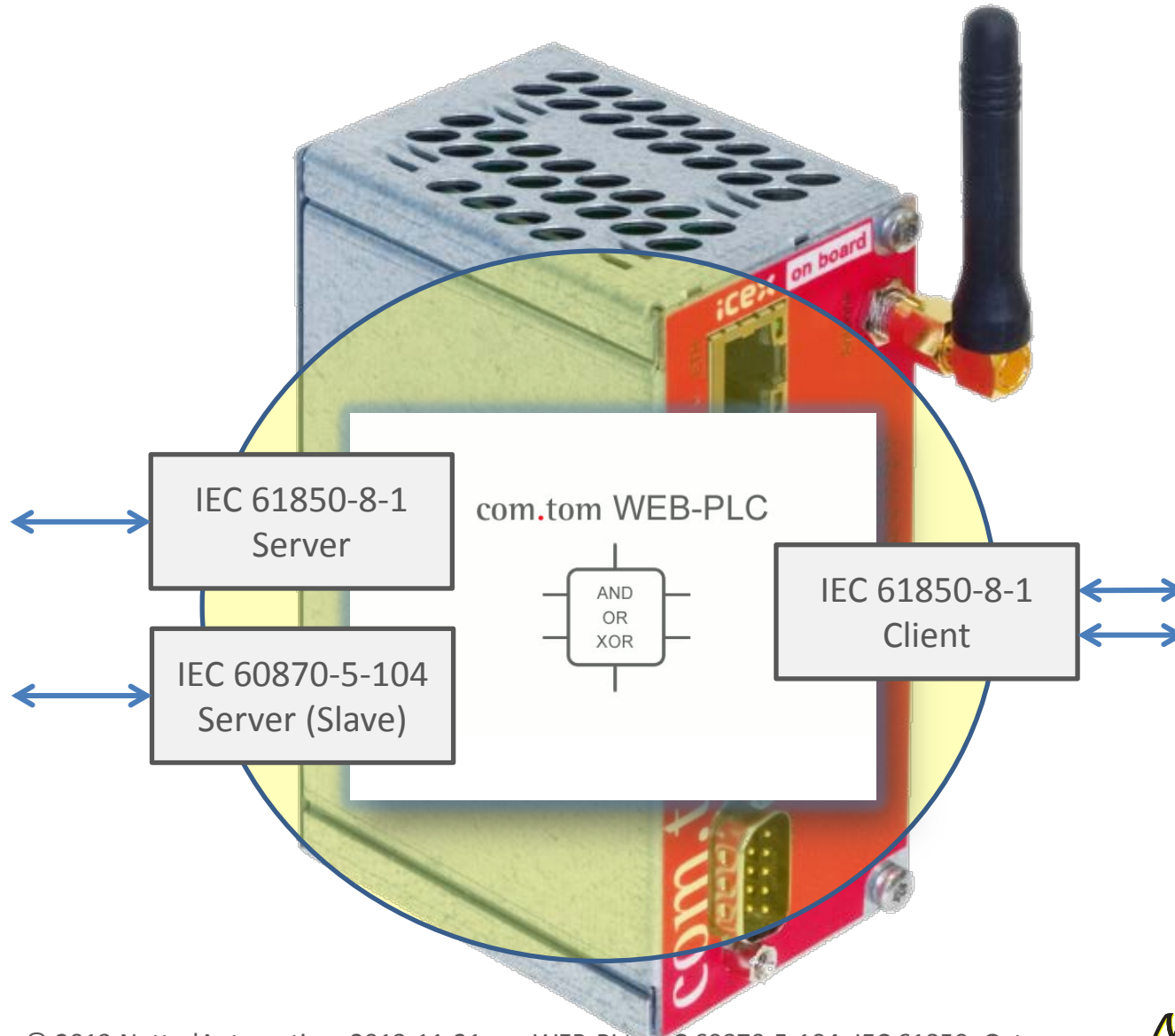
com.tom RADIO Starterkit - Portal, WEB-PLC and GSM/GPRS

Order no: 570595 Price: 499,00 €* 

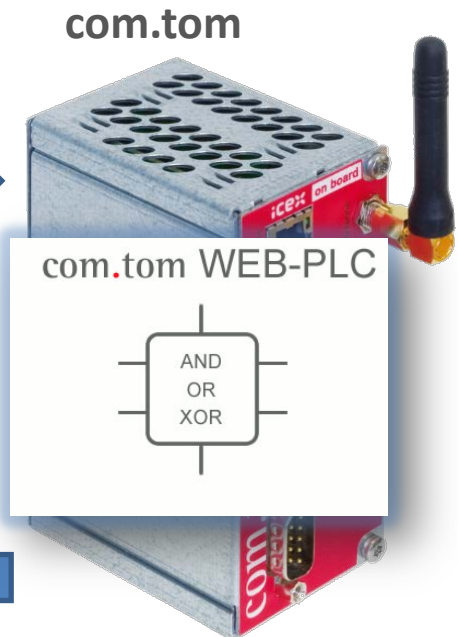
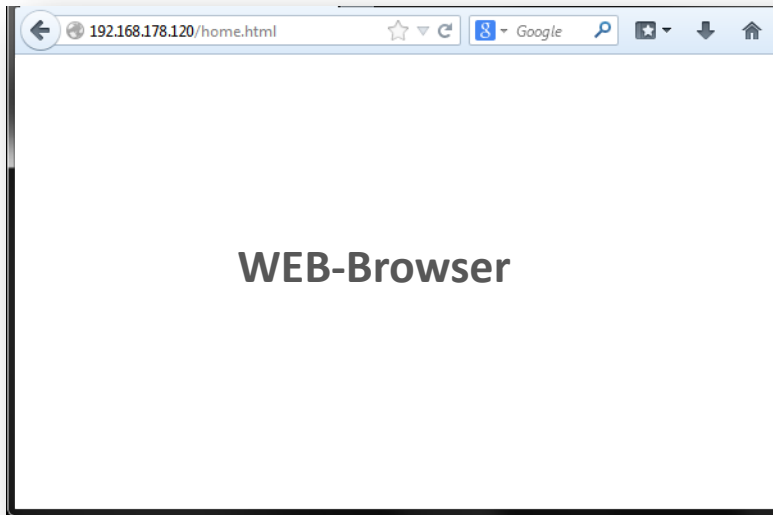
IEC 61850 and IEC 60870-5-104 are available for:

com.tom BASIC 4.0
com.tom BASIC 5.0
com.tom BASIC 5.0 S
com.tom BASIC 5.0 S
com.tom BASIC 6.0
com.tom BASIC 6.0
com.tom BASIC 7.0
com.tom BASIC 7.0
com.tom BASIC 8.0
com.tom BASIC 8.0
com.tom M-BUS 2.0
com.tom M-BUS 2.0
com.tom RADIO 2.0
com.tom RADIO 2.0
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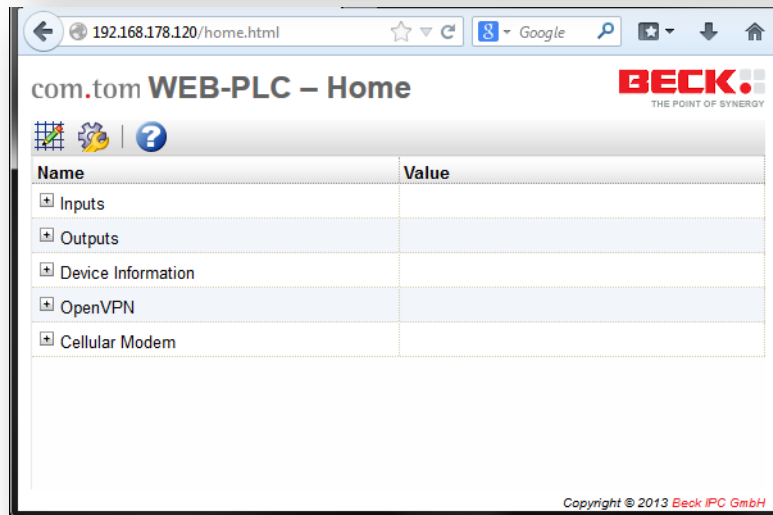
WEB-PLC: Simplifies Gateways



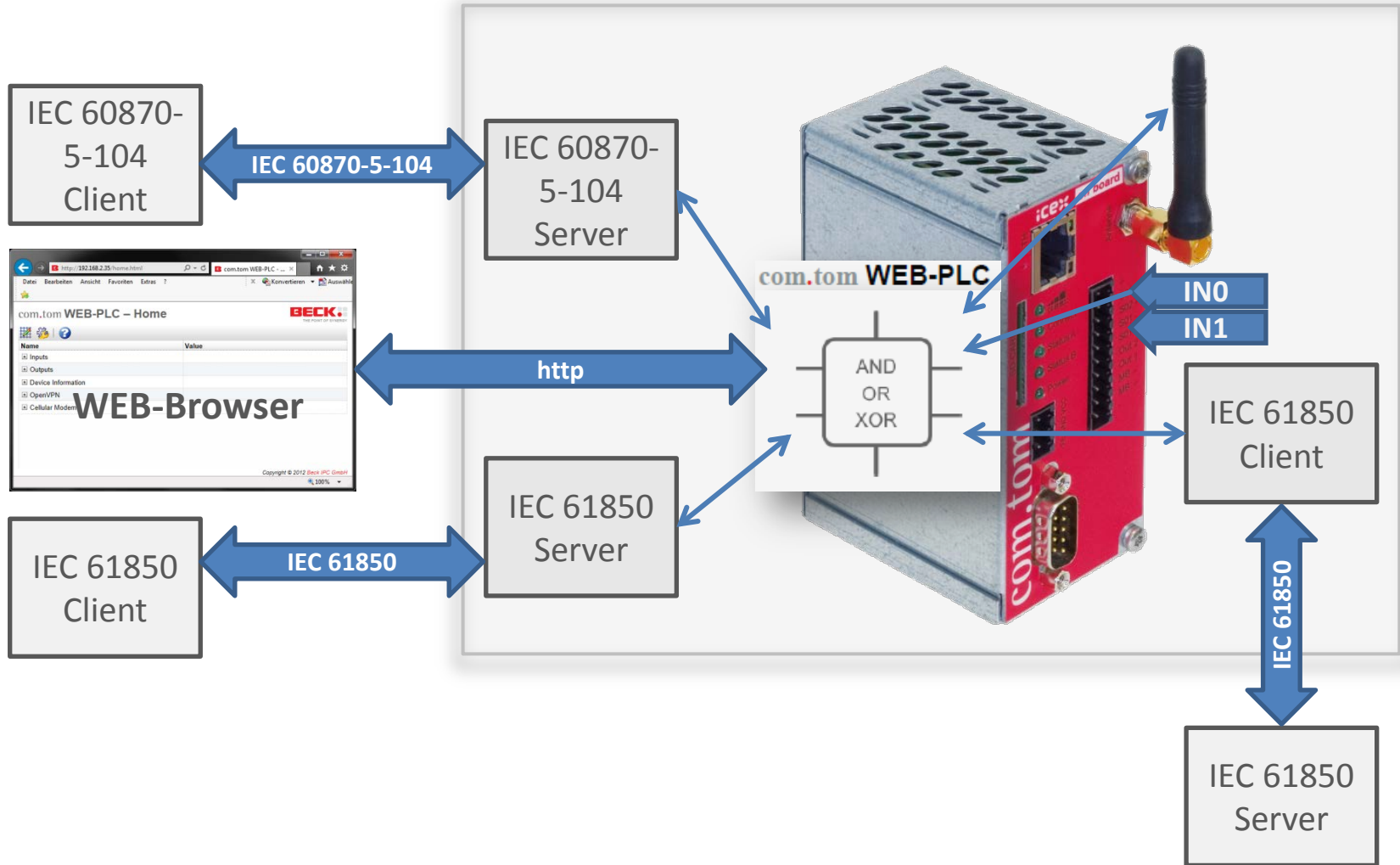
WEB-PLC: Needs just a WEB-Browser



Configuration of WEB-PLC with Web Browser!



WEB-PLC in the center of the platform

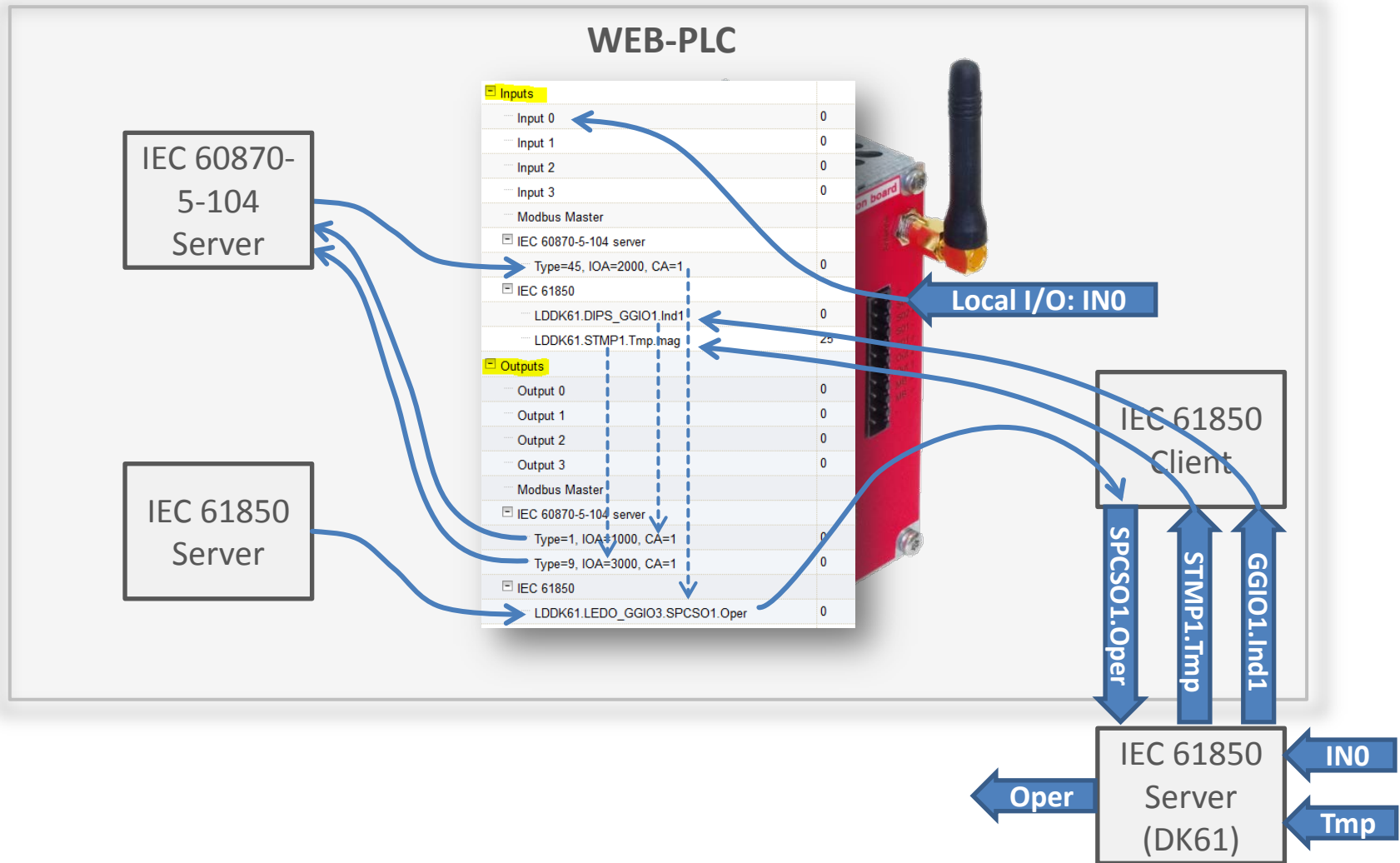


“Home” of WEB-PLC

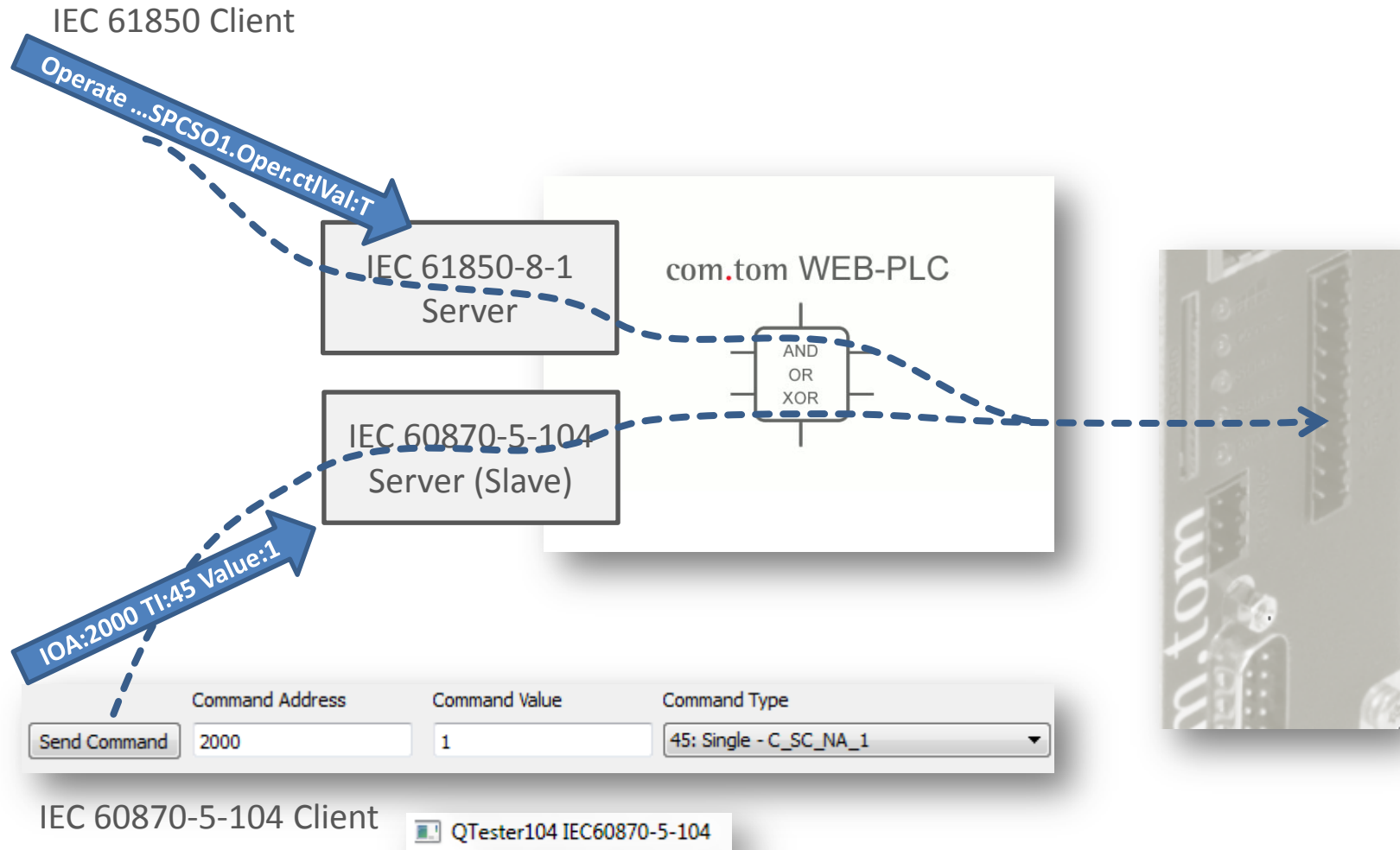
Name	Value
Inputs	
Input 0	0
Input 1	0
Input 2	0
Input 3	0
Modbus Master	
IEC 60870-5-104 server	
Type=45, IOA=2000, CA=1	0
IEC 61850	
LDDK61.DIPS_GGIO1.Ind1	0
LDDK61.STMP1.Tmp.mag	25
Outputs	
Output 0	0
Output 1	0
Output 2	0
Output 3	0
Modbus Master	
IEC 60870-5-104 server	
Type=1, IOA=1000, CA=1	0
Type=9, IOA=3000, CA=1	0
IEC 61850	
LDDK61.LEDO_GGIO3.SPCS01.Oper	0
Device Information	
OpenVPN	

- The home of the WEB-PLC comprises mainly:
 - Inputs and
 - Outputs
- These can be used to build signal flows and logics

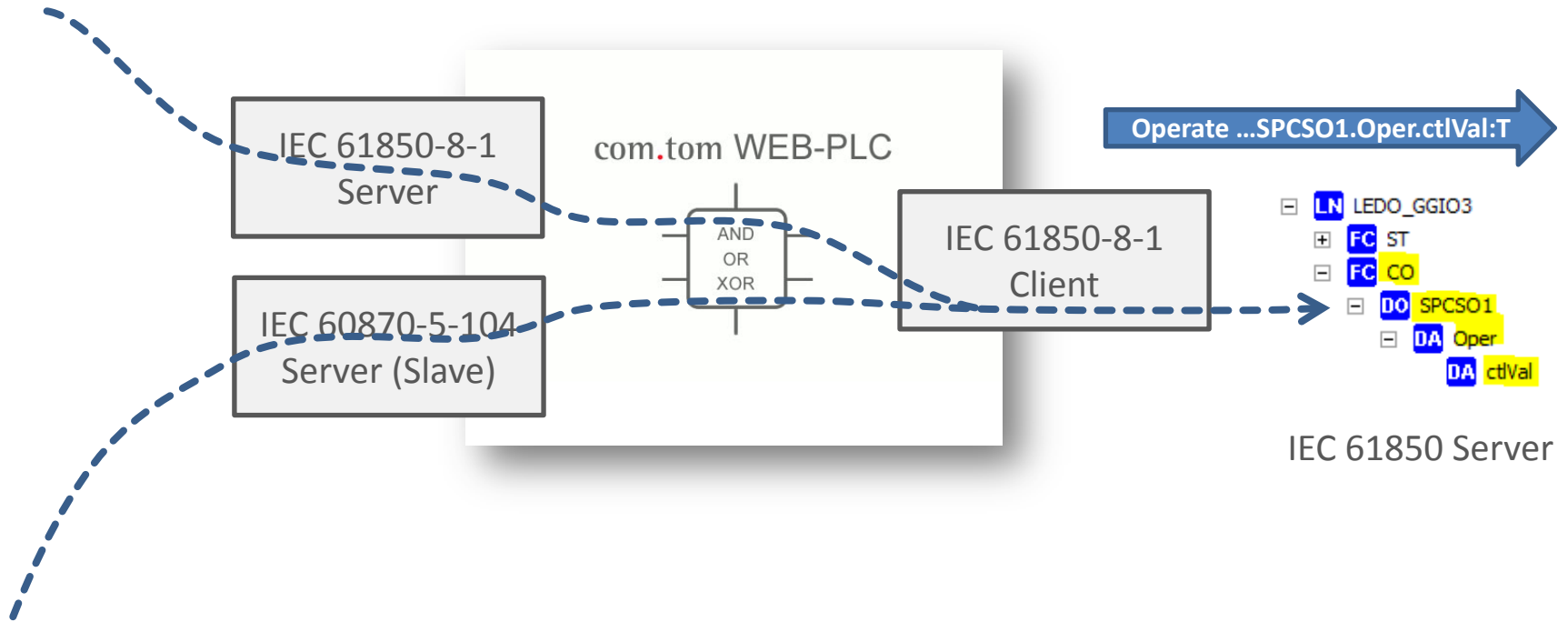
WEB-PLC: Incoming and outgoing signals



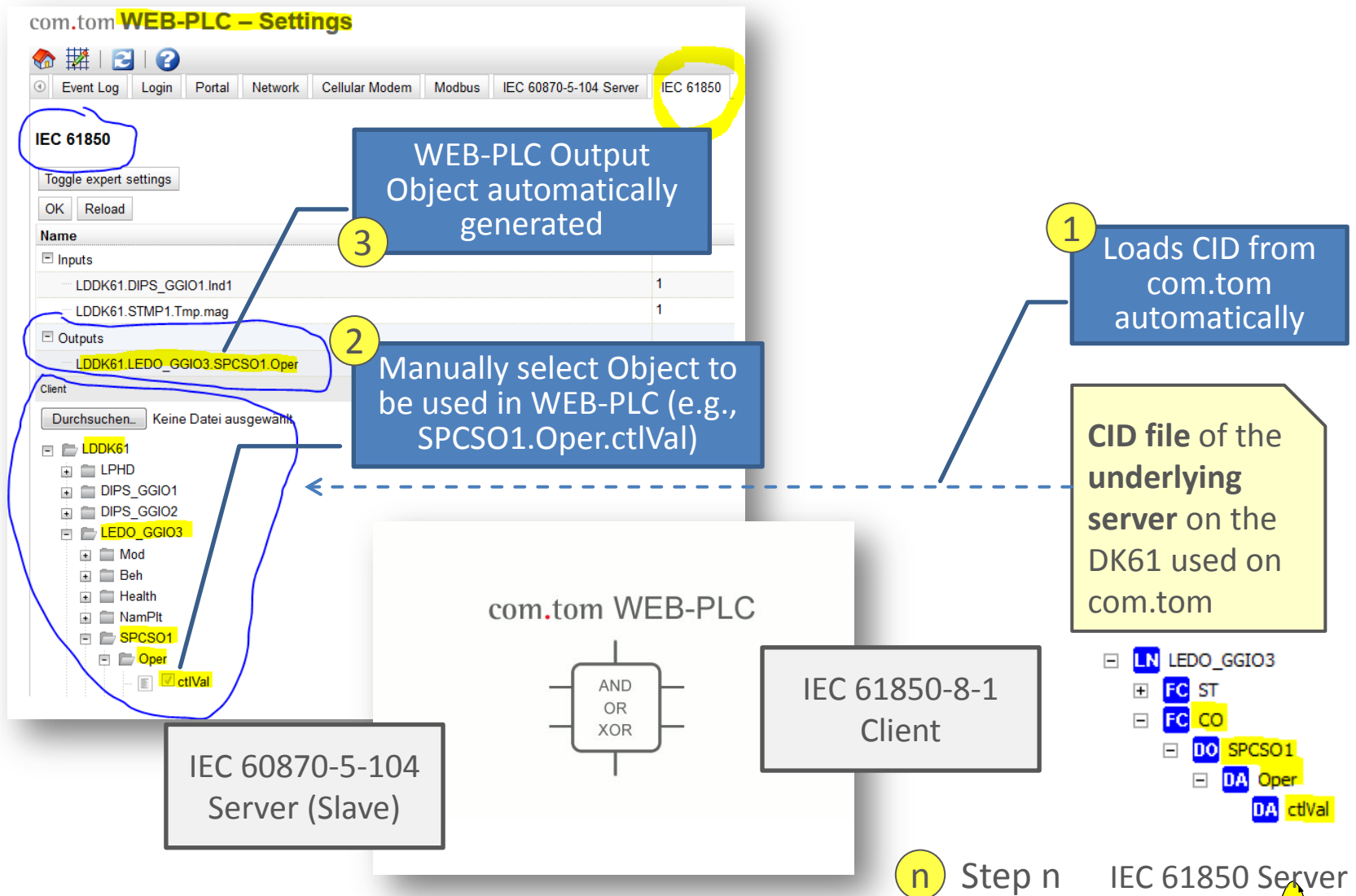
WEB-PLC: Marshal signals (to local I/Os)



WEB-PLC: Marshal signals (to IEC 61850)



WEB-PLC: Settings to provide Inputs and Outputs



WEB-PLC: Settings to provide Inputs and Outputs

- 1 CID File of com.tom loaded automatically by WEB-PLC Setting process.
- 2 WEB-PLC Setting process parses Server model and exposes model as tree.
- 3 After Restart of com.tom the Input and Output objects are available to be used by any WEB-PLC application.

The reference of the WEB-PLC Objects are automatically derived from the Server of the CID File: "LDDK61.LEDO_GGIO1.SPCSO1.Oper"

The reference is the path name of the IEC 61850 Object:

Logical Device = LDDK61

Logical Node = LEDO_GGIO1

Data Object = SPCSO1.Oper

WEB-PLC: Settings to provide Inputs and Outputs

com.tom **WEB-PLC – Settings**

Event Log Login Portal Network Cellular Modem Modbus **IEC 60870-5-104 Server** IEC 61850 T...

IEC 60870-5-104 Server

Name	IOA	Range
<input type="checkbox"/> Inputs		
Type=45, IOA=2000, CA=1	2000	1
Single command (45)		
<input type="checkbox"/> Outputs		

For new Objects

Manually configured Input Object

Add Edit Delete Clone

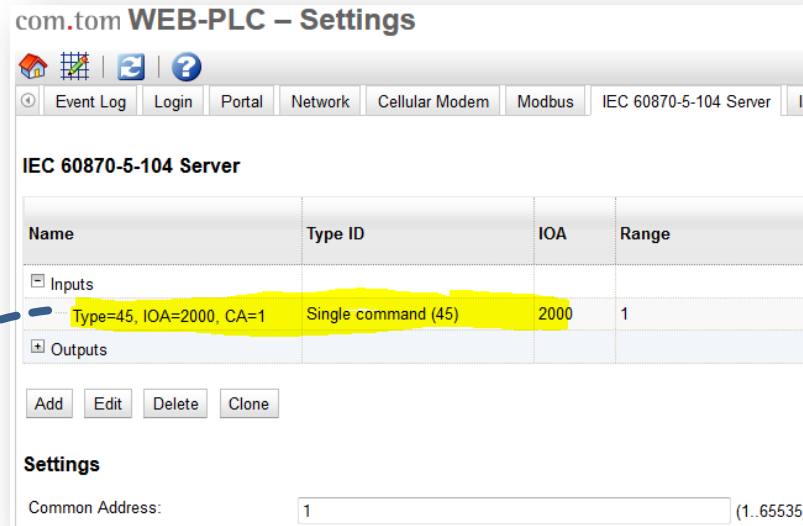
Settings

Common Address: 1 (1..65535)

The creation of IEC 60870-5-104 Objects is possible by adding new Inputs or Outputs.

WEB-PLC: Inputs and Outputs

How to map from 104 Objects to 61850 Objects?



com.tom WEB-PLC – Settings

Event Log Login Portal Network Cellular Modem Modbus IEC 60870-5-104 Server

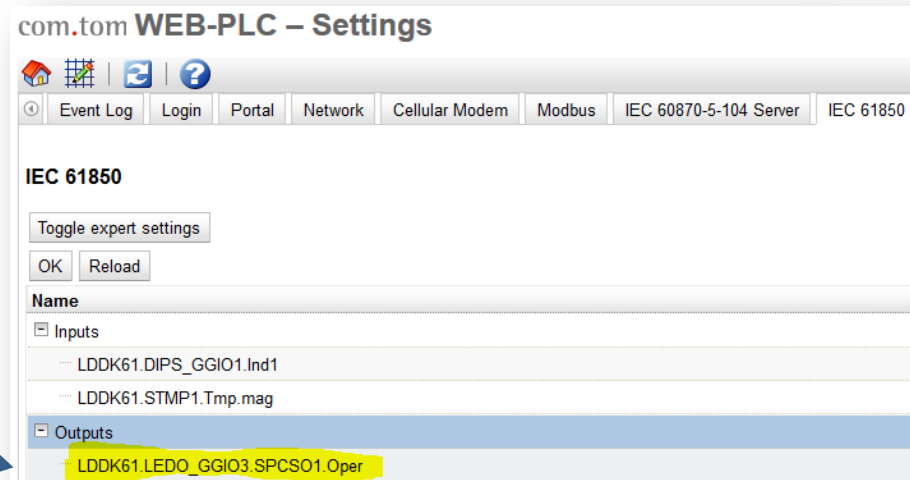
IEC 60870-5-104 Server

Name	Type ID	IOA	Range
Inputs			
Type=45, IOA=2000, CA=1	Single command (45)	2000	1
Outputs			

Add Edit Delete Clone

Settings

Common Address: 1 (1..65535)



com.tom WEB-PLC – Settings

Event Log Login Portal Network Cellular Modem Modbus IEC 60870-5-104 Server IEC 61850

IEC 61850

Toggle expert settings

OK Reload

Name

Inputs

- LDDK61.DIPS_GGIO1.Ind1
- LDDK61.STMP1.Tmp.mag

Outputs

- LDDK61.LEDO_GGIO3.SPCSO1.Oper

WEB-PLC Editor: Use Inputs and Outputs

The image shows a Firefox browser window displaying the 'com.tom WEB-PLC - Editor' interface. The address bar shows '192.168.178.120/sec/editor.html'. The main workspace contains a grid with a context menu open over it. The menu items include 'Input 0' through 'Input 3', 'Modbus Master', 'IEC 60870-5-104 server', 'IEC 61850', 'Output 0' through 'Output 3', 'Modbus Master', 'IEC 60870-5-104 server', and 'IEC 61850'. A blue box with the text 'How to bind Input to Output?' has arrows pointing to the 'IEC 60870-5-104 server' and 'IEC 61850' options in the menu. A dashed blue arrow labeled '4' points from a settings window to the editor. A dashed blue arrow labeled '5' points from the 'IEC 60870-5-104 server' option to the 'Type=45, IOA=2000, CA=1' option. Another dashed blue arrow points from the 'IEC 61850' option to the 'LDDK61.LEDO_GGIO3.SPCSO1.Oper' option. Two inset windows show configuration details: the top-left window shows the 'IEC 60870-5-104 Server' settings with a table of inputs and outputs, and the bottom-left window shows the 'IEC 61850' settings with a list of inputs and outputs. A copyright notice at the bottom right reads 'Copyright © 2013 Beck IPC GmbH'. A notification at the bottom says 'Firefox sendet automatisch einige Daten an Mozilla, damit die Benutzerzufriedenheit verbessert werden kann.' with a button 'Zu übermittelnde Daten festlegen'.

com.tom WEB-PLC - Settings

IEC 60870-5-104 Server

Name	Type ID	IOA	Range
Type=45, IOA=2000, CA=1	Single command (45)	2000	1

Settings

Common Address: 1 (1.65535)

com.tom WEB-PLC - Settings

IEC 61850

Toggle expert settings

OK Reload

Name

Inputs

- LDDK61.DIPS_GGIO1.Ind1
- LDDK61.STMP1.Tmp.mag

Outputs

- LDDK61.LEDO_GGIO3.SPCSO1.Oper

Firefox

com.tom WEB-PLC - Editor

192.168.178.120/sec/editor.html

com.tom WEB-PLC - Editor

BECK THE POINT OF SYNERGY

Input 0

Input 1

Input 2

Input 3

Modbus Master

IEC 60870-5-104 server

IEC 61850

Output 0

Output 1

Output 2

Output 3

Modbus Master

IEC 60870-5-104 server

IEC 61850

Type=45, IOA=2000, CA=1

LDDK61.LEDO_GGIO3.SPCSO1.Oper

Copyright © 2013 Beck IPC GmbH

Firefox sendet automatisch einige Daten an Mozilla, damit die Benutzerzufriedenheit verbessert werden kann.

Zu übermittelnde Daten festlegen

WEB-PLC Editor: Use Inputs and Outputs

- 4 Open WEB-PLC Editor to configure Logic, use Inputs and Outputs
- 5 The upper list exposes all Inputs (local, Modbus, 104, and 61850); the lower part shows the list of all Outputs.

WEB-PLC Editor: Place objects on work area

IEC 60870-5-104 server
Type=45, IOA=2000, CA=1

Val	IEC 60870-5-104 server ▶	Type=45, IOA=2000, CA=1
Qual	IEC 61850	
TS	Output 0	
	Output 1	

6

Input

IEC 60870-5-104 server
Type=45, IOA=2000, CA=1

Val	Modbus Master ▶	
Qual	IEC 60870-5-104 server ▶	
TS	IEC 61850	
	Output 0	
	Output 1	
	Output 2	
	Output 3	
	Modbus Master ▶	
	IEC 60870-5-104 server ▶	
	IEC 61850	

Output

IEC 61850
LDDK61.LEDO_GGIO3.SPCS01.Oper

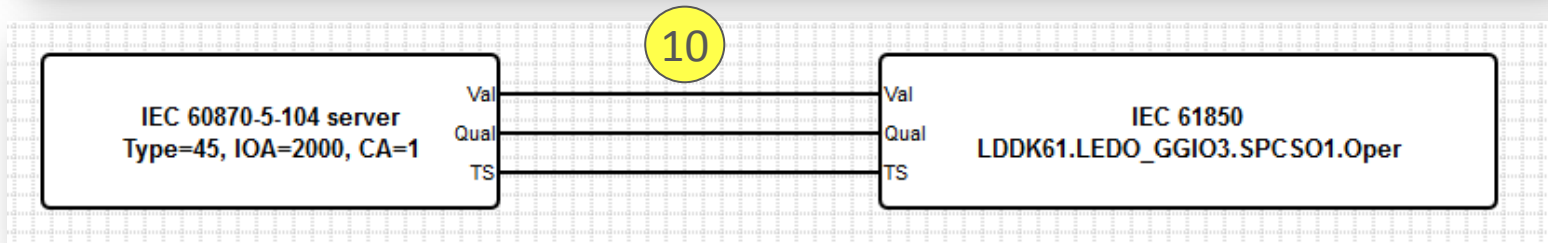
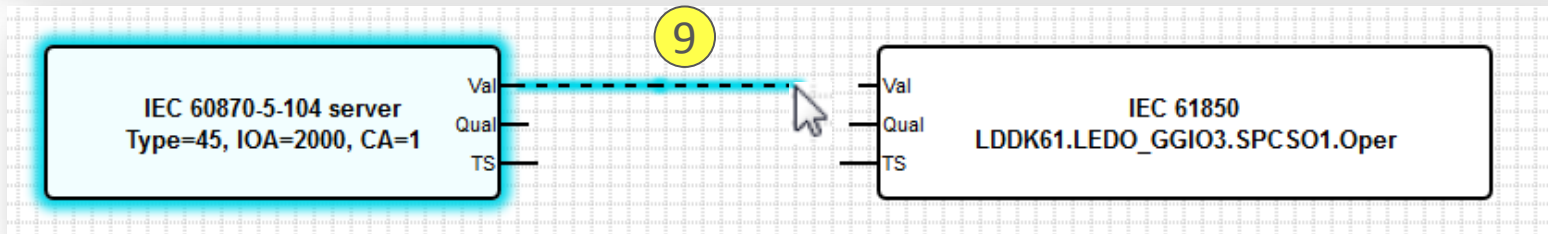
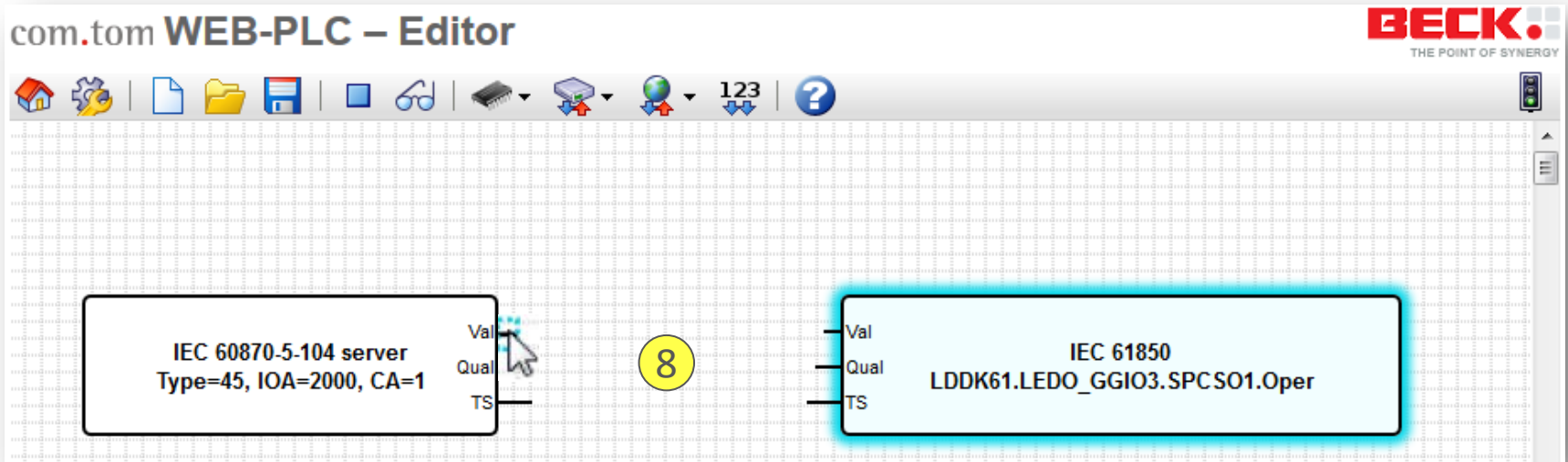
Val	IEC 61850 ▶	LDDK61.LEDO_GGIO3.SPCS01.Oper
Qual		
TS		

7

WEB-PLC Editor: Place objects on work area

- 6 **Select Input** “IEC 60870-5-104 server / Type=45, IOA=2000, CA=1” and left Mouse click → places graphical box with Val, Quality and Timestamp to be used as Input to WEB-PLC. Box can be freely moved.
The 104 Object is used to **Receive a 104 Operate command** from a 104 client (e.g., control center)
- 7 **Select Output** “IEC 61850 / LDDK61.LEDO_GGIO1.SPCSO1.Oper” and left Mouse click → places graphical box with Val, Quality and Timestamp to be used as Output from WEB-PLC.
The 61850 Object is used to **Send a 61850 Operate message** to the underlying DK61 (61850 Server) to switch the first LED on.

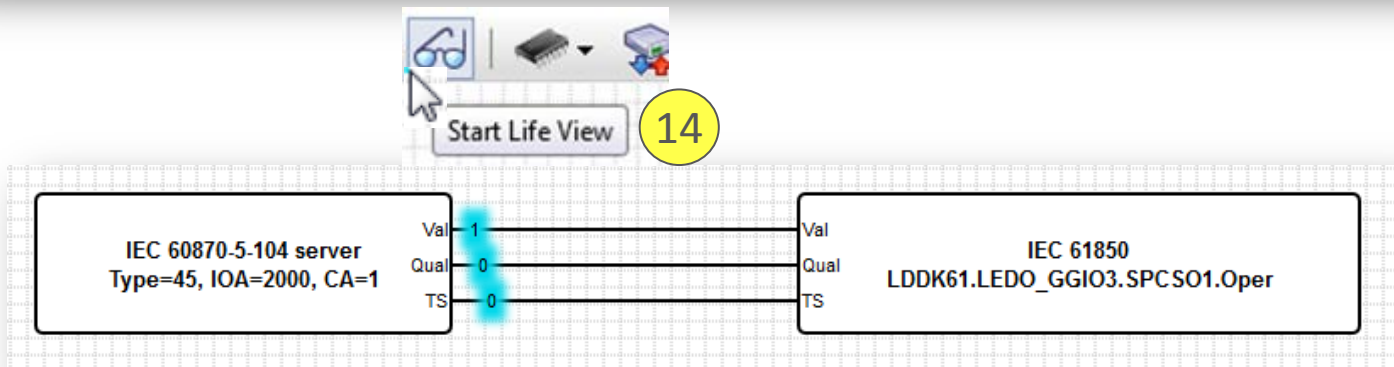
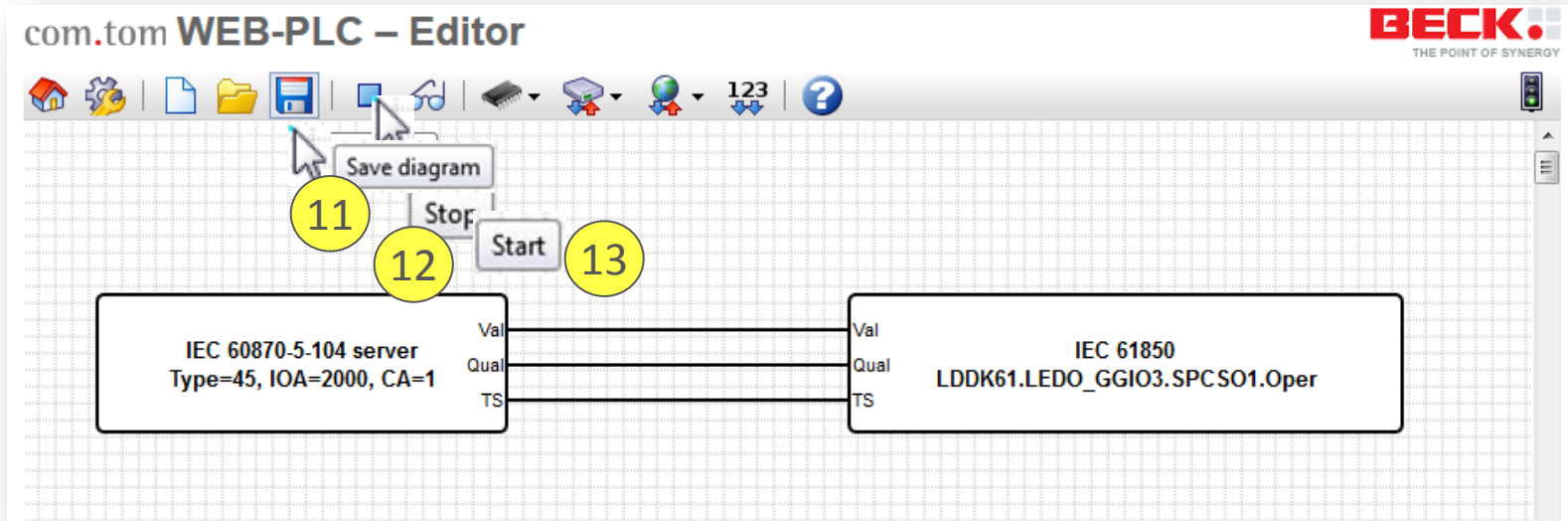
WEB-PLC Editor: Connect Input with Output



WEB-PLC Editor: Connect Input with Output

- 8 Select Val of Input.
- 9 Draw line from Input to Output (or Output to Input) of the Val of the IEC 61850 Object to the Val of the Output of the IEC 60870-5-104 object.
- 10 Repeat for Quality and Timestamp.

WEB-PLC Editor: Save, Stop, and Start PLC



WEB-PLC Editor: Save, Stop, and Start PLC

- 11 Save Diagram (application) to com.tom
- 12 Stop application (could be done earlier as well)
- 13 Start Diagram (application)
- 14 Start Life View of values in the diagram

The Gateway is ready to be used in control and monitoring direction – the kind of signals depends on the Objects generated: 104 Objects have to be manually generated. The 61850 Objects are automatically generated.

The generation of the 61850 Objects requires just a manual selection of the signals to be used on the WEB-PLC by clicking on the signals needed.

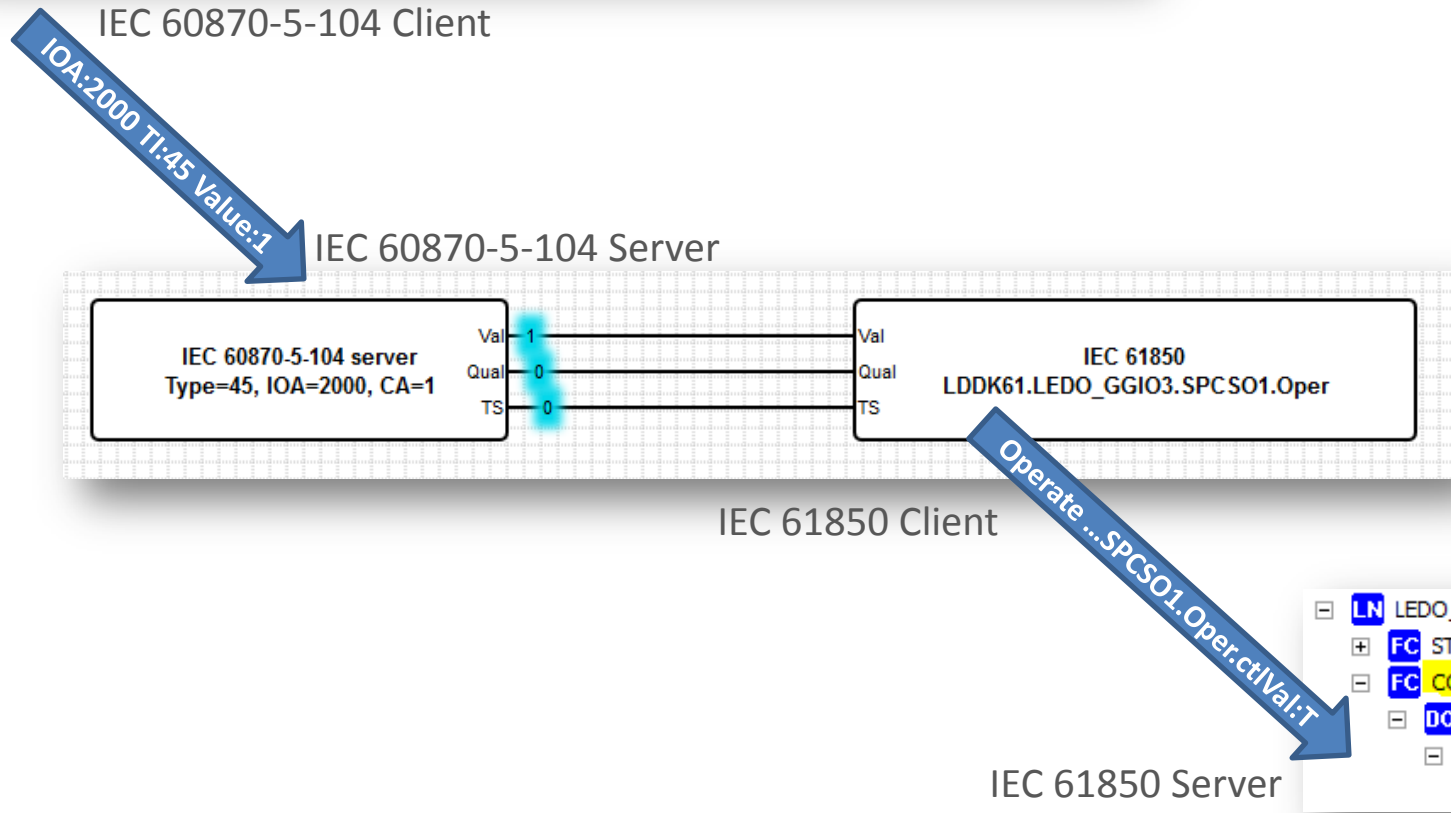
The whole process of generation the Private elements with the five Fields needed by the IEC 61850 Stack/API is hidden – no need to look into the “decorated” CID File used by the IEC 61850 Client Application.

WEB-PLC: Receive Command and issue Operate

QTester104 IEC60870-5-104

15

Command Address	Command Value	Command Type
Send Command 2000	1	45: Single - C_SC_NA_1



WEB-PLC: Receive Command and issue Operate

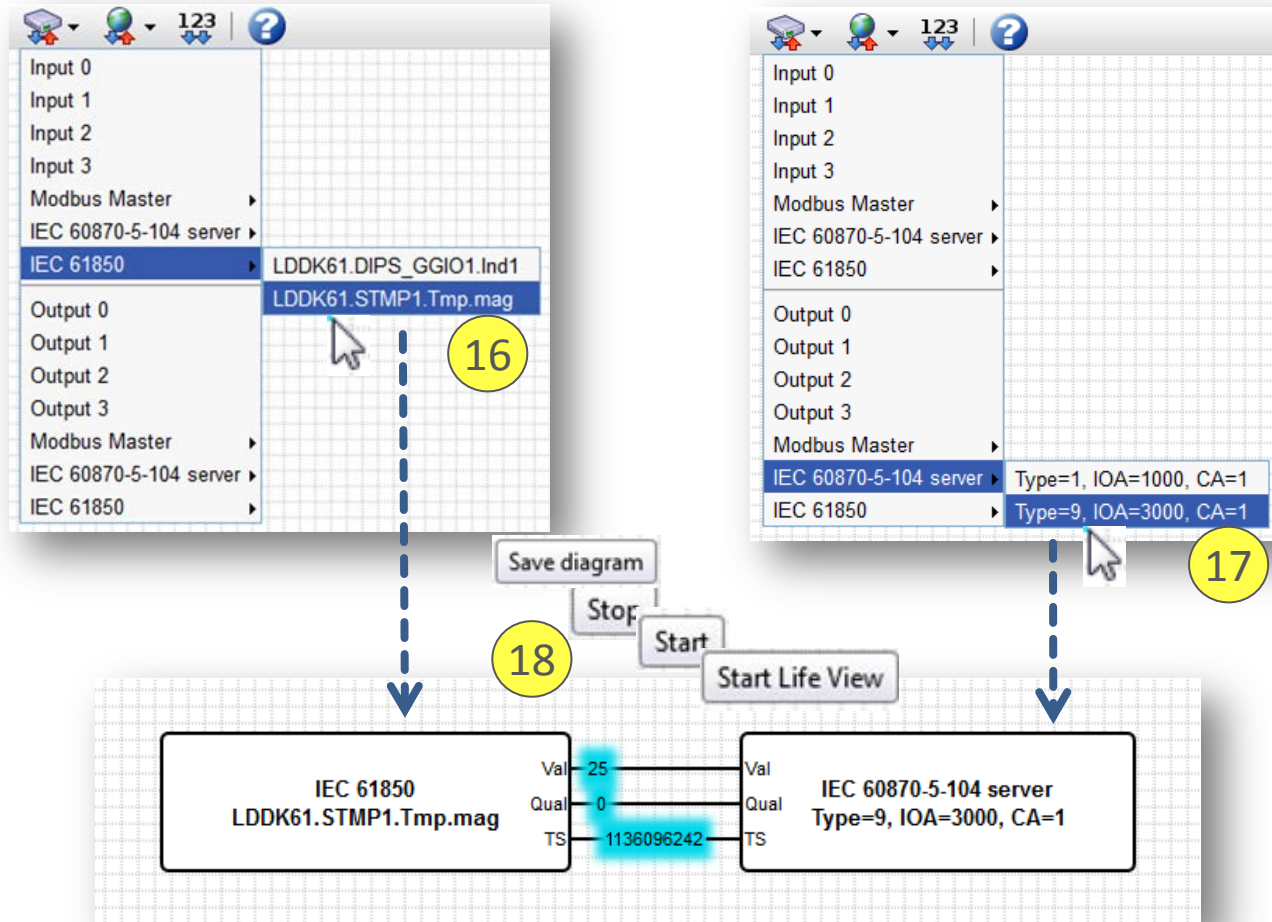
- 15 Used the QTester as 104 Client to send a command to the 104 server:

IOA:2000 TI:45 Value:1 → this is a 104 Single Command with value 1 (True)

The Value is received by the 104 Server and forwarded through the WEB-PLC to the IEC 61850 Client that issued an Operate message to the corresponding Control Object “SPCSO1.OperctlVal” of the 61850 Server in the DK61.

The “SPCSO1.OperctlVal” is bound to the first physical LED on the DK61.

WEB-PLC: Configure for Measurement



WEB-PLC: Configuration for Measurement

The next task is to spontaneously communicate a change in Temperature sensed by the DK61 (IEC 61850 Server) and forward a 104 message through the Gateway.

- 16 For this purpose the WEB-PLC Input Object “STMP1.Tmp.mag” (already available, derived automatically from the com.tom Client CID File) needs to be placed on the diagram screen.
- 17 Second the 104 Server Output Object needs to be placed on the diagram screen (Type=9, IOA=3000, CA=1).
- 18 Connect Input with Output, save the diagram (application) to the com.tom, Stop the old application, and Start the new ... and Start Life View.

Note: The IEC 61850 Client automatically connects with the Server (DK61) using the CID File (that has the IP Address and all Report Control Block instances). **The Client and Server are connected in a Plug&Play fashion.** The first value change of the Temperature causes a spontaneous Report message with the new value (25 °C).

WEB-PLC: Forwards Measurement (spontaneously)

```

COMMAND ACT CONF INDICATION
<-- BDTR: COMMAND ACCEPTED BY IEC104 SLAVE
14:57:53 --> 016: 68 0e 1e 00 08 00 2d 01 0a 00 01 00 d0 07 00 01
CA 1 TYPE 45 CAUSE 10 SQ 0 NUM 1
ACTIVATION TERMINATION POSITIVE SINGLE COMMAND ADDRESS 2000 SCS 1 QU
COMMAND ACT TERM INDICATION
14:57:55 <-- SUPERVISORY 20
14:58:02 <-- TESTFRACT
--> 006: 68 04 83 00 00 00
TESTFRCON
17:21:38 --> 018: 68 10 20 00 08 00 09 01 03 00 01 00 b8 0b 00 19 00 00
CA 1 TYPE 9 CAUSE 3 SQ 0 NUM 1
    
```

	Address	Value	Type	Cause
1	01000	0.000000	1	20
2	03000	25.000000	9	3

IEC 60870-5-104 Client

IOA:3000 TI:09 Value:25

com.tom WEB-PLC – Editor

IEC 60870-5-104 Server

IEC 61850
LDDK61.STMP1.Tmp.mag

Val: 25
Qual: 0
TS: 1136096242

IEC 60870-5-104 server
Type=9, IOA=3000, CA=1

IEC 61850 Client

Temperature changes

Spontaneous Report Tmp.mag:25

```

LN STMP1
FC MX
DO Tmp
  DA mag 19
  DA q
  DA t
    
```

IEC 61850 Server

WEB-PLC: Forward Measurement (spontaneously)

- 19 Every 1 °C value change of the Temperature causes a spontaneous Report message with the new Temperature value from DK61 (IEC 61850 Server) to the com.tom (IEC 61850 Client → IEC 60870-5-104 Server).
The 104 Server issues a spontaneous message (Ti:09 - measured value).

Content

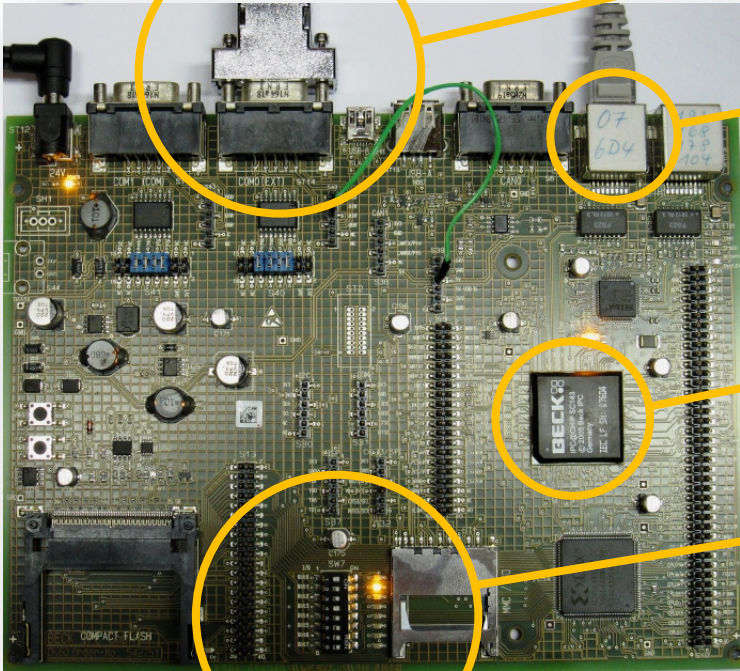
Situation, Objectives, Summary, Introduction, ...

WEB-PLC for Gateway IEC 61850 to IEC 60870-5-104

Background IEC 61850 Application (architecture, ...)

Former example (first steps) – kept for information

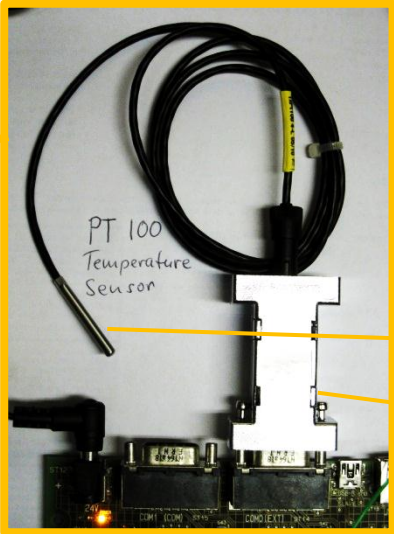
Process I/Os for our application at DK61



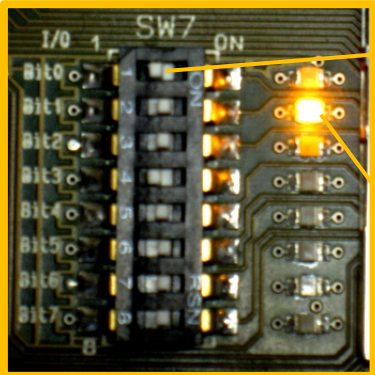
Ethernet

Embedded Controller

Beck IPC DK61



Temperature Sensor:
PT 100
@ RS 232 A/D Converter



8 Digital Input (DIP Switches)
DIP 1-4: Status
DIP 5-8: Alarm

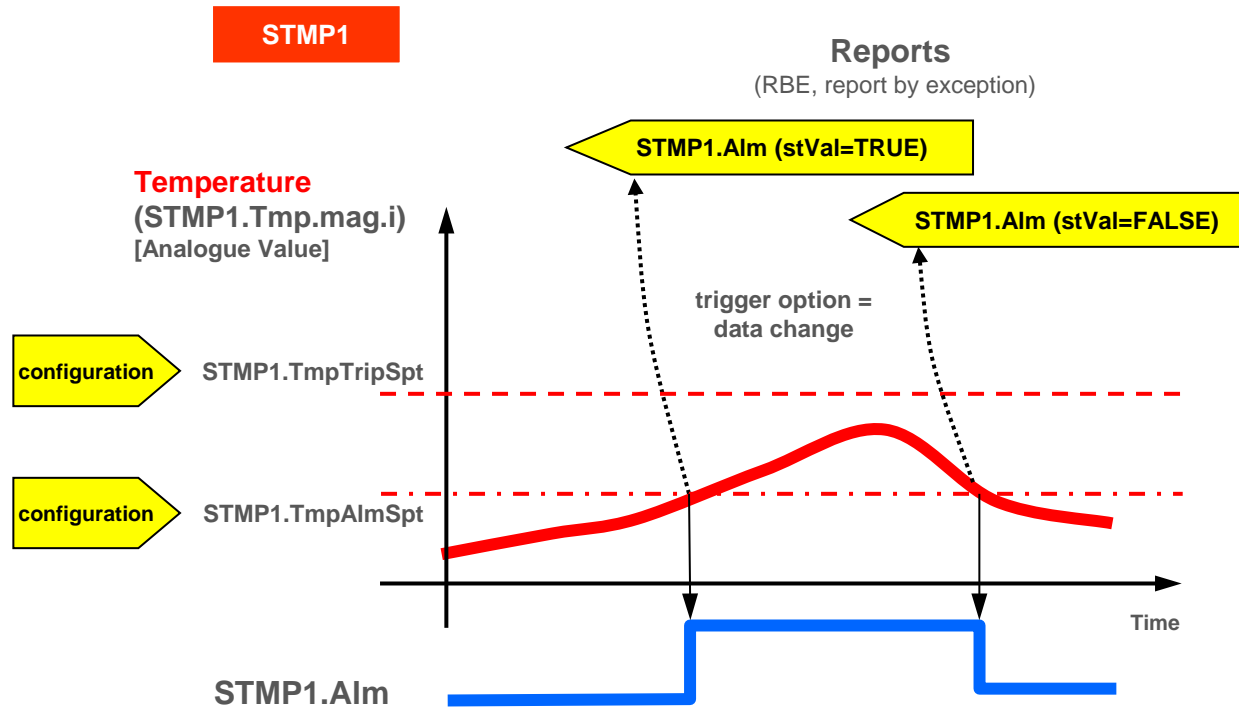
8 Digital Output (LEDs)

Application on DK61 in C++; could run on com.tom as well.

Model (Standard) – IEC 61850-7-4/7-3

		7-4 STMP class		
Data object name	Common data class			Expla
LNName	instMag	AnalogueValue	7-3	MX
Data objects	mag	AnalogueValue		MX dchg
Descriptions	range	ENUMERATED		MX dchg
	q	Quality		MX qchg
EENAME	t	TimeStamp		MX
Status information				
EEHealth	ENS	External equipment health		
Alm	SPS	Temperature alarm level reached		
Trip	SPS	Temperature trip level reached		
Measured and metered values				
Tmp	MV	Temperature		
Controls				
OpCntRs	INC	Resettable operation counter		
Settings				
TmpAlmSpt	ASG	Temperature alarm level set-point		
TmpTripSpt	ASG	Temperature trip level set-point		

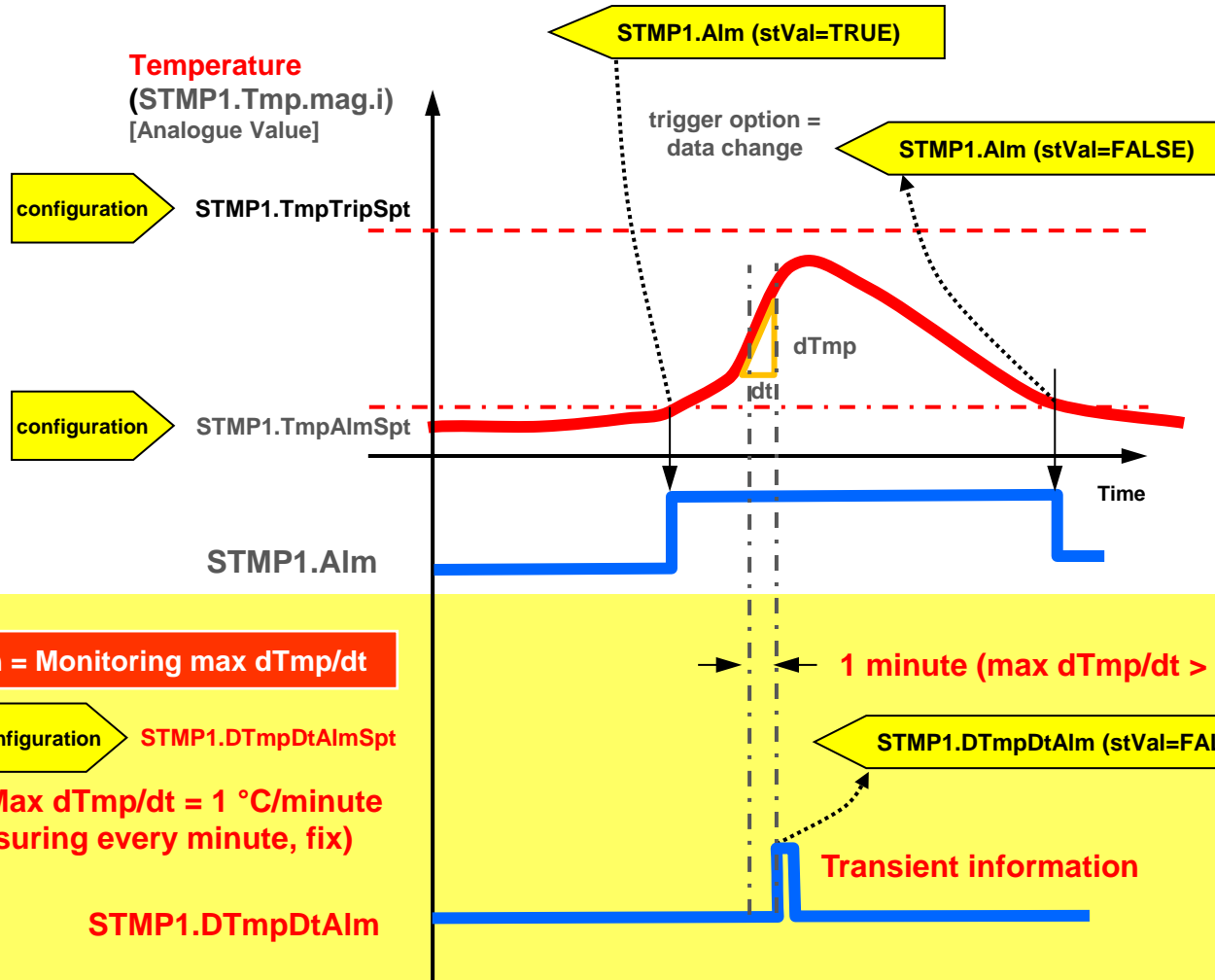
Model (Standard) – IEC 61850-7-4



Function and model extension

STMP1

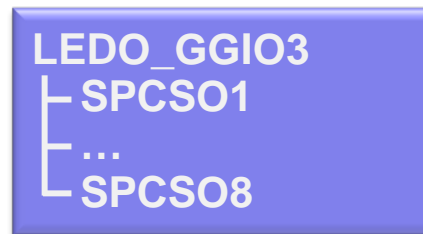
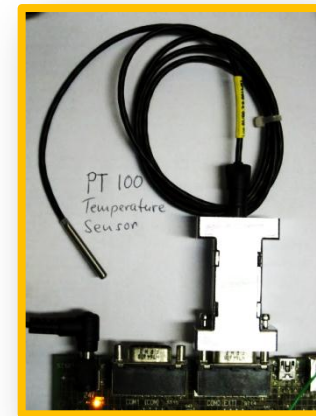
Reports
(RBE, report by exception)



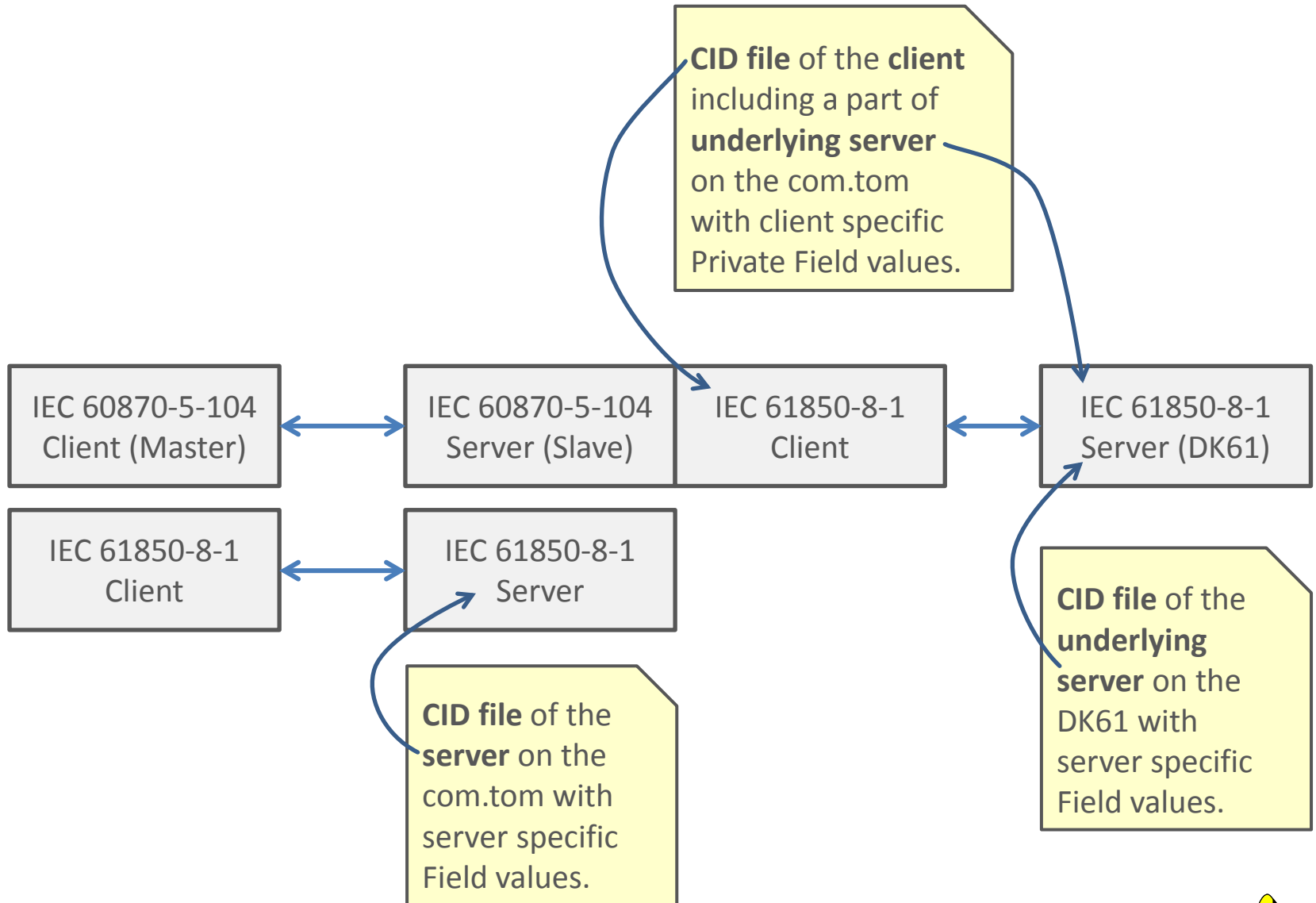
LN STMP Model extension

STMP class				
Data object name	Common data class	Explanation	T	M/O/C
LNName		The name shall be composed of the class name, the LN-Prefix and LN-Instance-ID according to IEC 61850-7-2, Clause 22.		
Data objects				
<i>Descriptions</i>				
EEName	DPL	External equipment nameplate		O
<i>Status information</i>				
EEHealth	ENS	External equipment health		O
Alm	SPS	Temperature alarm level reached		O
Trip	SPS	Temperature trip level reached		O
DTmpDtAlm	SPS	Temperature gradient alarm level reached (Name space: NA course)	T	O/EX
<i>Measured and metered values</i>				
Tmp	MV	Temperature		O
<i>Controls</i>				
OpCntRs	INC	Resettable operation counter		O
<i>Settings</i>				
TmpAlmSpt	ASG	Temperature alarm level set-point		O
TmpTripSpt	ASG	Temperature trip level set-point		O
DTmpDtAlmSpt	ASG	Temperature gradient alarm level set-point (Name space: NA course)		O/EX

Logical Node Classes and Data Objects used for example



Required SCL Files for the Gateway



Required SCL Files for the Gateway

without_iec61850cli.icd

```

6 <Communication>
7 <SubNetwork name="SubNetworkName">
8   <ConnectedAP iedName="MyClient" apName="SubstationRing1">
9     <Address>
10      <P type="IP">192.168.2.35</P>
11      <P type="IP-SUBNET">255.255.255.0</P>
12      <P type="IP-GATEWAY">192.168.2.1</P>
13      <P type="OSI-TSEL">00000001</P>
14      <P type="OSI-PSEL">01</P>
15      <P type="OSI-SSEL">01</P>
16    </Address>
17  </ConnectedAP>
18  <ConnectedAP iedName="DK61" apName="SubstationRing1">
19    <Address>
20      <P type="OSI-AP-Title">1,1,9999,1</P>
21      <P type="OSI-AE-Qualifier">12</P>
22      <P type="OSI-PSEL">00000001</P>
23      <P type="OSI-SSEL">0001</P>
24      <P type="OSI-TSEL">0001</P>
25      <P type="IP">192.168.2.36</P>
26      <P type="IP-SUBNET">255.255.255.0</P>
27      <P type="IP-GATEWAY">192.168.2.1</P>
28    </Address>
29    <GSE ldInst="LDevice1" cbName="GSE_CB_GOOSE">
30      <Address>
31        <P type="MAC-Address">01-0C-CD-01-00-36</P>
32        <P type="VLAN-PRIORITY">4</P>
33        <P type="VLAN-ID">0</P>
34        <P type="APPID">0</P>
35      </Address>
36    </GSE>
37    <GSE ldInst="LDevice1" cbName="Tmp_Trip_CB_GOOSE">
38      <Address>
39        <P type="MAC-Address">01-0C-CD-01-00-37</P>
40        <P type="VLAN-PRIORITY">4</P>
41        <P type="VLAN-ID">0</P>
42        <P type="APPID">0</P>
43      </Address>
44    </GSE>
45  </ConnectedAP>
46 </SubNetwork>
47 </Communication>
48 <IED name="MyClient">
49   <AccessPoint name="SubstationRing1">
50     <LN lnClass="IHMI" inst="1" lnType="IHMIa"/>
51   </AccessPoint>
52 </IED>
53 <IED type="Monitoring-Device" manufacturer="SystemCORP Pty Ltd / NettedAutomation" configVersion="1.1" name="DK61">
54   <Services>
55     <DynAssociation/>

```

CID file of the client including a part of underlying server on the com.tom with client specific Private Field values.

IEC 61850-8-1 Client

IEC 61850-8-1 Server (DK61)

CID file of the underlying server on the DK61 with server specific Field values.

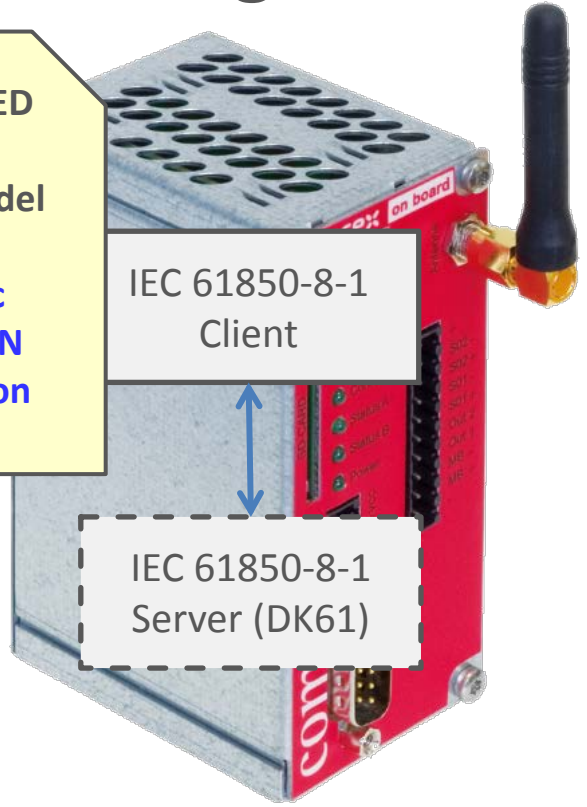
SCL File: Not yet Decorated by Settings Process

without_iec61850cli.icd

```

- <SCL xmlns="http://www.iec.ch/61850/2003/SCL" xmlns
  <!-- ICD file for Demo on Beck IOC DK61 - generated fo
  <!-- ICD file for Demo on Beck IOC DK61 - generated fo
  limits min and max; 2013-04-20 11:00-->
  <Header version="3" id="" />
  + <Communication>
  - <IED name="MyClient">
    - <AccessPoint name="SubstationRing1">
      <LN InType="IHMIa" inst="1" InClass="IHMI"/>
    </AccessPoint>
  </IED>
  - <IED name="DK61" type="Monitoring-Device" configVers
    + <Services>
    - <AccessPoint name="SubstationRing1">
      - <Server timeout="30">
        <Authentication/>
        - <LDevice inst="LDevice1" desc="">
          + <LN0 InType="LLNO_0" inst="" InClass="LLNO">
          + <LN InType="LPHD_0" inst="" InClass="LPHD" prefix="">
          <LN InType="GGIO_0" inst="1" InClass="GGIO" prefix="DIPS_"/>
          <LN InType="GGIO_10" inst="2" InClass="GGIO" prefix="DIPS_"/>
          <LN InType="GGIO_17" inst="3" InClass="GGIO" prefix="LEDO_"/>
          <LN InType="STMP_0" inst="1" InClass="STMP" prefix="" />
          <LN InType="TTMP_0" inst="1" InClass="TTMP" prefix="" />
        </LDevice>
      </Server>
    </AccessPoint>
  </IED>
  - <DataTypeTemplates>
  - <LNNodeType id="LLNO_0" InClass="LLNO">
    <DO name="Mod" type="INC_1"/>
    <DO name="Beh" type="INS_2"/>
    <DO name="Health" type="INS_3"/>
    <DO name="NamPlt" type="LPL_0"/>
  </LNNodeType>
  - <LNNodeType id="LPHD_0" InClass="LPHD">
    <DO name="PhyNam" type="DPL_0"/>
    <DO name="PhyHealth" type="INS_0"/>
    <DO name="Proxy" type="SPS_0"/>
  </LNNodeType>
  - <LNNodeType id="STMP_0" InClass="STMP">
    <DO name="Mod" type="INC_1"/>
  </LNNodeType>
  </DataTypeTemplates>
  </Communication>
  </SCL>
  
```

CID file of the client-IED includes a part of underlying server model on the com.tom; without client specific Private Field values; LN instances in IED Section are "empty".



IEC 61850-8-1 Client

IEC 61850-8-1 Server (DK61)

This SCL file is parsed by the WEB-PLC Settings process.

SCL File: Decorated by Settings Process

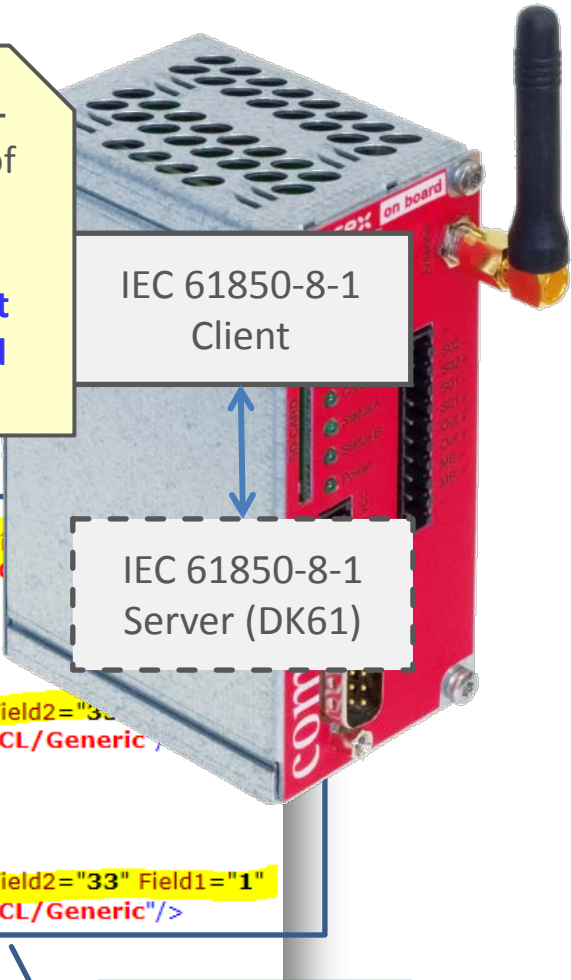
with_iec61850cli.icd → after decoration

```

- <LN InType="GGIO_0" inst="1" InClass="GGIO" prefix="DIPS" >
  + <DOI name="Mod">
  + <DOI name="Beh">
  + <DOI name="Health">
  + <DOI name="NamPlt">
  - <DOI name="Ind1">
    - <DAI name="stVal">
      - <Private type="SystemCorp_Generic">
        <SystemCorp_Generic:GenericPrivateObject Field5="1" Field4="7" Field3="45" Field2="33" Field1="1"
          xmlns:SystemCorp_Generic="http://www.systemcorp.com.au/61850/SCL/Generic">
        </Private>
      </DAI>
    - <DAI name="q">
      - <Private type="SystemCorp_Generic">
        <SystemCorp_Generic:GenericPrivateObject Field5="2" Field4="7" Field3="45" Field2="33" Field1="1"
          xmlns:SystemCorp_Generic="http://www.systemcorp.com.au/61850/SCL/Generic">
        </Private>
      </DAI>
    - <DAI name="t">
      - <Private type="SystemCorp_Generic">
        <SystemCorp_Generic:GenericPrivateObject Field5="4" Field4="7" Field3="45" Field2="33" Field1="1"
          xmlns:SystemCorp_Generic="http://www.systemcorp.com.au/61850/SCL/Generic">
        </Private>
      </DAI>
    </DOI>
  + <DOI name="Ind2">
  + <DOI name="Ind3">
  + <DOI name="Ind4">
</LN>

```

CID file of the client-IED includes a part of underlying server model on the com.tom; with client specific Private Field values



API Bindings automatically generated

Content

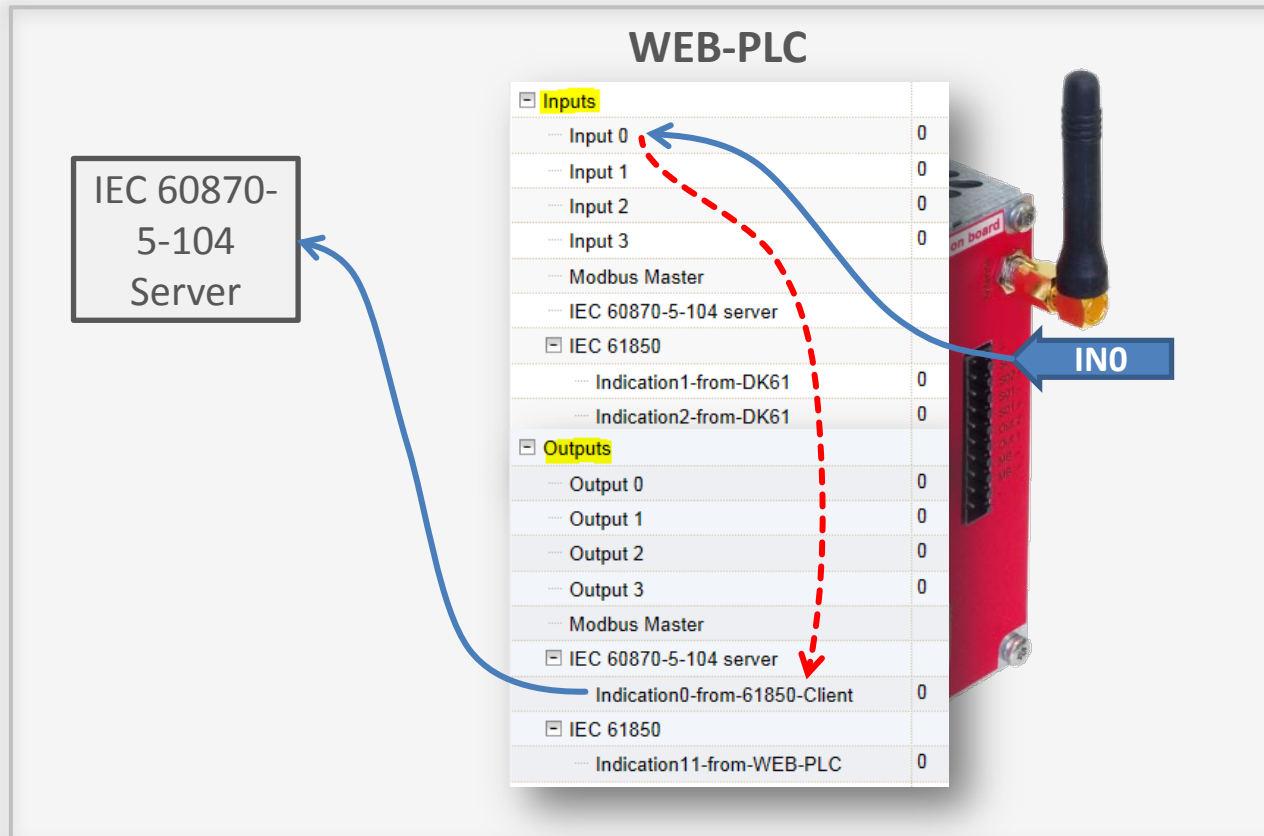
Situation, Objectives, Summary, Introduction, ...

WEB-PLC for Gateway IEC 61850 to IEC 60870-5-104

Background IEC 61850 Application (architecture, ...)

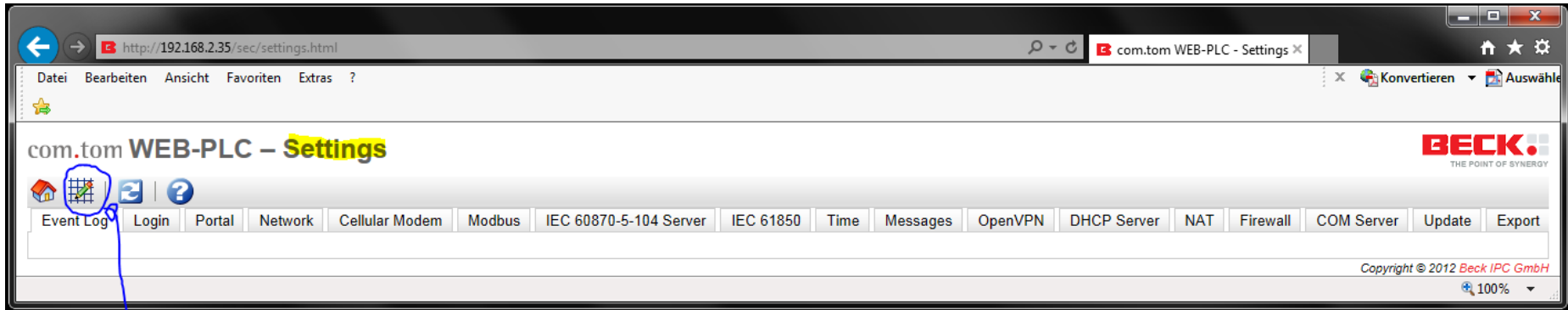
Former example (first steps) – kept for information

Use case 1 (com.tom RTU)

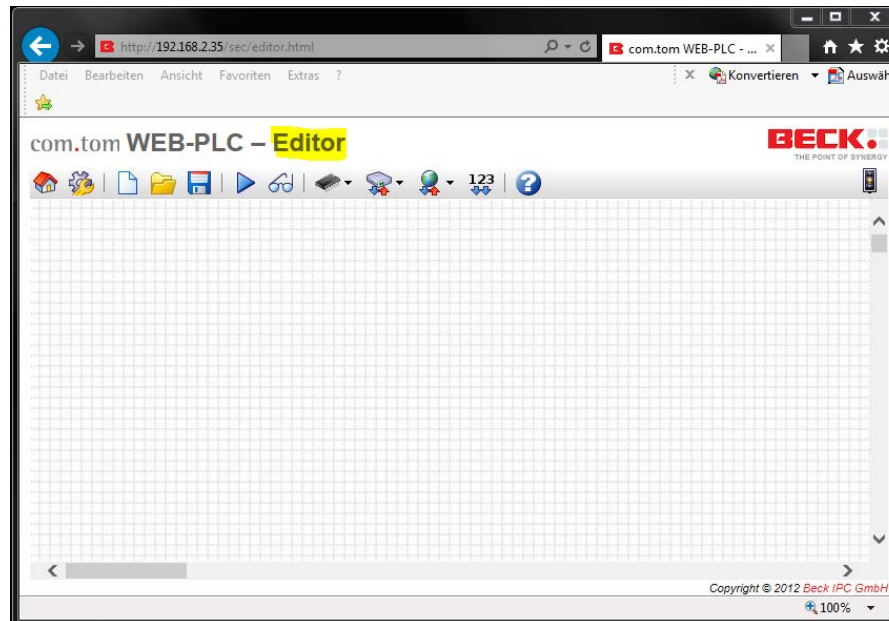


- Use com.tom as RTU like device
 - Input from terminal
 - Send spontaneous message over IEC 60870-5-104

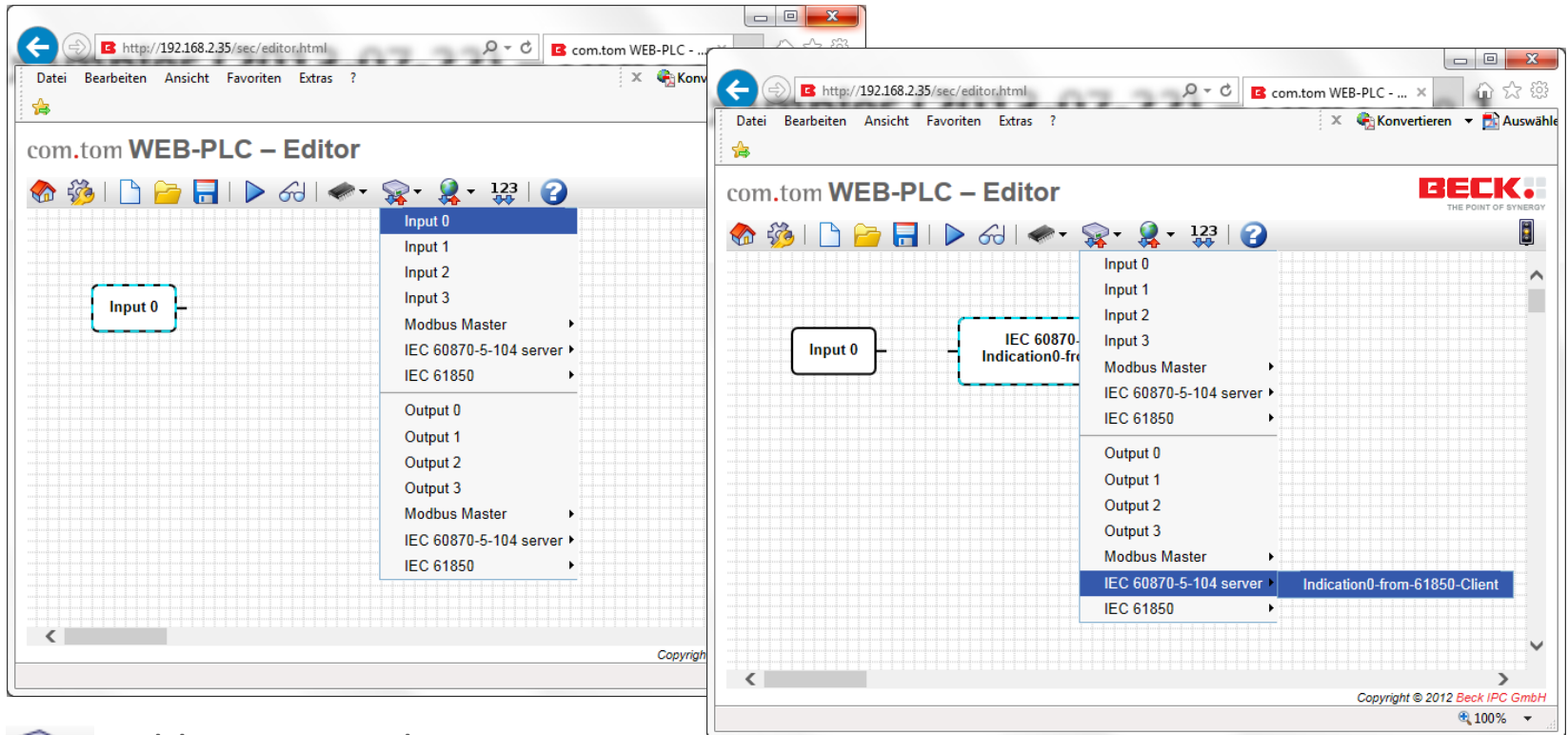
Use case 1 (com.tom RTU)



Use the **Editor** icon to go to the WEB-PLC editor.



Use case 1 (configure input and output)

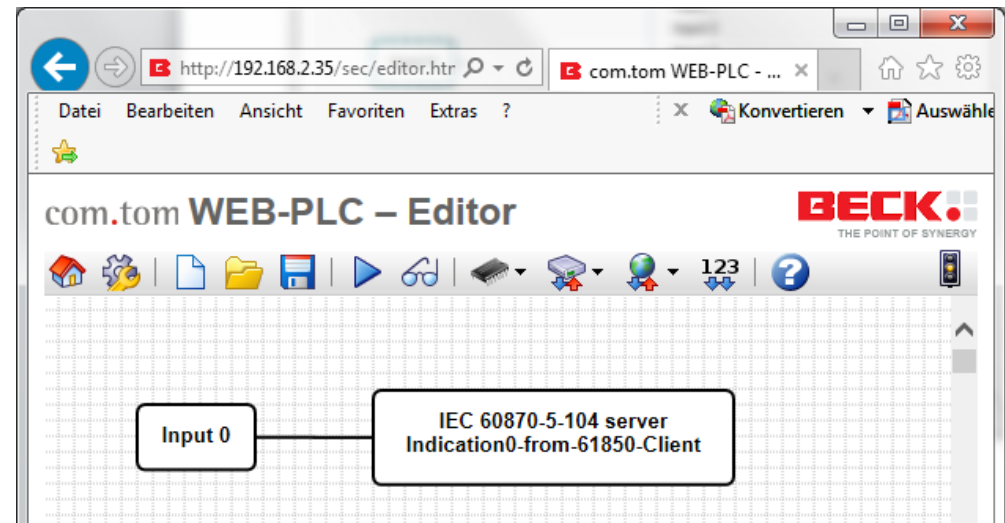
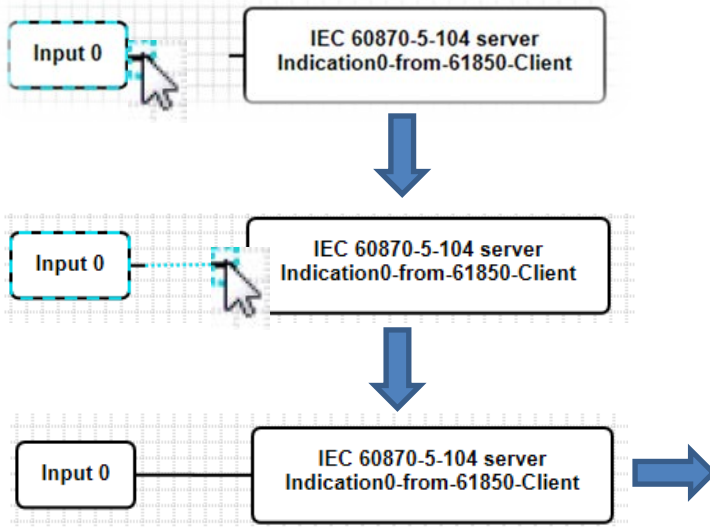


Add input signal Input0
(representing the first physical I/O of the com.tom)






Add 104 output signal Indication0-from-61850-Client
(representing a single point 104 indication; Name "Indication0-from-61850-Client" is used for later use with 61850 client)



Use case 1 (bind input to output)

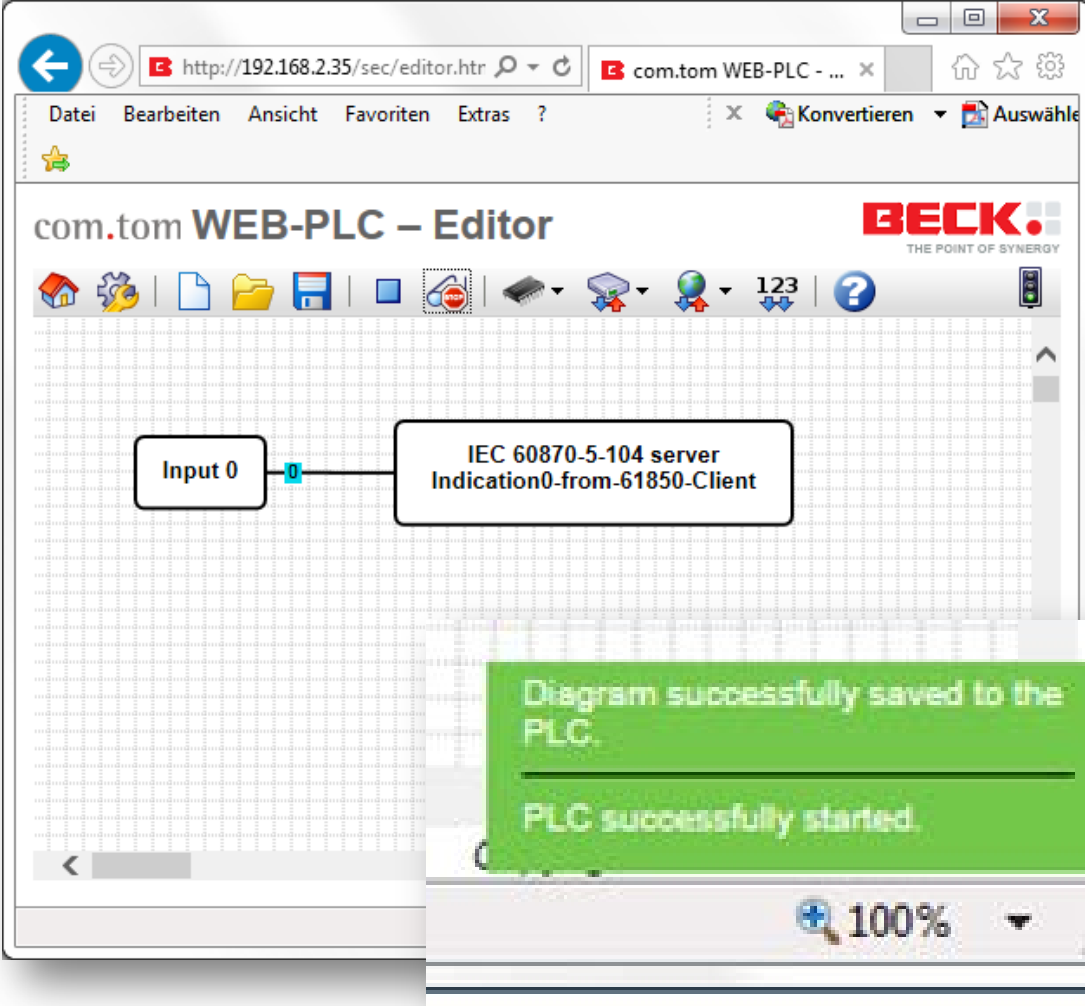


To create a connector between the two press the left mouse button while the cursor is over one of the ports ... drag the appearing blue dotted line ... and release the mouse button ... DONE

-  Press the *Save diagram* icon to store the diagram on the device.
-  To start execution, press the *Start* icon.
-  Press the *Start Life View* icon.

Use case 1 (save on com.tom and start)

-  Save diagram
-  and start PLC



com.tom WEB-PLC – Editor

BECK
THE POINT OF SYNERGY

Input 0 — IEC 60870-5-104 server
Indication0-from-61850-Client

Diagram successfully saved to the PLC.

PLC successfully started.

100%

Use case 1 (change physical input signal)

Change input to true.

com.tom WEB-PLC – Editor

BECKHOF
THE POINT OF SYNERGY

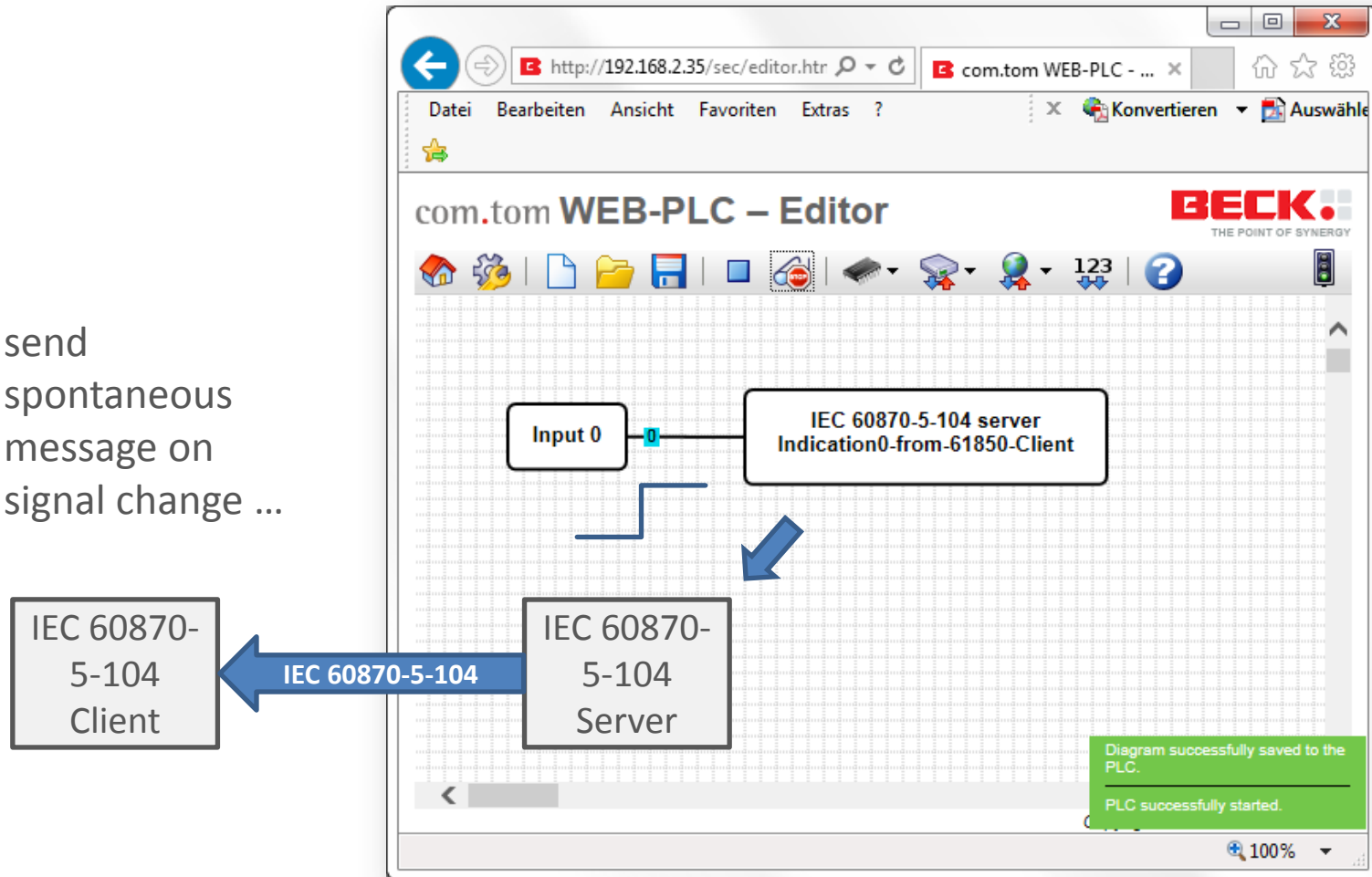
Input 0 — 0 — IEC 60870-5-104 server Indication0-from-61850-Client

Diagram successfully saved to the PLC.
PLC successfully started.

100%

Use case 1 (send spontaneous message)

send
spontaneous
message on
signal change ...



Use case 1 (receive spontaneous message)

QTester104 IEC60870-5-104

v1.04 © 2010,2011,2012 Ricardo L. Olsen

Remote IP Address: 192.168.2.35
Remote Link Address: 1
Local Link Address: 0
Primary: TCP CONNECTED!

Command Address: []
Command Value: []
Command Type: 45: Single - C_SC_NA_1
Command Duration: 0 = no additional definition
SBO: []

Log Messages AutoScroll

```
--> 016: 68 0e 0a 00 02 00 64 01 0a 00 01 00 00 00 00 14
CA 1 TYPE 100 CAUSE 10 SQ 0 NUM 1
INTERROGATION ACT TERM -----
Total objects in GI: 1
<-- BDTR: INTERROGATION END
<-- SUPERVISORY c
--> 016: 68 0e 0c 00 02 00 01 01 03 00 01 00 e8 03 00 00
CA 1 TYPE 1 CAUSE 3 SQ 0 NUM 1
19:38:12 <-- SUPERVISORY e
19:38:19 <-- TESTFRACT
--> 006: 68 04 83 00 00 00
TESTFRCON
19:39:14 --> 016: 68 0e 0e 00 02 00 01 01 03 00 01 00 e8 03 00 01
CA 1 TYPE 1 CAUSE 3 SQ 0 NUM 1
19:39:18 <-- SUPERVISORY 10
19:39:24 <-- TESTFRACT
19:39:25 --> 006: 68 04 83 00 00 00
TESTFRCON
19:39:48 --> 016: 68 0e 10 00 02 00 01 01 03 00 01 00 e8 03 00 00
CA 1 TYPE 1 CAUSE 3 SQ 0 NUM 1
19:39:50 --> 016: 68 0e 12 00 02 00 01 01 03 00 01 00 e8 03 00 01
CA 1 TYPE 1 CAUSE 3 SQ 0 NUM 1
19:39:51 <-- SUPERVISORY 14
```

Address	Value	Type	Cause	Flags	Cou
1	1.000000	1	3	on	10

Signal received by 104 client as single-point information with IOA=1000 ...

Use case 1 (settings for IEC 60870-5-104)

The screenshot shows the 'com.tom WEB-PLC - Settings' web interface. The navigation menu includes: Event Log, Login, Portal, Network, Cellular Modem, Modbus, **IEC 60870-5-104 Server**, IEC 61850, Time, Messages, OpenVPN, DHCP Server, NAT, Firewall, COM Server, Update, Export. The main content area is titled 'IEC 60870-5-104 Server' and contains a table of server configurations and a 'Settings' section.

Name	Type ID	IOA	Rang	Interrogation Group	Cyclic trans Index	time
Inputs						
Outputs						
Indication0-from-61850-Client	Single-point information (1)	1000	1	Interrogated by station interrogation (20)	0	0

Settings

Common Address:	1	(1..65535)
Maximum ADPU Size:	253	(20..253)
K:	12	(1..32767)
W:	8	(1..32767)
T0:	30	(1..255)
T1:	15	(1..255)
T2:	10	(1..255)
T3:	20	(1..255)
Character Timeout:	10	(0..255 ms)
TCP Port:	2404	(1..65535)
Short Pulse Time:	500	(100..65000 ms)
Long Pulse Time:	2000	(100..65000 ms)
Buffer Size:	500	(100..1000)
Buffer Full Percentage:	90	(0..100)
Background Scan Percentage:	0	(0..100)
Slow GI Percentage:	0	(0..100)

Details of 104 server (slave or out-station): signal and settings

Use case 1 (settings for IEC 60870-5-104)

Select signal ...

com.tom WEB-PLC – Settings **BECK**
THE POINT OF SYNERGY

Home Portal Network Cellular Modem Modbus **IEC 60870-5-104 Server** IEC 61850 Time Messages OpenVPN DHCP

IEC 60870-5-104 Server

Name	Type ID	IOA	Range	Interrogation Group	Cyclic trans time	Index
Inputs						
Outputs						
Indication0-from-61850-Client	Single-point information (1)	1000	1	Interrogated by station interrogation (20)	0	0

Add Edit Delete Clone

Settings

Common Address:	1	(1..65535)
Maximum ADPU Size:	253	(20..253)
K:	12	(1..32767)
W:	8	(1..32767)
T0:	30	(1..255)
T1:	15	(1..255)
T2:	10	(1..255)
T3:	20	(1..255)
Character Timeout:	10	(0..255 ms)
TCP Port:	2404	(1..65535)
Short Pulse Time:	500	(100..65000 ms)
Long Pulse Time:	2000	(100..65000 ms)
Buffer Size:	500	(100..1000)
Buffer Full Percentage:	90	(0..100)
Background Scan Percentage:	0	(0..100)
Slow GI Percentage:	0	(0..100)

OK Reload

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Use case 1 (settings for IEC 60870-5-104)

com.tom WEB-PLC – Settings

BECK.
THE POINT OF SYNERGY

Login Portal Network Cellular Modem Modbus IEC 60870-5-104 Server IEC 61850 Time Messages OpenVPN DHCP

IEC 60870-5-104 Server

Name	Type ID	IOA	Range	Interrogation Group	Cyclic trans time	Index
Inputs						
Outputs						
Indication0-from-61850-Client	Single-point information (1)	1000	1	Interrogated by station interrogation (20)	0	0

Edit value

Name: Indication0-from-61850-Client (Up to 31 printable ASCII characters)

Type ID: Single-point information (1)

Information Object Address: 1000 (1..16777216)

Range: 1 (1..255)

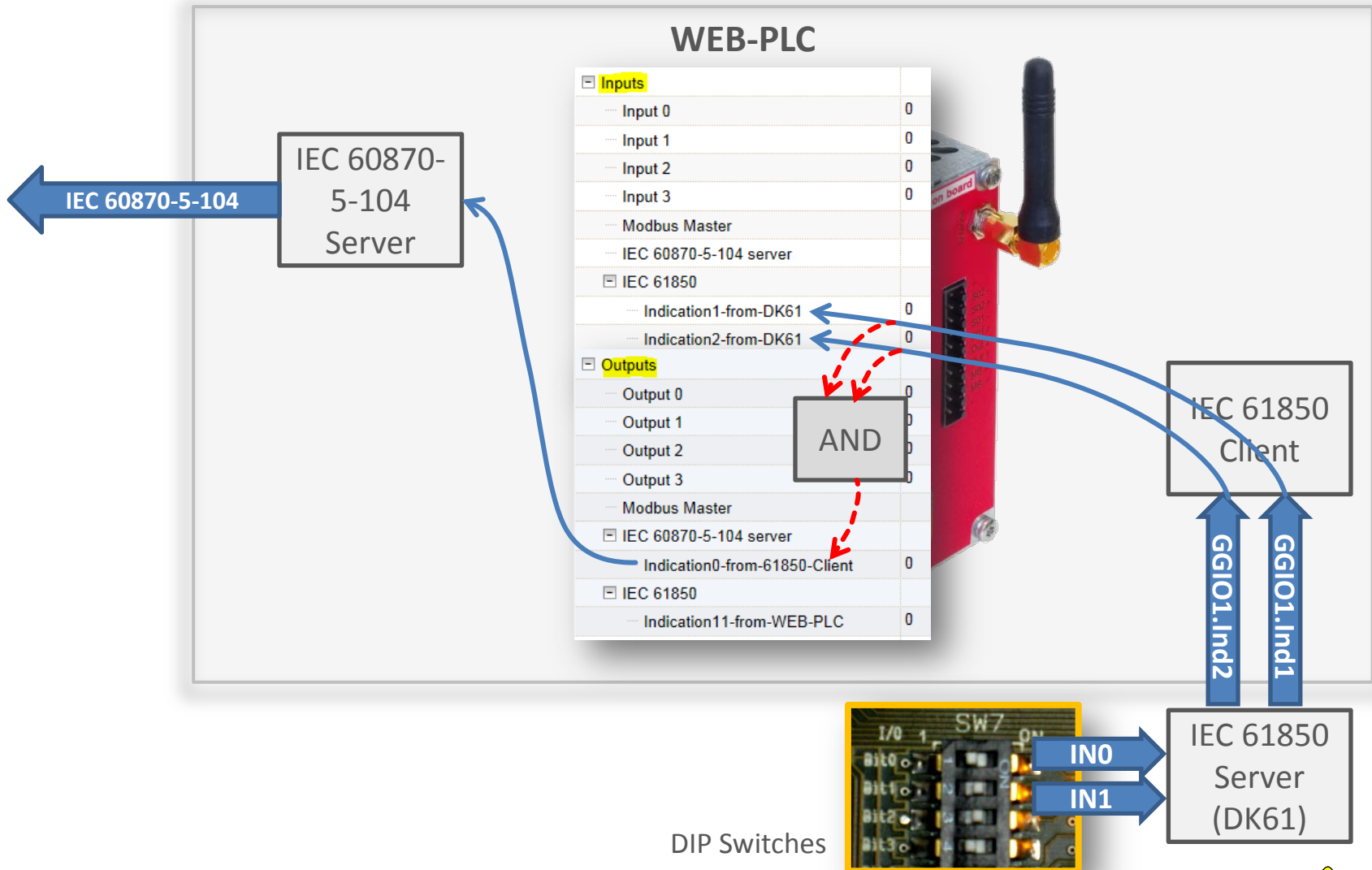
Interrogation Group: Interrogated by station interrogation (20)

Cyclic Transmission Time: 0 (0..86400000 ms)

OK Cancel

Signal is communicated as 104 single-point information with IOA=1000 ...

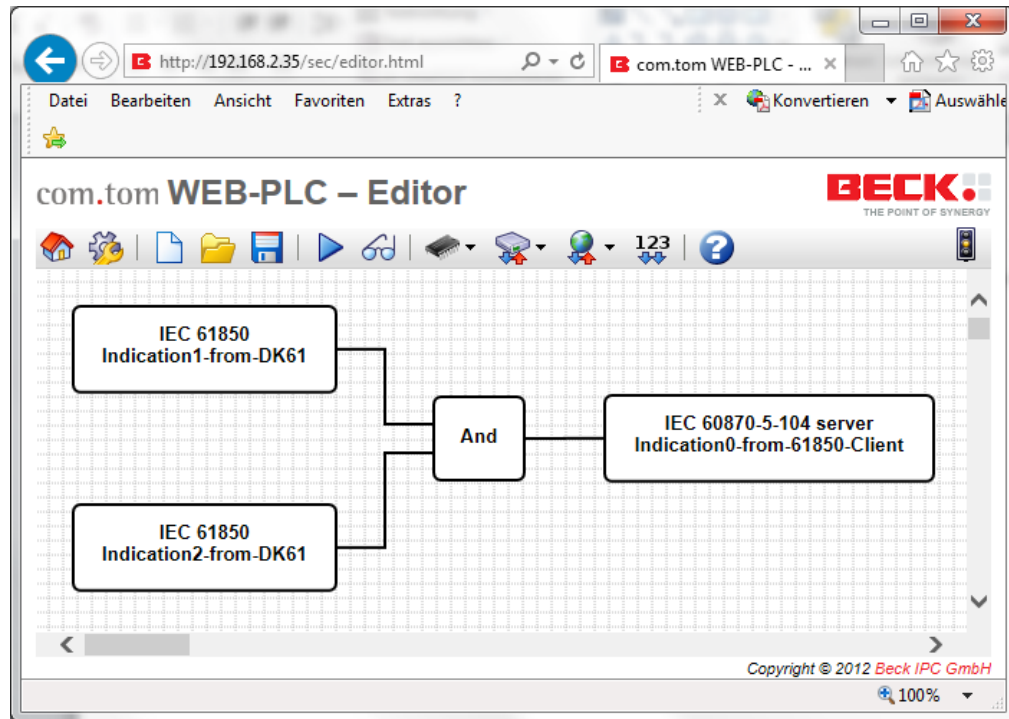
Use case 2 (IEC 61850 – IEC 60870-5-104 Gateway)



Use case 2 (configure diagram)

Replace **Input0** by two signals from DK61 through IEC 61850 Server on DK61 to IEC 61850 Client on the com.tom, add logic AND and connect AND result to 104 server (as before) ... or to the IEC 61850 server on the com.tom ...

The IEC 61850 on the com.tom could be used to aggregate or concentrate signals from several IEC 61850 servers (protection, monitoring or other IEDs)



Press the *Save diagram* icon to store the diagram on the device.



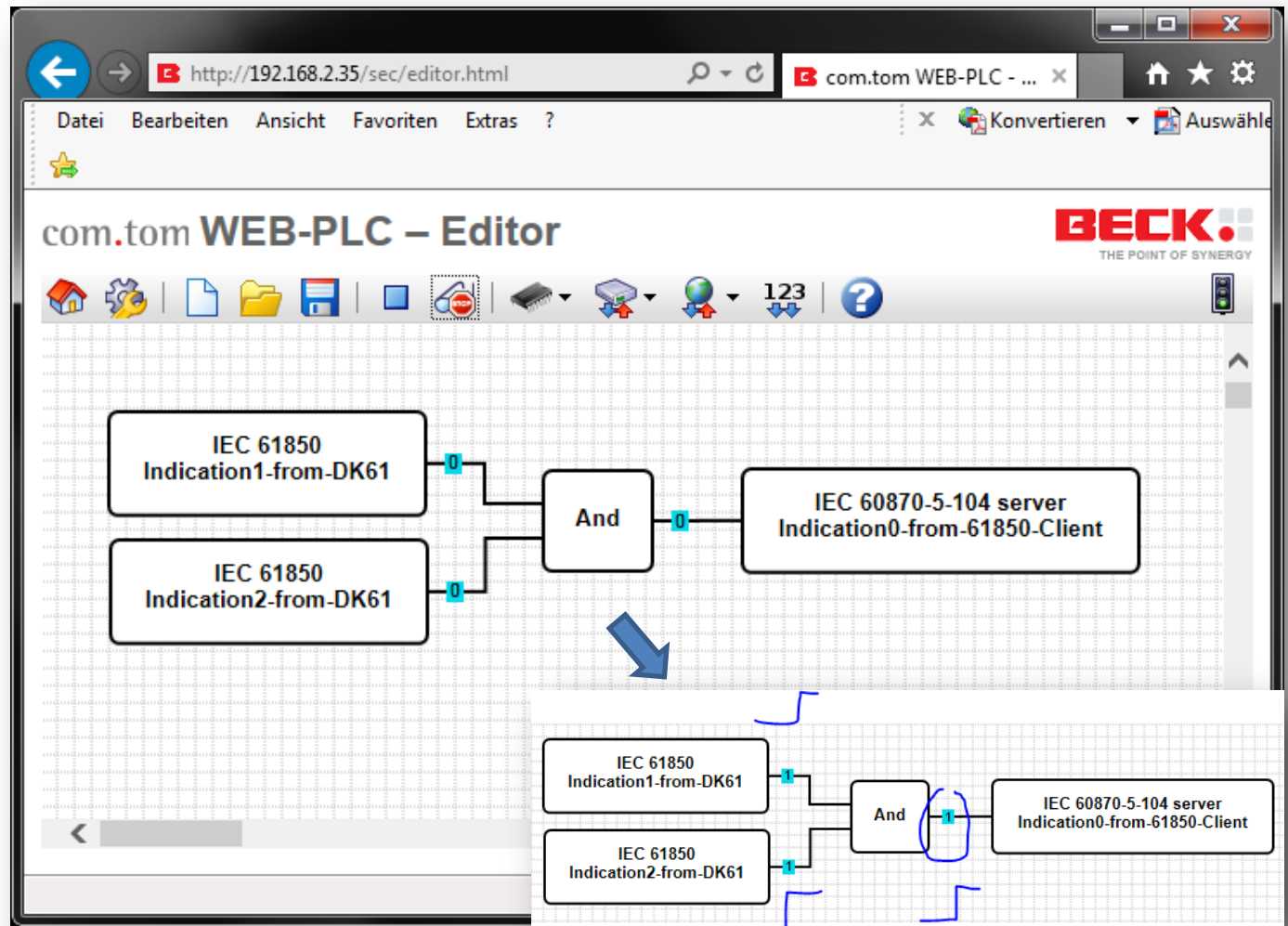
To start execution, press the *Start* icon.



Press the *Start Life View* icon.

Use case 2 (change values on DK61)

Change input(s) on DK61 to true/false ... check if AND gate works fine and 104 message has been sent ... DONE



Use case 2 (receive IEC 60870-5-104 message)

QTester104 IEC60870-5-104

v1.04 © 2010,2011,2012 Ricardo L. Olsen

Remote IP Address: 192.168.2.35
Remote Link Address: 1
Local Link Address: 0
Primary: TCP CONNECTED!

Command Address: [Empty]
Command Value: [Empty]
Command Type: 45: Single - C_SC_NA_1
Command Duration: 0 = no additional definition
SBO: [Unchecked]

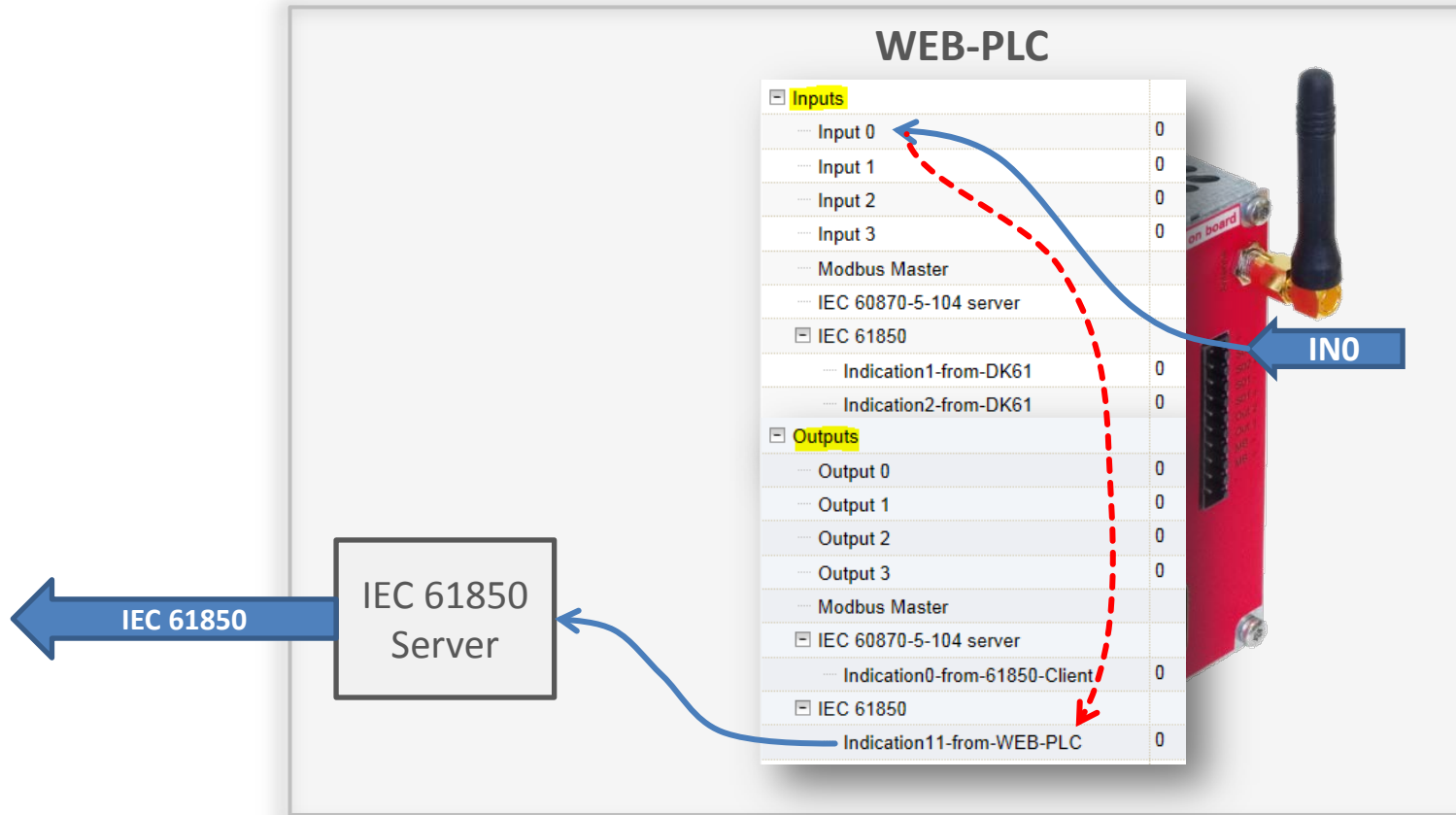
Log Messages AutoScroll

```
CA 1 TYPE 100 CAUSE 7 SQ 0 NUM 1
INTERROGATION ACT CON -----
<-- BDTR: INTERROGATION BEGIN
<-- SUPERVISORY 8
--> 016: 68 0e 08 00 02 00 01 01 14 00 01 00 e8 03 00 00
CA 1 TYPE 1 CAUSE 20 SQ 0 NUM 1
--> 016: 68 0e 0a 00 02 00 64 01 0a 00 01 00 00 00 14
CA 1 TYPE 100 CAUSE 10 SQ 0 NUM 1
INTERROGATION ACT TERM -----
Total objects in GI: 1
<-- BDTR: INTERROGATION END
--> 016: 68 0e 0c 00 02 00 01 01 03 00 01 00 e8 03 00 01
CA 1 TYPE 1 CAUSE 3 SQ 0 NUM 1
20:01:22 --> 016: 68 0e 0e 00 02 00 01 01 03 00 01 00 e8 03 00 00
CA 1 TYPE 1 CAUSE 3 SQ 0 NUM 1
<-- SUPERVISORY 10
20:01:23 --- BDTR: BECOMING PRIMARY BY TIMEOUT
--> 016: 68 0e 10 00 02 00 01 01 03 00 01 00 e8 03 00 01
CA 1 TYPE 1 CAUSE 3 SQ 0 NUM 1
20:01:26 <-- SUPERVISORY 12
20:01:32 <-- TESTFRAC
20:01:33 --> 006: 68 04 83 00 00 00
TESTFRCON
```

Address	Value	Type	Cause	Flags	Count
1	1.000000	1	3	on	10

Signal received by 104 client as single-point information with IOA=1000 ...

Use case 3 (IEC 61850 IED for RTU, ..)



Use case 3

