

Read Me First

IEC 61850

Communication networks and systems for power utility automation

Hints for the use of the DLL-Tree-Demonstration Package

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DRAFT 03

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- The core stack/API software of the demonstrations is provided by [SystemCorp](#):

SystemCORP Embedded Technology Pty Ltd

Address 15/50 William St

Beckenham WA 6107 / Australia

info@systemcorp.com.au

www.systemcorp.com.au

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<<[End-User-Software-License-Agreement-Embedded-Products.pdf](#)>>

- Please note the attached <<Readme.txt>>

Objective of the DLL-Tree-Demonstration Package

The main purpose is to provide a **free of charge simple and easy to use IEC 61850 Client/Subscriber Tool** (running on Windows PCs) that can be used **to communicate with a Server/Publisher** implemented on the platforms:

- [Beck IPC DK151 Development Kit for SC145 \(DK61\)](#)
- [Beck IPC com.tom / IXXAT SG-gateways \(WEB-PLC\)](#)
- [SystemCorp Smart Grid Controllers](#)
- Windows PC
- ...



The demonstration uses a **single generic SCL model** (and a derived JSON file [JavaScript Object Notation]) that can (beyond the main purpose) be used on the above platforms to automatically configure (tree structured graphical applications) for Clients, Server/Publisher, and Client/Subscriber roles as shown on the next slides.

The specification of additional models (.icd and .json) could be provided for a fee. Contact NettedAutomation if you are looking for other models, please.

Useful Links

The DLL-Tree-Demo package can be downloaded from:

<http://www.nettedautomation.com/solutions/demo/dll>

Information about the underlying stack/API software (plus a demo) can be found here:

<https://www.systemcorp.com.au/products/smart-grid-software/iec-61850/>

Usefull information about IEC 61850 can be accessed through the IEC 61850 blog:

<http://blog.iec61850.com/>

Seminars and training for protection, control, SCADA, ... ask the experts:

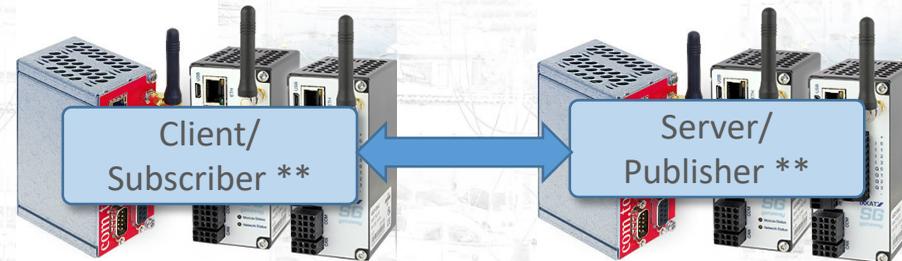
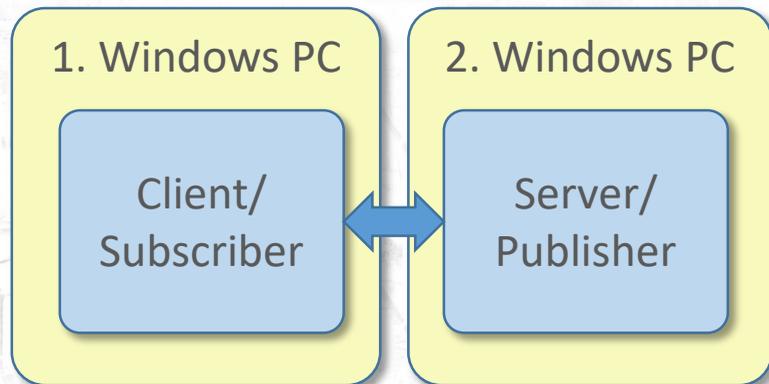
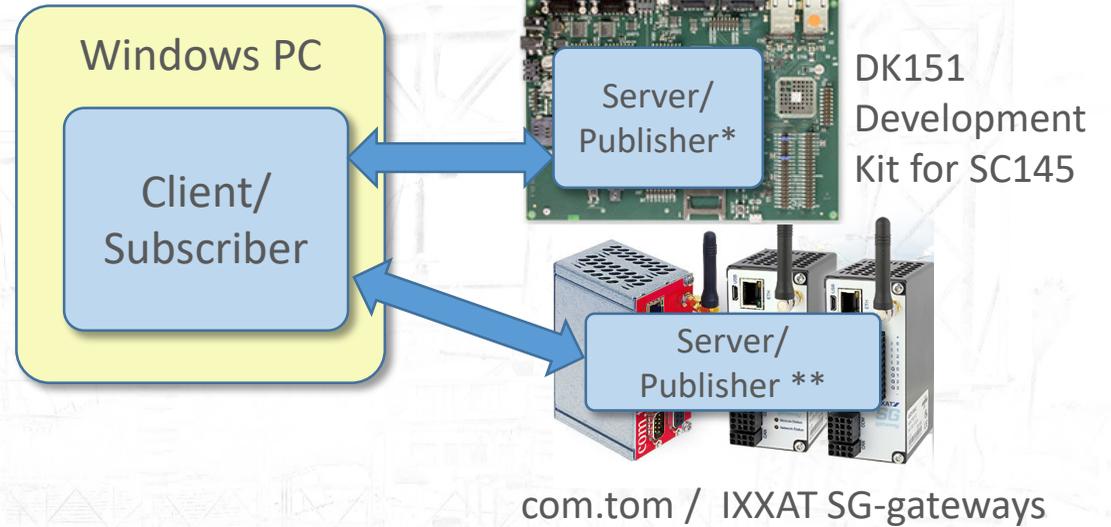
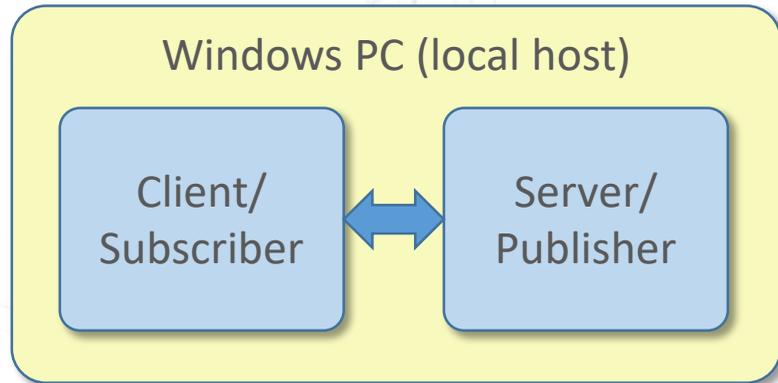
<http://www.nettedautomation.com/seminars/uca/sem.html>

VHPready demo package:

<http://www.nettedautomation.com/iec61850li/dll/index.html>

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Application use-cases of the new IEC 61850 DLL-Tree-Demo



* Using the same SCL Files for the configuration of the IED and C++-Application
** Using the same SCL Files for the configuration of the IEDs and WEB-PLC Appl.

<https://www.com-tom.de/>
<https://www.beck-ipc.com/en/produkte/dk151/>
<https://www.ixxat.com/products/energy/sg-gateways/ixxat-sg-gateway-overview>

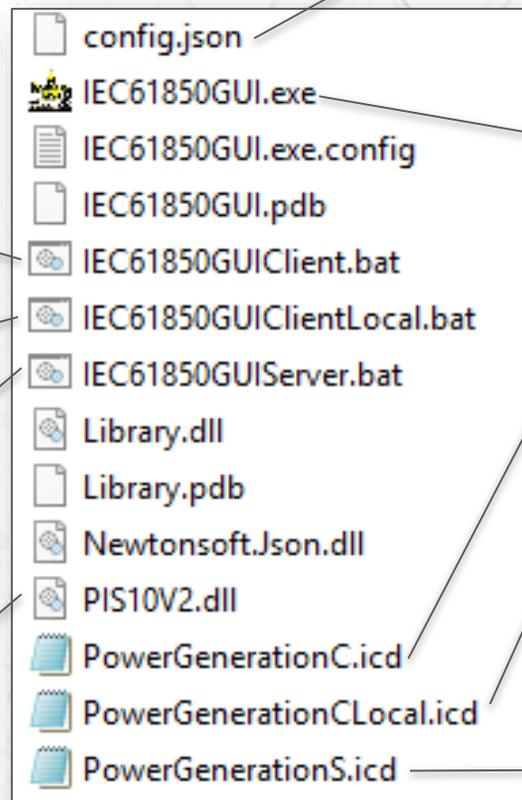
Folder with files for DLL-Tree-Demo

Run Client for
Server on 2nd PC

Run Client for
Server on local host

Run Server on local
host or 2nd PC

Stack/API provided
by SystemCorp *



JSON: configuration of
Model for Stack/API
generated by WEB-PLC **

Application for Client,
Server, Publisher, and
Client/Subscriber

Client Model for Server
on 2nd PC

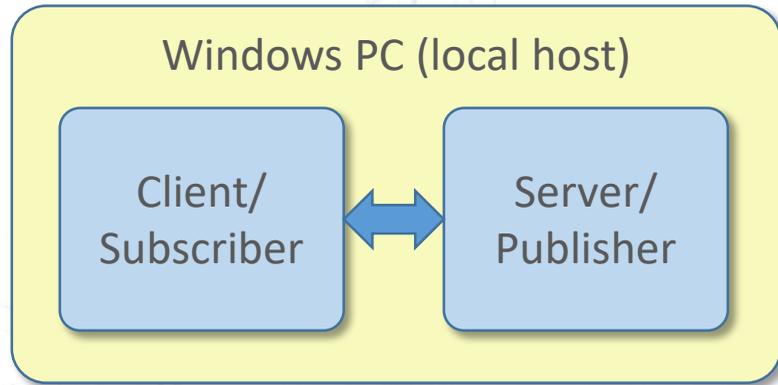
Client Model for Server
on local host

Server Model for Server
on local host

* <https://www.systemcorp.com.au/products/smart-grid-software/iec-61850/>

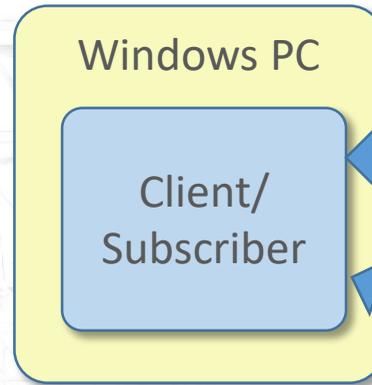
** The JSON document is generated by the WEB-PLC for the given SCL model used in the three .icd files. If you need further sample models (.icd and derived .json) please contact NettedAutomation.

Application use-cases of the new IEC 61850 DLL-Tree-Demo



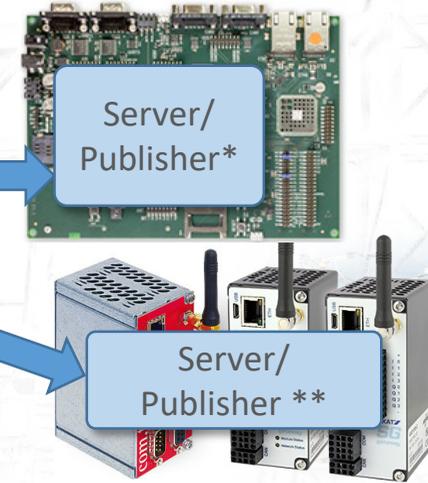
IEC61850GUIClientLocal.bat
PowerGenerationCLocal.icd

IEC61850GUIServer.bat
PowerGenerationS.icd

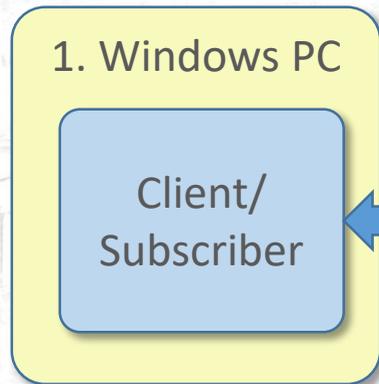


IEC61850GUIClient.bat
PowerGenerationC.icd

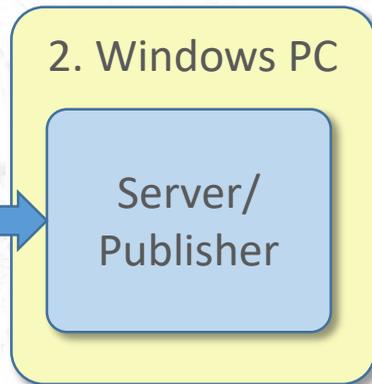
PowerGenerationS.icd



PowerGenerationS.icd



IEC61850GUIClient.bat
PowerGenerationC.icd



IEC61850GUIServer.bat
PowerGenerationS.icd



PowerGenerationC.icd



PowerGenerationS.icd

All Models are the same – the IP addresses and MAC addresses are specific for each IED!

Topology of Demo (on one Windows machine) – local host

2. Run Client for Server on local host

1. Run Server on local host

Client IED

nettedautomation.com

PowerGen_MONITOR.MMXU1.TotW.mag.f

Value: 2344

Quality: GOOD

Time stamp: 04/21/17 07:18:00

MM/dd/yy HH:mm:ss

Read Write Operate

BECK SystemCORP Embedded Technology Pty Ltd

NettedAutomation GmbH Information & Communication Systems

Server IED

nettedautomation.com

PowerGen_MONITOR.MMXU1.TotW.mag.f

Value: 2344

Quality: GOOD

Time stamp: 04/21/17 07:18:00

MM/dd/yy HH:mm:ss

Update

BECK SystemCORP Embedded Technology Pty Ltd

NettedAutomation GmbH Information & Communication Systems

<P type="IP">127.0.0.1</P>

PC internal communication

<P type="IP">127.0.0.1</P>

Topology of Demo (on two Windows machines)

2. Run Client for Server on 2nd PC

1. Run Server on 2nd PC

The screenshot shows the 'Client IED' application window. On the left is a tree view of the IED structure: IED -> PowerGen_MONITOR -> SPOS1 -> AlmSpt -> Alm -> stVal -> PosPct -> DRCC1 -> MMET1 -> MMTR1 -> MMXU1 -> TotW -> mag. The main area displays data for 'PowerGen_MONITOR.MMXU1.TotW.mag.f' with a value of 2344, quality of GOOD, and a time stamp of 04/21/17 07:18:00. Below the data are 'Read', 'Write', and 'Operate' buttons. The bottom of the window features logos for BECK SystemCORP and NettedAutomation GmbH.

<P type="IP">192.168.178.100</P>

The screenshot shows the 'Server IED' application window. It has the same tree view as the client. The main area displays data for 'PowerGen_MONITOR.MMXU1.TotW.mag.f' with a value of 2344, quality of GOOD, and a time stamp of 04/21/17 07:18:00. Below the data is an 'Update' button. The bottom of the window features logos for BECK SystemCORP and NettedAutomation GmbH.

<P type="IP">192.168.178.151</P>

MMS, TCP/IP, GOOSE, Ethernet/Ethertype, ...visible with Wireshark

Services used

The services used are:

1. Services are driven by the .icd file.
2. Client connects automatically to the Server.
3. Client enables automatically the Report Control Block (if it is not reserved, Client checks if reserved or not).
4. Events are sent by the configured GOOSE message.
5. Measurements are sent by the RCB every 10 seconds.
6. Read and Write could be used for corresponding attributes.
7. Operate could be used for controlling the LN DRCC (manually change stVal to allow another Operate).
8. Quality may be changed manually (not recommended)
9. Time stamp may be set manually to another time.
10. When Client and Server run on two machines, you can trace the traffic with Wireshark.
11. DataSets with members from the existing models (LD/LN.DO.DA ...), Report Control Blocks, and GOOSE Control Blocks may be added, modified or removed. They do not have an impact on the JSON file.
Note that any change in an icd file has to be made in ALL icd files!!
12. GOOSE messages may be “manipulated” by managed Ethernet Switches. Some may remove the VLAN-Header for example or may duplicate the GOOSE messages (one with and one without VLAN Header).

Prerequisites

In some cases your Windows computer may not like the demo exe file. Then try the following:

1. Modify the IP Address and MAC Address for the server/publisher and client/subscriber to match with the PCs. For the usecase “local host” you just need to modify the MAC Addresses in **both** .icd files; use the MAC Address of the Ethernet Adapter where the Server/Publisher is running.
2. Switch of the Windows Firewall or open port 102 (where the MMS Server is running).
3. Start the program as Admin ... if you are allowed to do so.
4. Check if the .Net-Framework is installed (one of the latest versions, e.g., 4.6.2).
5. WinPcap needs to be installed (will be installed with Wireshark).
6. Maybe you need “Visual C++ Redistributable Packages install run-time components that are required to run C++ applications built using Visual Studio 2015”:
<https://www.microsoft.com/en-us/download/details.aspx?id=48145>
7. In some cases you have to deactivate the WLAN adapter.
8. In a few cases you have to connect an Ethernet cable to another PC or an Ethernet Switch. Check if the LED at the Ethernet port is flashing.
9. Very seldom it helps just to reboot your computer.
10. In some cases Windows restricts the Read and Write services in the usecase “local host”.

Excerpt of icd file of Sever Model

PowerGenerationS.icd

Server/Publisher

```
40 <IED type="Monitoring-Device" name="PowerGen_" manufacturer="NettedAutomation GmbH" configVersion="1.0">
41 <Services>
58 <AccessPoint name="SubstationRing1">
59 <Server timeout="30">
60 <Authentication />
61 <LDevice desc="Demo of models and services on DK151" inst="MONITOR">
62 <LN0 inst="" lnClass="LLN0" lnType="LLN0_0">
63 <DataSet name="Status" desc="Status information for GOOSE">
64 <FCDA lnClass="SPOS" lnInst="1" doName="Alm" fc="ST" ldInst="MONITOR" />
65 <FCDA lnClass="DRCC" lnInst="1" doName="DERStr" fc="ST" ldInst="MONITOR" />
66 </DataSet>
67 <DataSet name="Measurements" desc="Measurements for reporting">
68 <FCDA lnClass="SPOS" lnInst="1" doName="PosPct" fc="MX" ldInst="MONITOR" />
69 <FCDA lnClass="MMET" lnInst="1" doName="DffInsol" fc="MX" ldInst="MONITOR" />
70 <FCDA lnClass="MMTR" lnInst="1" doName="TotWh" fc="ST" ldInst="MONITOR" />
71 <FCDA lnClass="MMCU" lnInst="1" doName="TotW" fc="MX" ldInst="MONITOR" />
72 </DataSet>
73 <ReportControl name="Status_Report" rptID="Status_Values" intgPd="0" datSet="Status" confRev="1" buffered="false">
74 <TrgOps dchg="true" qchg="false" dupd="false" period="false" />
75 <OptFields seqNum="true" timeStamp="true" reasonCode="true" dataSet="true" />
76 <RptEnabled max="2">
77 <ClientLN iedName="MyClient" lnClass="IHMI" prefix="" lnInst="1" ldInst="none" />
78 </RptEnabled>
79 </ReportControl>
80 <ReportControl name="Measurement_Report" rptID="Measured_and_counted_Values" intgPd="5000" datSet="Measurements" confRev="1" buffered="false">
81 <TrgOps dchg="false" qchg="false" dupd="false" period="true" />
82 <OptFields seqNum="true" timeStamp="true" reasonCode="true" dataSet="true" />
83 <RptEnabled max="2">
84 <ClientLN iedName="MyClient" lnClass="IHMI" prefix="" lnInst="1" ldInst="none" />
85 </RptEnabled>
86 </ReportControl>
87 <DOI name="NamPlt">
88 <DAI name="vendor" valKind="Set">
89 <Val>Beck IPC / NettedAutomation GmbH</Val>
90 </DAI>
91 <DAI name="swRev" valKind="Set">
92 <Val>2.07.18</Val>
```

Excerpt of icd file of Client Model

PowerGenerationC.icd

```
10 </Header>
11 <Communication>
12   <SubNetwork type="8-MMS" name="SubNetworkName">
13     <ConnectedAP IEDName="MyClient" apName="SubstationRing1"> ← IED: Client/Subscriber
14       <Address>
15         <P type="IP">192.168.178.100</P>
16         <P type="MAC-Address">34-E6-D7-16-C7-A8</P>
17         <P type="IP-SUBNET">255.255.255.0</P>
18         <P type="IP-GATEWAY">192.168.178.1</P>
19         <P type="OSI-TSEL">00000001</P>
20         <P type="OSI-PSEL">01</P>
21         <P type="OSI-SSEL">01</P>
22       </Address>
23     </ConnectedAP>
24     <ConnectedAP IEDName="PowerGen_" apName="SubstationRing1"> ← IED: Shadow Server/Publisher
25       <Address>
26         <P type="OSI-AP-Title">1,1,9999,1</P>
27         <P type="OSI-AE-Qualifier">12</P>
28         <P type="OSI-PSEL">00000001</P>
29         <P type="OSI-SSEL">0001</P>
30         <P type="OSI-TSEL">0001</P>
31         <P type="IP">192.168.178.151</P>
32         <!-- Enter the korrekt IP address of the DK151 acting as 61850 server here; 0.0.0.0 means DK151 will use the configured IP of the device -->
33         <P type="IP-SUBNET">255.255.255.0</P>
34         <P type="IP-GATEWAY">192.168.178.1</P>
35         <!-- <P type="MAC-Address">D0-67-E5-4A-91-E6</P> -->
36         <P type="MAC-Address">00-30-56-50-01-4D</P>
37         <!-- Enter the MAC address of the DK151 acting as 61850 server here; needed for GOOSE -->
38       </Address>
39       <GSE cbName="Status_CB_GOOSE" ldInst="MONITOR">
40         <Address>
41           <P type="MAC-Address">01-0C-CD-01-00-36</P>
42           <P type="VLAN-PRIORITY">4</P>
43           <P type="VLAN-ID">000</P>
44           <P type="APPID">0000</P>
45         </Address>
46         <MinTime unit="s" multiplier="m">200</MinTime>
47         <MaxTime unit="s" multiplier="m">10000</MaxTime>
48       </GSE>
49     </ConnectedAP>
50   </SubNetwork>
51 </Communication>
52 <IED name="MyClient"> ← IED: Client/Subscriber
53   <AccessPoint name="SubstationRing1">
54     <LN lnClass="IHMI" inst="1" lnType="IHMIa"/>
55   </AccessPoint>
56 </IED>
57 <IED type="Monitoring-Device" name="PowerGen_" manufacturer="NettedAutomation GmbH" configVersion="1.0"> ← IED: Shadow Server/Publisher
58 </DataTypes>
```

IEC 61850 Gerätemodell für Beck IPC DK151

Karlheinz Schwarz, NettedAutomation GmbH

2017-04-10

Die folgenden Modelle enthalten nur instanziierte Logische Knoten, Daten Objekte und Daten Attribute. Referenzierte Typen werden nicht expandiert. Es werden die dekorierten Signale (mit Private-Elementen) dargestellt.

Die Modelle werden durch eine XSL-Transformation eines CID-Files erzeugt. (Die Endung des CID-Files muss in .xml geändert werden. Die Attribute des SCL-Elements müssen entfernt werden; <SCL attr ...> in Kommentare setzen und <SCL> einfügen.

Transformation durch:

Server_Report-Meas-Status_Operate_publish-GOOSE_Decorated_2017-04-10_14-30_Final(3).xsl

IED = PowerGen_

LD	MONITOR	
LN	LLN0	LLN0_0
	Mod.stVal	on
	NamPlt.configRev	0.1
	NamPlt.d	Demonstration of IEC61850 using multiple Models and services with DK151.
	NamPlt.IdNs	IEC61850-7-4:2007B
	NamPlt.swRev	2.07.18
	NamPlt.vendor	Beck IPC / NettedAutomation GmbH
DataSet	Status	
	- MONITOR/SPOS1.ST.Alm.	
	- MONITOR/DRCC1.ST.DERStr.	
DataSet	Measurements	
	- MONITOR/SPOS1.MX.PosPct.	
	- MONITOR/MMET1.MX.DffInsol.	
	- MONITOR/MMTR1.ST.TotWh.	
	- MONITOR/MMXU1.MX.TotW.	
Report Control	RCB-Name = Status_Report	Beschr = , Zyklus = 0 ms, ReportID = Status_Values
	Datensatz = Status	DataChange = true, zyklisch = false, QualityChange = false, DataUpdate = false
Report Control	RCB-Name = Measurement_Report	Beschr = , Zyklus = 5000 ms, ReportID = Measured_and_counted_Values
	Datensatz = Measurements	DataChange = false, zyklisch = true, QualityChange = false, DataUpdate = false
GOOSE Control	GCBName = Status_CB_GOOSE	
	DataSet = Status	
	appID = Status	
LN	LPHD1	
	PhyHealth.stVal	0
	PhyNam.location	All over
	PhyNam.model	SC145
	PhyNam.serNum	76D4
	PhyNam.vendor	Beck IPC DK151
	Proxy.stVal	0
LN	SPOS1	
	Alm.q	
	Alm.stVal	
	Alm.t	
	AlmSpt.setMag.f	28
		Position measurement, by proximity sensor

	PosPct.d	on DK151
	PosPct.q	
	PosPct.t	
	PosPct.mag.f	
	PosPct.units.multiplier	0
	PosPct.units.SIUnit	2
LN	MMET1	
	DffInsol.d	Diffuse insolation by light sensor on DK151
	DffInsol.q	
	DffInsol.t	
	DffInsol.mag.f	
	DffInsol.units.multiplier	0
	DffInsol.units.SIUnit	55
LN	MMTR1	
	TotWh.actVal	
	TotWh.d	Counter of energy
	TotWh.q	
	TotWh.t	
	TotWh.units.multiplier	3
	TotWh.units.SIUnit	72
LN	MMXU1	
	TotW.d	Current power generated
	TotW.q	
	TotW.t	
	TotW.mag.f	
	TotW.units.multiplier	3
	TotW.units.SIUnit	38
LN	DRCC1	
	DERStr.ctlModel	direct-with-normal-security
	DERStr.stVal	
	Mod.stVal	on
	Oper.ctlVal	

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2017-04-24

Version 1.0

The wait for a FREE IEC 61850/61400-25 Evaluation/Starter Kit is over - here it is for immediate use.

Congratulation!

SystemCorp (Perth, Australia) and NettedAutomation offer an IEC 61850/61400-25 DLL (Dynamic Link Library) and four Application examples using the DLL (runs under Windows):

- C/C++ Server Application (simple Console)
- C/C++ Client Application (simple Console)
- .Net/C# Server Application (nice graphical interface)
- .Net/C# Client Application (nice graphical interface)

The packages contain executable software and the source code of the C and .Net/C# Applications (projects).

You can use these applications and modify them according to your needs.

NOTE 1: The Clients and the server run on ONE machine (localhost). If you want to run the server on one machine and the clients on another you have to configure both (client and server)! This is done by modifying the ICD files that are in the same folders where the client/server executables are located. Read the Documentation for details!

NOTE 2: To see information communicated by GOOSE messages at the client you have to install WinPcap driver (latest version is 4.1.3 or so / <http://www.winpcap.org>). And you have to have your Ethernet adapter active and running - any other adapter like WiFi MUST be off and disabled!!

NOTE 3: To trace the messages exchanged between Client/Server (Publisher/Subscriber) you have to run them on different machines. Then you can trace the traffic, e.g. with Wireshark.

Run first the simple console applications ... follow the instructions.

Before you start the server and client (launchapp.bat) it is recommended to read first the <<Getting_Started_DLL_IEC61850.pdf>> in the Documentation folder; this folder is generated through installation and is contained in the package.

For the console applications you have to change the IP and MAC Addresses first!!

For Client and Server running on one machine (local host) you have to set the IP Address in both icd files to 127.0.0.1 and you have to set the MAC Address to the MAC Address of your Ethernet adapter. This may cause problems when you use virtual machines.

NOTE 4: The server must run before the client is started.

NOTE 5: You may also use the IEDScout (Omicron, free demo version) and browse the server. This is quite convenient - but the Browser cannot be used to connect to a client application!

NOTE 6: This Evaluation/Starter Kit requires basic understanding of IEC 61850 Information Models, Information Exchange Services, and Configuration Language!!

NOTE 7: The server uses the same Information Model as the BECK IPC Development Kit DK151. The DK151 is a platform to run IEC 61850/61400-25 in real-time - for real-time applications! The PIS10 runs also on the DK61 (Beck Chip) or the IXXAT SG10, SG20 and SG40 with Profinet. All use the same simple Stack API.

We offer all services for the integration of the PIS10 stack (DLL, ...) into your application

We offer implementation support provided by our experienced application programmer: Andreas Pfefferle, Karlsruhe, Germany.
Andreas is familiar with Substation Automation, RTUs, IEC 60870-5-10x, protocol integration, ... SystemCorp PIS10-Stack API and many other domains.

Please contact us, in case you need comprehensive education and/or help for the integration and application development.

I am confident, that our experience and service would help to get started in short time! You would get first-hand, very comprehensive, vendor neutral and up-to-date knowledge, experience, and guidance; learn how to reach interoperability of devices;

You would get best advice and help - for the best price.

Please note also the copyright statements and other crucial information.

Best Regards,

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