

Software Development and Engineering the Future

Substation Automation System

V 1.0

Mannheim, 01. 07. 2017.



Kajganic Energy Systems GmbH

Graudenzer Linie 43 68307 Mannheim, Germany Tel.: +49 621 4309631 Fax: +49 621 30787808 Web: <u>www.kajganic.com</u> E-mail:info@kajganic.com

Please contact

Dr. Boris Kajganic Tel.: +49 621 4309631 Email: boris.kajganic@kajganic.com

Table of Contents

1	SAS Over	view					
	1.1	SAS features					
2	NetzAge	nt Short Manual 6					
3 Installation 7							
	3.1	Windows Installation					
	3.1.1	Preinstallation Requirements7					
	3.1.2	Installation7					
	3.2	Linux Installation7					
	3.2.1	Preinstallation Requirements					
	3.2.2	Installation 11					
4	Start of N	NetzAgent					
	4.1	Windows version of NetzAgent					
	4.1.1	Debug Output 12					
	4.1.2	Open SCL configuration file					
	4.1.3	Single Line Diagram 14					
	4.1.4	Communication 16					
	4.1.5	RT Chart					
	4.1.6	DB Chart					
	4.1.7	Export Chart 19					
	4.1.8	Topology Change Commands 21					
	4.1.9	Login					
	4.1.10	Users administration					
	4.1.11	Alarm and Event List					
	4.2	Linux version of NetzAgent					
5	Editing S	ingle Line Diagram					
	5.1	Symbols					
	5.2	Breaker and Disconnector					
	5.3	Alarms					

1 SAS Overview

This document consists the technical specification and short manual of KES NetzAgent Substation Automation System.

As default, SAS uses IEC 61850 SCL configuration files (Substation Configuration *.scd) or IED configuration file *.icd). For basic case, receiving analogs and signalization, charts, storing into database, no additional engineering is required. This dramatically reduce the amount of work to prove the communication and data. The setup file is the same as is used for protection itself.

Start of the system is just open file operation and start the communication. The system is up and running in few minutes.

HMI interface for single line diagram is based on Scalable Vector Graphics (SVG). This allows easy scaling of the pictures and all used symbols in the project are user defined. High flexibility and no proprietary format.

All data are stored inside SQLite3 database (up to 140TB). The database is not encrypted, it could be open with any other tools or simple moved between different operation systems or computers.

1.1 SAS features

NetzAgent SAS has the following features:

- Single user Master SCADA/SAS with integrated HMI interface
- Single line diagram (SLD) with Scalable Vector Graphics (SVG)
- SVG Editor Inkscape is used for SLD
- Logging
 - o Alarms
 - o Events
- Hierarchically relation of objects in database and presentation
- Relation database SQLite3
- Possibility to interchange database between Windows and Linux systems. File copy operation.
- Database is NOT encrypted. User with appropriate right can use simple SQL command to browse DB.
- No addition cost of third party software
- User defined number of Masters
- Supported protocols
 - o IEC 61850
 - o IEC 60870-5-104 (optional)
 - o MODBUS (optional)
- Number of I/O Point is limited with license contract
- Plotting
 - Real-time plots of current values
 - Charts from historical database
- Storing of data for analysis and export. Received measurements and signalization are stored into database with timestamps.
- DB Export
 - o Export into CSV file
 - \circ $\;$ DB can by simply copied and used
- DB Backup
- In house developing and testing
- Platform independent and portable code, directly support
 - Linux 64 bits (Centos 7)
 - o Microsoft Window 64 bits
- Object oriented development based on C++11
- 1 year warranty period included
- upgrade and maintenance for user defined period (optional)

2 NetzAgent Short Manual

This is the short manual related to Windows and Linux version of the SAS NetzAgent.

The NetzAgent[™] is single user SCADA / Substation Automation System (SAS), uses the latest technology, supports main communication protocols (including the new standard protocol IEC 61850) and is independent from the operating system. It can work under Windows, Linux as well as other devices such as raspberry PI. This feature is of major importance for incorporating low cost solutions that are also compatible with the existing data. Another important feature is that the SCADA-System includes an interface to the real-time database, which enables the incorporation of further applications independent from the ones we offer. These features enable to reduce significantly the installation costs, especially when targeting a distributed model in the distribution network, for example by using Raspberry PI devices.

Build-in Single line diagram (SLD) is the representation of a power system using the simple symbol for each component. The SLD of a power system is the network which shows the main connections and arrangement of the system components along with their data. SLD takes the current status of the topology elements and shows different symbols according the topology status.

3 Installation

The software installation comes as the archive in two types:

NetzAgent_ZZZXXYY.tar.gz

Linux Centos 7 64 bits

NetzAgent_ZZZXXYY.7z Windows 64 bits

3.1 Windows Installation

3.1.1 Preinstallation Requirements

The NetzAgent, requires installation of WinPcap driver. WinPcap is the industry-standard tool for link-layer network access in Windows environments: it allows applications to capture and transmit network packets bypassing the protocol stack, and has additional useful features, including kernel-level packet filtering, a network statistics engine and support for remote packet capture.

Download WinPcap_4_1_3.zip from FTP site (<u>ftp.kajganic.com</u>). Unpack the archive to one destination folder. Start installation program WinPcap_4_1_3.exe and install Winpcap driver on your system.

3.1.2 Installation

Download NetzAgent from FTP site (<u>ftp.kajganic.com</u>). Unpack the archive to one destination folder. The archive is not password protected.

3.2 Linux Installation

Linux version of NetzAgent is tested on:

[kes@KES]\$ cat /etc/redhat-release CentOS Linux release 7.3.1611 (Core) And

[kes@KES]\$ cat /etc/redhat-release CentOS Linux release 7.2.1511 (Core)

3.2.1 Preinstallation Requirements

Usage of NetzAgent required one computer with Centos 7 64 bits operation system. Download the ISO disk (CentOS-7-x86_64-Everything-1611.iso) from Centos web site (https://www.centos.org/download/)

a) Install Centos 7 64 bits version with default settings.

Write down root password and create user for the usage of NetzAgent. Let's call user *kes* in the rest of the documentation.

b) Login in the system as root

Open terminal and install the missing software.

[root@KES]\$ yum install gnome-packagekit-updater [root@KES]\$ yum install gnome-packagekit-installer [root@KES]\$ yum install dconf-editor [root@KES]\$ yum install SDL [root@KES]\$ yum install xerces-c

c) VNC Server

Strictly speaking VNC server is not require for proper work of NetzAgent, but it is used for remote access in the case of software update or maintenance. Install as root:

```
[root@KES]$ yum groupinstall "GNOME Desktop"
[root@KES]$ yum install tigervnc-server
[root@KES]$ firewall-cmd --permanent --zone=public --add-service
vnc-server
[root@KES]$ firewall-cmd --permanent --add-port=5900-5999/tcp
[root@KES]$ firewall-cmd --permanent --add-port=5800-5899/tcp
[root@KES]$ firewall-cmd --reload
```

d) Add sas folder

[root@KES]\$ cd /
[root@KES\$ mkdir sas
[root@KES]\$ chmod 777 sas

- e) Reboot the computer
- f) Login as user kes. This could be any user chosen during the installation process.
- g) Start VNC Server

Open terminal.

[kes@KES]\$ vncserver -geometry 1280x960 :33

First time, the program will ask for the password of the remote session.

To stop vncserver use kill command.

[kes@KES]\$ vncserver -kill :33

h) Test VNC connection from Windows to Linux computer

Download on Windows computer TightVNC software from <u>http://www.tightvnc.com/download.php</u>. and start the installation. Use custom installation and install only VNC Viewer, Server side is not required.

Start TightVNC Viewer



Use IP address of the Centos computer with the same number used to start vncserver.

🚾 Vnc Authentication							
Connected to: 192.168.178.15:33							
Password:							
OK Cancel							

For the password use the same password used to start vncserver first time.



i) How to execute a script just by double clicking like .EXE files in Windows?

Follow these steps:

Hit Alt+F2, type dconf-editor and hit Enter.

In dconfg-editor goto: org ➤ gnome ➤ nautilus ➤ preferences

Click on executable-text-activation and from drop down menu select:

launch: to launch scripts as programs.

OR

ask: to ask what to do via a dialog. This is preferable option in the test phase.

Close dconf-editor. That's it!

3.2.2 Installation

The installation of the software is under normal user (not root).

Download Linux version (extension tar.gz) of NetzAgent from FTP site (<u>ftp.kajganic.com</u>). Unpack the archive to *sas* folder, created as root in previous step. The archive is not password protected.

[kes@KES]\$ tar -xzvf NetzAgent ZZZXXYY.tar.gz

New folder NetzAgent with appropriate structures and the programs is created.

Copy as root user, the file 99-matrix.rules into /etc/udev/rules.d and test if the dongle is founded.

[kes@KES]\$./dongletest
There is a MXSPS dongle connected to USB.
Model: 651
Version: 6.0
Memory: 60

4 Start of NetzAgent

4.1 Windows version of NetzAgent

The program could be started with double click on the NetzAgent.exe from Windows Explorer.



4.1.1 Debug Output

NetzAgent has integrated debug output window. To achieve debug output, the application must be started with /D as command parameter or simple execute debug.bat.

In the debug output user can see internal states of the program as the complete communication between NetzAgent and IEDs.



4.1.2 Open SCL configuration file

User could use File ➤ Open or press Open icon.



In Open dialog chose Substation Configuration (*.scd) or IED configuration file (*.icd)

Treasury and		-						-
5AS NetzAge	ent	-						
He Lut view	hep							
T Open File		_			-			2
	Computer • Data (D:) • Dev • Projects •	wxWi	igets → Muna → tests → SCL	▼ ≦2	Search SCL			0
Organize 💌	New folder					. .		,
	ABBTools		Name ^	Date modified	Type	Size		
	FormatValidator_20	1	P			_		
	graphics		ExampleT1-1-2007B.scd	15.01.2017 04:59	CET850 Configurati		30 KB	
	ListToolbox-1							
	ListToolbox-2							
	LogIn-Tutorial							
	MaskedTextCtrl							
1 🖡	Muna							
	🍌 bin							
	🍌 cfg							
	🗼 contrib							
	DB DB							
2	Documents							
	🍌 doxygen							
-	Eorms							
	Forms-Copy							
	🗼 images							
	🕌 include							
	Jib Ib							
	(i ob)							
	res							
	Save							
	tecte							
· · · · ·		-						
	File name:			•	Substation Configura	ation (*.s	cd) d 🔻	
				_	Substation Config	uration ('.scd)	
					IED Capability (*.ic	d)		
-					Air files (";")			11.

The Imported configuration file create workspace and the project inside the program as is showed in the next picture.



4.1.3 Single Line Diagram

If exists a single line diagram file (*.svg) with the same name as the IED configuration, the file will be opened automatically when user opens the IED configuration file. Otherwise open the file with selecting open operation (File \succ Open). Demo predefined SLD (Demo.svg) are located inside Demo folder.

Remarks: The measurements and the signalizations are connected inside Demo.svg.





Click on the "Button" opens the new SLD picture. Click on the measurement opens real time plots and the click on the breaker or disconnector change the topology.



4.1.4 Communication

Start and Stop of the communication is toggle operation.



Configuration data from SCL file is sent to IEC61850 Driver. The driver sent the received data back to the application. Some IEDs as GE F650 has only rudimentary support of IEC61850. The report are not working properly. If the driver detect error in the subscription of the report, the driver will emulate report with cyclic pooling of the data set.

4.1.5 RT Chart

Click on analog measurement will open real time chart for the current selected measurement. The chart is updated as the new data are received.





Second option to open real time chart is from toolbar. Select the first IED in the tree control.



Click on RT Chart in the toolbar.



Chose one or more (all) analog measurements assigned to the IED.

Real time Ar	alogs		×
	npleIO		
	simpleIOGenericIO/GGIO1.AnIn1.mag.f		l
	simpleIOGenericIO/GGIO1.AnIn2.mag.f		
	simpleIOGenericIO/GGIO1.AnIn3.mag.f		
····-	simpleIOGenericIO/GGIO1.AnIn4.mag.f		
			i i i i i i i i i i i i i i i i i i i
			Ē
		I	
		ОК	Cancel

The same chart will be opened as is chosen from single line diagram. The dialog is receiving the data from connected IED. The communication must work otherwise the dialog is empty.

4.1.6 DB Chart

r 100

Every received measurement are stored in the relation database with appropriate timestamp. Click on DB Chart in the toolbar.

RT Chart	DB Chart Chart	. ▼		
Stored Anal	ogs			×
E D-	asurements from DB			
	simpleIOGenericIO/GGIO1.AnIn1. simpleIOGenericIO/GGIO1.AnIn2.	.mag.f .mag.f		
	simpleIOGenericIO/GGIO1.AnIn3.	.mag.f		
	simpleIOGenericIO/GGIO1.AnIn4.	.mag.f		
From	04/12/17 💌	01:00:00		
То	05/24/17 💌	07:46:47		
			ОК	Cancel

Chose the analog measurement(s) and the interval.

4.1.7 Export Chart

All received data are stored in the relation database with appropriate timestamp. Click on Export Chart in the toolbar.



Select time range, exported values and the name of the CSV file where the data will be stored.

Stored Mea	surements	×
	xport from DB	
	simpleIOGenericIO/GGIO1.AnIn1.mag.f	
	simpleIOGenericIO/GGIO1.AnIn1.q	
	simpleIOGenericIO/GGIO1.AnIn2.mag.f	
	simpleIOGenericIO/GGIO1.AnIn2.q	
	simpleIOGenericIO/GGIO1.AnIn3.mag.f	
	simpleIOGenericIO/GGIO1.AnIn3.q	
	simpleIOGenericIO/GGIO1.AnIn4.mag.f	
	simpleIOGenericIO/GGIO1.AnIn4.q	
	simpleIOGenericIO/GGIO1.SPCSO1.q	
	simpleIOGenericIO/GGIO1.SPCSO1.stVal	
	simpleIOGenericIO/GGIO1.SPCSO1.t	
	simpleIOGenericIO/GGIO1.SPCSO2.q	
	simpleIOGenericIO/GGIO1.SPCSO2.stVal	
	simpleIOGenericIO/GGIO1.SPCSO2.t	
	simpleIOGenericIO/GGIO1.SPCSO3.q	
	simpleIOGenericIO/GGIO1.SPCSO3.stVal	
	simpleIOGenericIO/GGIO1.SPCSO3.t	
	simpleIOGenericIO/GGIO1.SPCSO4.q	
	simpleIOGenericIO/GGIO1.SPCSO4.stVal	
·····	simpleIOGenericIO/GGIO1.SPCSO4.t	
From	05/01/17 08:11:18	
То		
	05/24/17	
File		
	or l c	ancol
		ancei

Example: Part of the exported data:

entryID;time(<pre>DfEntry;reasonCode;dataRef;value</pre>
1;2017-05-06	09:04:19;4;simpleIOGenericIO/GGIO1.SPCSO1.stVal;true
2;2017-05-06	09:04:19;4;simpleIOGenericIO/GGIO1.SPCSO2.stVal;false
3;2017-05-06	09:04:19;4;simpleIOGenericIO/GGIO1.SPCSO3.stVal;true
4;2017-05-06	09:04:19;4;simpleIOGenericIO/GGIO1.SPCSO4.stVal;false
5;2017-05-06	09:04:19;4;simpleIOGenericIO/GGIO1.SPCSO1.stVal;true
6;2017-05-06	09:04:19;4;simpleIOGenericIO/GGIO1.SPCSO2.stVal;false
7;2017-05-06	09:04:19;4;simpleIOGenericIO/GGIO1.SPCSO3.stVal;true
8;2017-05-06	09:04:19;4;simpleIOGenericIO/GGIO1.SPCSO4.stVal;false
9;2017-05-06	09:04:19;0;simpleIOGenericIO/GGIO1.SPCSO1.q;000000000000
9;2017-05-06	09:04:19;0;simpleIOGenericIO/GGIO1.SPCSO1.stVal;true
9;2017-05-06	09:04:19;0;simpleIOGenericIO/GGIO1.SPCSO1.t;20170506055426.626Z
10;2017-05-06	5 09:04:19;0;simpleIOGenericIO/GGIO1.SPCSO2.q;0000000000000
10;2017-05-06	5 09:04:19;0;simpleIOGenericIO/GGIO1.SPCSO2.stVal;false
10;2017-05-06	5 09:04:19;0;simpleIOGenericIO/GGI01.SPCS02.t;19700101000000.000Z
11;2017-05-06	5 09:04:19;0;simpleIOGenericIO/GGIO1.SPCSO3.q;000000000000
11;2017-05-06	5 09:04:19;0;simpleIOGenericIO/GGIO1.SPCSO3.stVal;true
11;2017-05-06	5 09:04:19;0;simpleIOGenericIO/GGI01.SPCS03.t;20170506055426.696Z

CSV file could be open directly with Microsoft Excel for the additional analysis.

4.1.8 Topology Change Commands

If the communication is established, click on the breaker or disconnector will open the dialog to change the topology status of the selected element.



Switch or Brea	ker	×
-Current Status -		
Id	simpleIOGenericIO/GGIO1.SPCSO2.stVal	
Status	Opend	-
	Open Close Cancel	

Changed status:



Remarks: This could work only if the SCL configuration file for the IED has commands and it is appropriate configured.

4.1.9 Login

Depends on the project configuration it is possible to set up the commands to be active only in the case if the user is login in the system.



	Login - User/Password	×
1	User	<u> </u>
	Password	
		OV Cancel

Default user and password are: sadmin/sadmin.

4.1.10 Users administration

By clikcking on the "Users" and "User List" menu shown on main screen, the dialog with user administration pops up.



User se	ttings	×	I
Columns	:		
- 🔶 📼	•		ļ
Name	Password	Rights	I
sadmin	sadmin	all	
user03	demo	read-only	I
user04	demo	read-only	I
user05	demo	all	I
user06	demo	start/stop	
		Cancel OK	

4.1.11 Alarm and Event List

Alarms and Events are logged. The screen shows all alarms and events related to switchgear or protective relays that are important for substation operation. Alarms and Events appearing in the list ion strict chronological order.

Filter operation allows:

- Alarm and Events
- Alarm Only
- Event Only

ł								×
ł	NetzAgent	NetzAgent Debug	Search	Communication	Event/Alarm	×		-
ł	Timestamp	Description					Object	 Alarms and Events 💌
	Innoctanp	Becomption				I.	00,000	Clear All
								Update
	Ready							///

4.2 Linux version of NetzAgent

The program could be started with double click on the **NetzAgent.sh** from File Explorer.

< >	lanco Net	zAgent				Q =	≡ _ □ ×
O Rece	ent						
Doci	uments	cfg	ICD Files	Lanco	lib	libIEC61850Driver. so	libMODBUSDriver.so
᠅ Dow	vnloads						
D Picto	ures	libSCLParser.so	libSECalc.so	libwxFreeChart.so	libwxSQLite3.so	libwxSVG.so	libwxToolBox.so
Me Vide	os h	libYamlCPP.so	NetzAgent	NetzAgent.sh	test	wxMuna	
G Flop	py Disk						
Com	ENSO 📤						
⊡ Brov	wse Network						
<u>부</u> Con	nect to Server						

Depend on chosen option in dconf-editor program will start or one addition dialog will popup.

Do you want to run "NetzAgent.sh", or display its contents?					
"NetzAgent.sh" is an executable text file.					
Run in Terminal	Display	Cancel	Run		

Run starts the program NetzAgent.

Run in Terminal opens additional terminal and then start NetzAgent. This additional terminal shows the same debug output as is NetzAgent started with option /D in Windows version. This is useful for tracking the communication messages.



The rest of the program usage is the same as for the Windows version.

5 Editing Single Line Diagram

The single line diagram is SVG file. Scalable Vector Graphics (SVG) is an XML-based vector image format for two-dimensional graphics with support for interactivity and animation. The SVG specification is an open standard developed by the World Wide Web Consortium (W3C) since 1999.

Inkscape Editor (v 0.92) is used for the demo project. Download the last version from <u>https://inkscape.org</u>



The SLD owns some symbols which could be reused. You can open the symbols pressing Shift+Ctrl+Y or from Menu Object ➤ Symbols

11	🚯 Symbols (Shift+Ctrl-	+Y)							×	C
	Symbol set:	Current D	ocument							2	
	%5.1f MM	%5.1f M/W	%5.1f www	%4.0f A	%3.1f kv	%3.2f PF	%4.2f Hz	0			
								0			8
		\diamond	ᆂ	$\mathbf{\nabla}$	$\boldsymbol{\mathcal{C}}$						-F1
	I —	•	-	•							⊡ P+
											_
											
											Ę
											X
									1	-	٦
	44								0 0)	
	Fill and S	Stroke (Shi	ft+Ctrl+F)		<u>^</u> 🕺	Object Pro	perties (Shi	ft+Ctrl+O)		*	
	Symbols	(Shift+Ct	·l+Y)		• <u>T</u>	Text and F	ont (Shift+	Ctrl+T)		*	9

Assign of the new values to the measurement is quite simple. Open XML Editor (Shift+Ctrl+x or from Menu Edit ➤ XML Editor)

L		1000000	
I		Name 🔺 Value	.0
I	<svg:use id="use5326"></svg:use>	Nume Value	
I	<svg:use id="use5753"></svg:use>	height 100%	-0
I	<svg:use id="use9484"></svg:use>	id Trans1F650F650/MMXU1.TotW.mag.f	
I	<svg:use ;<="" id="BayControllerQ/T1MMXU1.A.phsA.cVal.mag.f" td=""><td>transform_translate(109.59175,21.245622)</td><td></td></svg:use>	transform_translate(109.59175,21.245622)	
I	<svg:use baycontrollerq="" id="BayControllerQ/T1MMXU1.PhV.phsA.cVal.mag.</th><th>width 100%</th><th></th></tr><tr><th>I</th><th><svg:use id=" t1mmxu1.phv.phsb.cval.mag.f<="" th=""><th>x 0</th><th>Т</th></svg:use>	x 0	Т
I	<svg:use id="Trans1F650F650/MMXU1.TotW.mag.f"></svg:use>	xlink:href #AnalogMW	л
I	<svg:use id="Trans1F650F650/MMXU1.TotVAr.mag.f"></svg:use>	y 0	9
I	<svg:use id="Trans1F650F650/MMXU1.TotVA.mag.f"></svg:use>		
I	<svg:use id="Trans1F650F650/MMXU1.AphsA.cVal.mag.f"></svg:use>	Set	\sim
I	<svg:use id="use5326-8"></svg:use>		
I	<svg:use id="use5753-6"></svg:use>		
I	<svq:use id="use9484-0"></svq:use>		
I			1 ST
I	Click to select nodes, drag to rearrange.		Se

For Object id use the 61850 address and the link is reference to the symbol. In the example, the analog measurement from Transformer Bay 1 will be present as symbol AnalogMW. The symbol is predefined and all objects with the reference to the symbol, will look the same on the screen. In the symbol Analog MW %5.1 is use as output format of the value. If you are changing the id or symbol reference don't forget to press **Set** otherwise the changes are ignored.

The same logic is used for the circuit breaker.

Svg:gpath id="path22331-6"> Svg:use id="use22369-3"> Svg:use id="use21455-4"> Svg:use id="use21455-4"> Svg:use id="use21455-4"> Svg:use id="use21455-4"> Svg:use id="use21455-4"> Svg:use id="trans1F650F650/eveGGI01.Ind150.stVal"> Svg:use id="Trans1F650F650/eveGGI01.Ind24.stVal"> Svg:use id="Trans1F650F650/eveGGI01.Ind22.stVal"> Svg:use id="Trans1F650F650/eveGGI01.Ind150.stVal"> Svg:use id="Trans1F650F650/eveGGI01.Ind150.stVal"> Svg:use id="Trans1F650F650/eveGGI01.Ind150.stVal"> Svg:use id="Trans1F650F650/eveGGI01.Ind150.stVal"> Svg:use id="Trans1F650F650/eveGGI01.Ind150.stVal"> Svg:use id="Trans1F650F650/eveGGI01.Ind30.stVal"> Svg:use id="Trans1F650F650/eveGGI01.Ind30.stVal"> Svg:use id="Trans1F650F650/eveGGI01.Ind30.stVal"> Svg:use id="Trans1F650F650/eveGGI01.Ind30.stVal"> Svg:use id="Trans1F650F650/eveGGI01.Ind30.stVal"> Svg:use id="Trans1F650F650/eveGGI01.Ind30.stVal">	××××			
	<pre></pre>	Name A height id transform width x xlink:href y	Value 100% Trans 1F650F650/eveGGIO1.Ind150.stVal translate(333.29457,273.91134) 100% 0 #Breaker 0 Set	

Example of the disconnector.



The second way to assign IEC61850 address to the ID is with the help of Object properties (Shift+Ctrl+X or from Menu Object ➤ Object Properties)

If you have changed the id, don't forget to press **Set** otherwise the changes are ignored. One additional remark for Object properties. Inkscape do not like "/" as part of the ID.

The IEC61850 address "Trans1F650F650/eveGGIO1.Ind20.stVal" will be stored as "Trans1F650F650_eveGGIO1.Ind20.stVal". This is internally handled by NetzAgent and converted back to "Trans1F650F650/eveGGIO1.Ind20.stVal". In any case you can use XML Editor to set id and avoid this difference between IEC61850 addresses and IDs.

Object Properties (Shift+Ctrl+O)			111
ID: Trans1F650F650/eveGGIO1.	Ind20.stVal		C T t
Label: #Trans1F650F650/eveGGIO	1.Ind20.stVal		+ (chil
<u>T</u> itle:			L Fon
Description:			vh and
			j
🔲 <u>H</u> ide	🗖 L <u>o</u> ck	<u>S</u> et	
1 Interactivity			
Fill and Stroke (Shift+Ctrl+F) 🔺	ि Symbols (Shift+Ctrl+Y) ▲	bject Properties (Shift+Ctrl+O) 🔺	

5.1 Symbols

Using the references to the symbols open the possibility of unlimited use of different symbols. The symbols are not hard coded in the application, the symbols are completely in the user domain, and the user can change any symbols. Only required is to define class for the symbol

Example: Class="Analog".

This defines an analog measurement. The type of the analog measurement is defined with symbol id and it is used as reference from the object to the symbol.

Example:

```
<symbol
    id="AnalogMVA"
    class="Analog">
    <rect
        id="AnalogMVA_background"
        x="0"
        y="0"
        width="55"
        height="21"
        style="fill:#ffffff;stroke:#000000;stroke-width:0" />
        <text
        style="fill:#ffffff;stroke:#000000;stroke-width:0" />
        <text
        style="fill:#ffffff;stroke:#000000;stroke-width:0" />
        <text
        style="font-style:normal;font-variant:normal;font-weight:normal;font-
stretch:normal;font-size:20px;line-height:125%;font-family:'Microsoft Sans Serif';-
```

inkscape-font-specification:'Microsoft	Sans	<pre>Serif';text-align:end;letter-</pre>
<pre>spacing:0px;word-spacing:0px;writing-mode:lr-</pre>	tb;text-anch	or:end;fill:#6a43e5;fill-
opacity:1;stroke:none"		
x="50"		
<u> у="21"</u>		
id="AnalogMVA_value">%5.1f		
<text< td=""><td></td><td></td></text<>		
<pre>style="font-style:normal;font-varian</pre>	t:normal;fon	t-weight:normal;font-
<pre>stretch:normal;font-size:16px;line-height:125</pre>	%;font-famil	y:Arial;-inkscape-font-
<pre>specification:Arial;text-align:start;letter-s</pre>	pacing:0px;w	ord-spacing:0px;writing-
<pre>mode:lr-tb;text-anchor:start;fill:#808080;fil</pre>	l-opacity:1;	stroke:none"

All symbols with the same class have "value" and "unit". Value is format how will be number present to the user. In this case the format is %5.1f. The syntax is the same as printf in C or C++ language. Unit is just a text.

Changing data associated with the symbol will affect all elements referencing to changed symbol in the svg file. The symbols are stored together with the file, there are no global symbols.

5.2 Breaker and Disconnector

x="57"

</svmbol

id="AnalogMVA unit">MVA</text>

Digital Measurements (single and double bits) are defined as N objects, with the same position (coordinates). Depend on a signalization only one of the status will be present to the user.

Example:

```
<symbol
id="Breaker"
   class="Switch">
   <rect
     id="B NU"
     x="1"
     y="1"
      width="10"
     height="10"
      style="visibility:visible;fill:#ff00ff;stroke:#000000;stroke-width:2" />
   <rect
     id="B 00"
     x="1"
      y="1"
      width="10"
     height="10"
      style="visibility:hidden;fill:#ffff00;stroke:#000000;stroke-width:2" />
   <rect
```

```
id="B on"
    x="1"
    v="1"
    width="10"
    height="10"
    style="visibility:hidden;fill:#000000;stroke:#000000;stroke-width:2" />
 <rect
    id="B_off"
    x="1"
    y="1"
    width="10"
    height="10"
    style="visibility:hidden;fill:#ffffff;stroke:#000000;stroke-width:2" />
  <rect
    id="11"
    x="1"
    y="1"
    width="10"
    height="10"
    style="visibility:hidden;fill:#ff0000;stroke:#000000;stroke-width:2" />
</symbol>
```

For double bits status it is predefined:

NU	Status is not updated, initial state of the switch
00	intermediate status
off (01)	Switch is open
on (10)	Switch is closed
11	bad status

For single bit status it is predefined:

NU	Status is not updated, initial state of the switch
off	Switch is open
on	Switch is closed

5.3 Alarms

Alarms are defined as N objects, with the same position (coordinates). Depend on a received signalization only one of the status will be present to the user.

Example:

```
<symbol
class="Alarm"
id="Alarm">
<rect
style="visibility:visible;fill:#ff00ff;stroke:#000000;stroke-width:2"
```

```
height="30"
    width="30"
    y="1"
    x="1"
    id="A_NU" />
 <rect
    style="visibility:hidden;fill:#000000;stroke:#000000;stroke-width:2"
    height="30"
    width="30"
    y="1"
    x="1"
    id="A on">
   <animate
      attributeType="XML"
      attributeName="fill"
      values="#800;#f00;#800;#800"
      dur="1"
      repeatCount="indefinite" />
 </rect>
 <rect
    style="visibility:hidden;fill:#ffffff;stroke:#000000;stroke-width:2"
    height="30"
    width="30"
    y="1"
    x="1"
    id="A_off" />
</symbol>
```

Alarms has predefined statuses:

NU	Alarm status is not updated, initial state of the alarm
off	Alarm gone
on	Object in alarm state (red blinking state)



Kajganic Energy Systems GmbH Graudenzer Linie 43 68307 Mannheim, Germany Tel.: +49 621 4309631 Fax: +49 621 30787808 Web: <u>www.kajganic.com</u> Email: info@kajganic.com