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GRID AUTOMATION PRODUCTS

# **MicroSCADA X SYS600 10.2**

## IEC 61850 Server







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## Section 2 Introduction

### 2.1 This manual

This manual provides thorough information on the use of IEC 61850 Server and information related to it. It describes how to configure the base system and the communication system to allow communication for IEC 61850 clients.

### 2.2 Use of symbols

This publication includes warning, caution and information symbols where appropriate to point out safety-related or other important information. It also includes tips to point out useful hints to the reader. The corresponding symbols should be interpreted as follows:



Warning icon indicates the presence of a hazard which could result in personal injury.



Caution icon indicates important information or a warning related to the concept discussed in the text. It might indicate the presence of a hazard, which could result in corruption of software or damage to equipment/property.



Information icon alerts the reader to relevant factors and conditions.



Tip icon indicates advice on, for example, how to design a project or how to use a certain function.

Although warning hazards are related to personal injury, and caution hazards are associated with equipment or property damage, it should be understood that operation of damaged equipment could, under certain operational conditions, result in degraded process performance leading to personal injury or death. Therefore, comply fully with all warnings and caution notices.

### 2.3 Document conventions

The following conventions are used for the presentation of material:

- The words in names of screen elements (for example, the title in the title bar of a dialog, the label for a field of a dialog box) are initially capitalized.
- Capital letters are used for file names.
- Capital letters are used for the name of a keyboard key if it is labeled on the keyboard. For example, press the CTRL key. Although the Enter and Shift keys are not labeled they are written in capital letters, e.g. press ENTER.
- Lowercase letters are used for the name of a keyboard key that is not labeled on the keyboard. For example, the space bar, comma key and so on.
- Press CTRL+C indicates that the user must hold down the CTRL key while pressing the C key (in this case, to copy a selected object).
- Press ALT E C indicates that the user presses and releases each key in sequence (in this case, to copy a selected object).

- The names of push and toggle buttons are boldfaced. For example, click **OK**.
- The names of menus and menu items are boldfaced. For example, the **File** menu.
  - The following convention is used for menu operations: **Menu Name/Menu Item/Cascaded Menu Item**. For example: select **File/Open/New Project**.
  - The **Start** menu name always refers to the **Start** menu on the Windows Task Bar.
- System prompts/messages and user responses/input are shown in the Courier font. For example, if the user enters a value that is out of range, the following message is displayed:  
`Entered value is not valid.`  
The user may be told to enter the string MIF349 in a field. The string is shown as follows in the procedure: MIF349
- Variables are shown using lowercase letters: sequence name

## 2.4 Related documents

The following SYS600 manuals should be available for reference during the use of this manual:

Name of the manual	Document ID
SYS600 10.2 System Configuration	1MRK 511 481-UEN
SYS600 10.2 System Objects	1MRK 511 482-UEN
SYS600 10.2 IEC 61850 System Design	1MRK 511 475-UEN
SYS600 10.2 COM500i User's guide	1MRK 511 468-UEN
SYS600 10.2 Status Codes	1MRK 511 480-UEN

### Other referenced manuals

This manual may contain references to or information from following documents:

SYS600 10.2 DuoDriver Installation Guide	1MRK 511 488-UEN
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## 2.5 Document revisions

Revision	Version number	Date	History
A	10.2	31.03.2021	New document for SYS600 10.2

## Section 3      Safety information

This section has information on the prevention of hazards and taking backups from the system.

### 3.1      Backup copies

#### 3.1.1      Taking backup copies

We recommend taking backup copies before making any changes, especially ones that might have side effects. Software and data need to be copied to another place.

Backup copying makes it easier to restore the application software in case of disk crash or other severe failure where stored data is lost. It is therefore recommended that backup copies are taken regularly.

There should be at least two system backup copies and two application copies. A new backup is copied over the oldest backup. This way the latest version is always available, even if the backup procedure fails.

Detailed information on how to take backup copies should be delivered to the customer with the application.

#### 3.1.2      System backup

Usually a system back up is taken after the application is made. It should be taken again when changes are made to the SYS600 system. This is required when the driver configuration or the network setup is changed.

#### 3.1.3      Application backup

An application backup is also taken at the same time with the system backup, after the application is made. It should be taken again when changes are made to the application, for example, if pictures or databases are edited or new pictures are added.

### 3.2      Fatal errors

A fatal error is an error that causes a breakdown or a locked situation in the SYS600 program execution.

#### 3.2.1      Handling

In case of a fatal error:

1. Write down the possible SYS600 error messages.
2. Shut down the SYS600 main program. If this cannot be done in the SYS600 Control Panel, try to end the task in Windows Task Manager.



Files may be damaged if the base system computers are shut down by switching the power off.

3. The data kept in the main memory at the moment of a fatal error is placed in the drwtsn32.log file with Windows 2003 Server, Windows XP and earlier. By default it is placed under %SYSTEMDRIVE%\Documents And Settings\All Users\Application Data\Microsoft\Dr Watson. Log and dump file paths can be checked with the drwtsn32 application. (Start -> run -> drwtsn32.exe). Analyze and copy the data in these files. Starting with Windows Server 2008 and Windows 7 the crash handling has changed. The location of the dump files can be read from the registry under the key HKEY\_LOCAL\_MACHINE\SOFTWARE\Microsoft\Windows\Windows Error Reporting\LocalDumps. The DumpFolder value tells the location of the dump files. Collect the data from this location.
4. Restart the system.

Report the program break-down together with the possible SYS600 error messages and the information from the drwtsn32.log file to the SYS600 supplier.

### 3.2.2 Status codes

Error messages in SCIL are called status codes. A list of status codes and short explanations for them can be found in SYS600 Status Codes.

## Section 4 Instructions

### 4.1 General

#### Protocol implementation

IEC 61850 protocol is a set of specifications, which details layered substation communication architecture. The International Standard IEC 61850 has been prepared by IEC technical committee 57: Power system control and associated communications. IEC 61850 specifies usage of Manufacturing Message Specification (MMS, ISO 9506) over TCP/IP as communication between the IEC 61850 server and client.

This manual describes the functionality of IEC 61850 Server in SYS600 product. Protocol is called as IEC 61850 later in this document.

When IEC 61850 operates as server in SYS600, it operates together with COM500*i* application. COM500*i* signal routing forwards the process data and incoming control commands according to the cross-reference information configured for COM500*i*. STA object type and data base type is IEC (STY 29).

IET600 tool is used to create the configuration for COM500*i* NCC type IEC 61850. This configuration is imported using IET Data Loader tool of SYS600 package, which creates the configuration files needed by IEC 61850 Server instances and also the process objects and configuration for the process devices if they are using IEC 61850 protocol. See IET600 documentation and related SYS600 manuals for details. IEC 61850 implementation is a separate executable which connects itself to the LAN Link of base system using CPI Interface. One instance of IEC 61850 Server is started for each NCC definition in COM500*i*.

Following configurations are supported with COM500*i* application:

- One NCC and one instance of IEC 61850 Server is used. All clients are connected to the same instance (max 8) and to same 61850 model and cross-reference information i.e. all clients are updated with the same data.
- Multiple NCCs and multiple instances of IEC 61850 Server are used. Clients are connected to different instances which are using **same** 61850 model and cross-reference information i.e. all clients are updated with the **same** data. Cross reference-information is the same in all NCCs of type IEC 61850.
- Multiple NCCs and multiple instances of IEC 61850 Server are used. Clients are connected to different instances which are using **different** 61850 models and cross-reference information i.e. all clients can be updated with the **different** data. Cross reference-information is **not** the same in all NCCs of type IEC 61850.

Combinations of these are possible as well, e.g. it is possible that two clients are connected to one instance and two other clients are connected to another instance. In this case, two NCCs need to be created to COM500*i* configuration.

For redundant connections, IEC 61850 Server can be used together with Duodriver. See SYS600 Duodriver installation guide for details.

For IEC 61850 client configuration, .CID (Configured IED Description) file of the IEC 61850 instance is extracted from the imported IET600 configuration to directory `\sc\prog\IEC61850_Link\bin\NCCx` (where x is NCC number). In case .IID (Instantiated IED Description) or .ICD (IED Capability description) files are needed, these files must be exported from IET600. Select model from the tree and click right button, select 'Export IED' and define filetype.

## Installation

IEC 61850 Server is installed automatically when SYS600 version 10.1 or newer is installed. In order to utilize the functionality, IEC 61850 modelling and cross-reference definitions must be made using IET600 tool, version 5.3 FP6 or newer. Configuration for security extensions (TLS, Transport Layer Security) require defining of certificates and other parameters related to encrypted and authenticated communication. SYS600 Installation package does not contain certificates for secure communication for IEC 61850 Server.

Communication using IEC 61850 Server requires following settings in firewalls:

- Ports 102 (normal) and/or 3782 (secured) are opened
- Executable '61850\_Server.exe' is configured as an allowed app in the Windows firewall

Usage of IEC 61850 Server requires a sufficient amount of licenses of type 'IEC 61850 Server' as well as licenses for COM500*i*.

## 4.2 Configuration

### 4.2.1 General

IEC 61850 configuration in base system requires:

- Node definition for each IEC 61850 instance
- STA:B definitions, type IEC

Configuration import from IET Data Loader does not create Node definitions, STA definition nor NCCs to COM500*i*. These need to be created before IET Data Loader is used. Node and STA:B definitions are instructed in following chapters. See SYS600 Manual Communication Gateway, COM500*i* for details how to configure NCCs of type IEC 61850 and other types of NCC. Each NCC must be created to using COM500*i* Signal X-reference tool before project importing is started.

### 4.2.2 Base system configuration

#### Node definition

It is recommended to make Node and Station definitions for Base system using System Configuration Tool, see SYS600 System Configuration manual for instructions. In case the System Configuration Tool is not used, permanent node definition for IEC 61850 node is done by adding a gateway nodes to the SYS\_BASCON.COM template as required:

```
;
;Gateway Nodes or nodes of the remote communication units
;
#local GW_NOD_Numbers = vector(15),- ;for example vector(20,22),-
GW_NOD_Addresses = vector(215)
```

The node created using this definition uses LAN Link of the system. The usage of IEC 61850 requires hardening setting REQUIRE\_ENCRYPTED\_ACP = "NETWORK", setting "ALL" cannot be used.

Each NCC (=cross reference) requires one node (= IEC 61850 Server instance). Multiple IEC 61850 clients can be connected to one instance at the same time, but they will see the system as modeled and cross-referenced for the COM500*i* NCC in question. In case different data model is needed by different NCCs, multiple nodes are needed and configuration in IET600 should be made accordingly.

Defining the same node number for a communication module is possible in two systems operating as Hot-Standby, too, as long as the communication module is not accessed directly by the adjacent system. This simplifies the used command procedures and system configuration in general. In case communication modules are accessed by adjacent systems in run-time or there are other reasons to use different node numbers in communication modules in a Hot-Standby pair, it is possible. In this case, all node number must be explicitly listed in SYS\_BASCON.COM or created in run-time using SCIL scripts. This approach is used e.g. in SAS reference application. See STA:B definition chapter for more details of this configuration.

In case nodes are defined using SCIL scripts instead of using SYS\_BASCON.COM template, node creation can be made as follows (CE definition is needed to show node correctly in on-line mode in System Configuration Tool):

```
;create node
#CREATE NOD50:B = list(SA = 250, LI = 1, NT= "NET", NN = "NCC1", CX =
"Test NCC1", CE = "IEC61850 Server")
```

The amount of instances are limited by license.

## STA:B definitions

If System Configuration Tool is not used, permanent STA definitions for IEC 61850 are made by adding the STA numbers to the SYS\_BASCON.COM template. Note that the node number must be equal to nodes created in previous chapter:

```
;
;Host stations are typically defined with the PC-NET system configuration
tool.
;Image stations, gateway stations etc. can be defined here.
;
; Server1 Server2
#local Stations = ( 101, 102)
#local Sta_ST = ( "IEC", "IEC")
#local Sta_Nodes = ( 15, 16 )
#local Sta_MR = ( "NONE", "NONE")
#local Sta_H_Apl = ( 0, 0 )
#local Sta_H_UN = ( 0, 0 )
#local Sta_I_Apl = ( 0, 0 )
#local Sta_I_UN = ( 0, 0 )
```

Each IEC 61850 Server instance requires exactly one STA:B object of type "IEC" to be created, and the number of these objects must match the Unit Numbers entered to IET600 tool for NCCs of type IEC 61850. STA:B objects of other types of NCCs are created as part of the communication configuration of slave lines using System Configuration Tool.

The STA number assigned for server functionality need to be entered to the COM500i configuration as a station object for NCC. Please note that in IEC 61850, one NCC definition may provide the same data to multiple clients.

In case system is HSB and different node numbers has been defined for IEC 61850 Server instances serving the same NCC, STA:B objects should be created and bound to respective node using SCIL procedures in system start-up, instead of SYS\_BASCON.COM. This approach is used e.g. in SAS reference application.

If STA:B objects are defined using SCIL scripts instead of using SYS\_BASCON.COM template, STA:B creation can be made as follows:

```
;create sta
#CREATE STA910:B = LIST (TT = "EXTERNAL", ST = "IEC", ND = 50, TN = 910)
```

## Process Objects

Process objects used for command reception from NCC are created when project is imported using IET Data Loader. These need not be created manually. These objects are named as BNCC\* and are updated by each client connected to the same server instance.

Process objects for process devices using IEC 61850 are created by the IET Data Loader independently from NCC configuration. See details from SYS600 61850 System Design manual. This functionality is similar to cases where none of the NCCs are of type IEC 61850.

## 4.2.3 Communication system configuration

### 4.2.3.1 General

IEC 61850 Server configuration is divided to two parts

- Data model and signal cross-reference configuration
- IEC 61850 Server instance configuration

Refer to IET600 documentation for data model and signal cross-reference configuration for each NCC. Unlike in other NCC protocols, entering the identifiers to the "Identifier" column in COM500/Signal X-reference tool is practically impossible since these unique numbers are generated as part of the configuration process.

IEC 61850 Server instance configuration is made using the command line parameters in start-up. When configuration is imported, IET Data loader creates one start procedure, START\_61850\_SERVERS:C, and it should be called from APL\_INIT\_1:C of the main application. This procedure calls SCIL code stored in files named START\_61850\_SERVER.SCL under NCC specific configuration folders, one of each per instance. Refer to SYS600 System Configuration manual related to details of system redundancy with COM500*i*.

Similarly to other protocols in SYS600, a set of node, line and station layer attributes are provided for detailed configuration, runtime control and diagnostics.

In case encrypted communication using TLS is required, see chapter 'TLS Configuration' for detailed description. Encrypted communication can be used parallel to normal IEC 61850 functionality. Usage of encrypted communication does not affect configuration process made in IET600.

### 4.2.3.2 Configuration import using IET Data Loader

IET Data Loader tool in SYS600 loads data exported from the IET600 engineering tool. Version 5.3 FP6 and later of IET600 supports NCCs of type IEC 61850 For the configuration importing related to IEC61850 configuration in process direction, see SYS600 IEC61850 System Design manual for details. Project to be imported must be exported using option ".sasmsc with scd" in IET600. Furthermore, the allowed access point range for NCCs is S11..S18.

For the NCC connections, configuration importing and writing updates following items in the system:

- COM500*i*cross reference for each NCC, including BNCC\* process object creation for control reception
- CCF-files for each IEC 61850 Server instance
- Start-up SCL-file START\_61850\_SERVER.SCL for each instance
- Start-up procedure START\_61850\_SERVERS:C to be added to main application





Before proceeding to importing phase, all nodes and station object for basesystem must have been created, see [Section 4.2.2](#) for more details. This applies to NCC configuration, too. See SYS600 COM500/User's guide for more information.

### Steps for importing a .sasmsc file from IET600:

1. Open IET Data Loader from SYS600 Tool Launcher or from Monitor Pro menus (**Tools/Engineering Tools/IET Data Loader**).
2. Enter a name to a new project if none exists or select an existing one from 'Manage Projects'.
3. Select 'Import File' and select the .sasmsc file to be imported.
4. Select the target system. One export file may contain multiple target systems.



In HSB systems, the .sasmsc file contains the information for both systems of a HSB pair. In IET600, the data points are kept identical, but SYS A and SYS B must have different names (IED). The importing of the .sasmsc file should be made separately to both systems of a HSB pair. The correct IED is selected in the IET Data loader in the importing phase, question 'Choose target system'.

5. In case of SCL validation errors or warnings, a list of these is displayed. Abort configuration and take necessary actions in IET600 configuration or continue.
6. Verify imported parameters and objects in 'Communication' and 'Application Objects' tabs. IEC 61850 Server specific parameters can be found under the model selected as target (without 'OPCx' extension). There should be an access point 'Sxx' for each configured NCC. Check parameters and modify as necessary according to the detailed description in parameter [Table 1](#) below.



In HSB systems, parameters BIND\_ADDR, IED\_NAME and SYS\_NODE are different between SYS A and SYS B. SRV\_NODE may also be if different node numbers between HSB pair are used, see [Section Node definition](#) for more details.



In HSB Systems, the access points within the selected IED must reflect to mapping of NCCs in COM500i. Configuration is correct if same access point is used with the same NCC in both systems, e.g. access point S11 is mapped to NCC1 in both systems SYS A and SYS B. It is not allowed to use access point S11 in SYS A and access point S12 in SYS B for same NCC1. Different access point are still needed when multiple NCCs are configured.

7. Press 'Write Configuration' to update configuration for COM500i and IEC 61850 Server instances. Note that the configuration in process direction is updated at the same time (61850 OPC server, External OPC DA Clients and process objects).
8. In case of problems, a list of these with proposed solution is displayed. Abort configuration and take necessary actions in IET600 configuration or apply proposed solutions and continue.
9. Enter rollback description for the current configuration. In case of a malfunction, configuration can be reverted to a configuration stored as a rollback.
10. Save .CID file from `\sc\prog\IEC61850_Link\bin\NCCx` directory to be used in IEC 61850 Client configuration. If .IID or .ICD files are needed, these files must be exported from IET600. Select model from the tree and click right button, select 'Export IED' and define filetype.

The parameters used in the starting of each instance of IEC 61850 Server are listed below. IET Data loader parameters marked as 'none' are not visible in the user interface.

Table 1: Start-up parameters

IET Data Loader parameter	Variable in start procedure	Command line parameter	Values
SrvNode	SRV_NODE	'c'	Node number of instance, range 1..55. SA address of the node is 200+Node number.
Applic	APPLIC	'a'	COM500/application number in SYS600.
Stanum	STANUM	'd'	Station object number of the COM500/NCC definition of the instance.
SysNode	SYS_NODE	'r'	Basesystem node number, range 1..55.
Sys600Addr	SYS600_ADDR	'p'	IP-address of the LAN link in basesystem. Recommended value is "127.0.0.1" if IEC 61850 Server is running in the same computer.
(none)	(none)	'l' (Lower case L)	Initial value for node attribute LM, Log Mask. Can be used to direct e.g. TLS errors to a log file when process console is not visible. <b>Note! Non-zero values should be used only temporarily.</b> See description of node attribute LM for details.
(none)	(none)	'f'	0=configuration file not used, '-' parameters are defined in command line.
BindAddr	BIND_ADDR	'-c'	Listening address for IEC 61850 Server, e.g. "168.22.10.120". Defined IP address must exist in the local computer. Value "ANY" means that all local IP-addresses are listened (cannot be used if multiple instances). Value "CCF" means that the used listening address is the one which is defined in IET600 configuration and stored to used CCF file. If system is HSB and value "CCF" is used, same CCF file cannot be used in both systems.
(none)	GATEWAY	'-d'	IP address of gateway. Use "0.0.0.0". Function not supported in this version.
(none)	MASK	'-e'	Subnet mask of IP-address. Use "255.255.0.0".
(none)	ETHADAPT	'-f'	System dependent network adapter ID (e.g. "{12430486-780F-4A16-AE65-8A3BB580276B}") or adapter index (range1-9) for GOOSE communication. Use "1". Function not supported in this version.
(none)	ETHINDEX	'-g'	System dependent network adapter sub-index. Use "1". Function not supported in this version.
ErrorLog	ERRORLOG	'-h'	Enable logfiles for configuration error tracing, "True" or "False".
Ieced	IECED	'-i'	IEC 61850 edition. Use value = 2.
(none)	SCLCONF	'-l'	Port configuration from SCL. Use "False". Function not supported in this version.
Tracea	TRACEA	'-m'	Allow trace tool access. Use "False", trace tool is not included in SYS600 package.
(none)	GOENA	'-n'	Allow writing GSE.GoEna. Use "False". Function not supported in this version.
(none)	SVENA	'-o'	Allow writing SVCB.SvEna. Use "False". Function not supported in this version.
Cmdresp	CMDRESP	'-t1'	Time-out in milliseconds, used by IEC 61850 Server for waiting on a command response from application before internal negative response is generated. Range [5000-900000 ms], recommended default with 15000 ms (should be bigger than corresponding com500/timeout).
Table continues on next page			

IET Data Loader parameter	Variable in start procedure	Command line parameter	Values
Drfilter	DRFILTER	'-q1'	Only the directories containing this string mask can be read e.g 'drec'. Use "" (no filter).
Drsubdir	DRSUBDIR	'-q2'	This is the subdirectory name to be replaced on the bus e.g 'drec'. Use "COMTRADE".
Drreplace	DRREPLACE	'-q3'	This is the name used as replacement for the subdirectory specified in 'ISS_DR_origin_dir_name' on bus. Use "COMTRADE".
Drfolder1	DRFOLDER1	'-q4'	Name of the first directory to be scanned for COMTRADE files. With COM500 <i>i</i> , use "\SC\APL\APPL-NAME\COM500\NCC'X'_File_Transfer", where 'APPLNAME' is COM500 <i>i</i> application name 'X' is NCC number in COM500 <i>i</i> If project specific procedure are used for file transfer, define this parameter to the source directory for file transfer to NCCs. Empty string is not allowed, otherwise communication does not start. Parameter '-p' controls if the directory is created if it does not exist.
Drfolder2	DRFOLDER2	'-q5'	Name of the second directory to be scanned for COMTRADE files. With COM500 <i>i</i> , use "".
TLSoptions	TLSC	'-s'	TLS operation mode, possible values 0= no secure MMS over TLS support (NO_SECURE_MMS) 2= secure MMS over TLS support, configured using configuration file 'TLS_ISS_Config.cfg' (TLS_FILE)
Isotsap	ISOTSAP	'-s1'	Set "True" to enable the ISO-TSAP port (102) when TLS is active. This allows the server to listen to unsecured MMS traffic in parallel to TLS traffic. Option has no effect if TLS is not active. Default "False".
(none)	MKDIRS	'-p'	Create not existing directories which are defined using parameters '-p1', '-p2', '-p3', '-p4' and '-q4'. Use "True".
Logdir	LOGDIR	'-p1'	Absolute or relative path for where to store the debug log files.
(none)	SMVDIR	'-p2'	Absolute or relative path for where to store the 'ISS_SMV_CONFIG.cfg' file.
Persdir	PERSDIR	'-p3'	Absolute or relative path for where to store IEC 61850 persistent logs (LCB).
Cmddir	CMDDIR	'-p4'	Absolute or relative path for command interpreter in-output.

Call the start procedure START\_61850\_SERVERS:C from APL\_INIT\_1:C of the MAIN application using #EXEC.

### 4.2.3.3 TLS Configuration

For cyber security, TLS (Transport Layer Security) in IEC 61850 Server supports TLS versions 1.2 and 1.3. For highest security, the cipher suites are limited to following set:

Table 2: TLS ciphers

Cipher (IANA naming)	Cipher (OpenSSL naming)	TLS version
TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384	ECDHE-RSA-AES256-GCM-SHA384	1.2
TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256	ECDHE-RSA-AES128-GCM-SHA256	1.2
TLS_AES_128_GCM_SHA256	TLS_AES_128_GCM_SHA256	1.3
TLS_AES_256_GCM_SHA384	TLS_AES_256_GCM_SHA384	1.3
TLS_CHACHA20_POLY1305_SHA256	TLS_CHACHA20_POLY1305_SHA256	1.3

A mutual certificate validation is made for all connections and with all ciphers. Configuring TLS Configuration requires following steps

- Generating or acquiring certificate and key file of type .pem to be provided to the remote client
- Generating or acquiring a trusted certificate authority file to validate the certificate received from the remote client
- Creation of configuration file 'ISS\_TLS\_Config.cfg' file(s) as instructed below
- Enabling the TLS functionality using start-up parameter '-s' (TLSC) value 2. In case normal IEC 61850 communication is operating parallel to TLS, parameter '-s1' need to be set to "True" in instance start-up.

File 'ISS\_TLS\_Config.cfg' need to be created and copied to same directory where the CCF-file generated by the IED Data loader exists for the instance. This is a sample of the file and can be used as model for the real configuration:

```

crt_name ""
crt_store file
keycrt_file C:\sc\sys\active\sys_\KEYS\server.pem
cacrt_file C:\sc\sys\active\sys_\KEYS\rootCA.pem
ses_res both
crl_chk none
ocsp_chk none
tls_vmax 1.3
tls_vmin 1.2

```

Meaning of the parameters are as follows:

Table 3: TLS parameters

Parameter	Description
crt_name	Validation string for the local certificate defined with parameter 'keycrt_file'. Use empty string here to validate all locally configured certificate.
crt_store	Use 'file'. No other methods of certificate storage is supported at the moment.
keycrt_file	Location and the name of the certificate and key file (.pem). The recommended location for the file is '\sc\sys\active\sys_\KEYS', this directory has a limited access and certificates related to SYS600 internal communication are located, too. Same file may contain multiple certificates.
cacrt_file	Location and the name of the trusted certificate authority file (.pem). The recommended location for the file is '\sc\sys\active\sys_\KEYS'. Same file may contain multiple certificates from different authorities.
ses_res	Use 'both' here.
crl_chk	Use 'none' here. CRL functionality is not supported at the moment.
ocsp_chk	Use 'none' here. OCSP functionality is not supported at the moment.
tls_vmax	Maximum TLS version accepted, use '1.2' or '1.3'.
tls_vmin	Minimum TLS version accepted, use '1.2' or '1.3'.

When configuration steps described are completed, instance in question can be started using TLSC option '-s' equal to 2. Verifying the initialization is possible in following ways:

- By executing the start procedure of the instance from test dialog using OPS\_PROCESS setting "CLIENT". Console of the process is opened and possible errors are readable from console output.
- By setting the bits 5 and 7 (value 160) for a start-up parameter 'I' (initial value for attribute LM Log Mask). See details from the start-up parameter table and description of the Node Attribute LM.

When connection to remote client is established, possible errors related to validation and communication failures can be seen using same techniques. In case of a validation failures or other exceptions, TCP connection is disconnected according to rules in TS IEC62351-3. In such cases, corresponding event generated to User Activity Log event list in SYS600 Monitor Pro. 'Source' column of the event defines the module from the event is originated and 'ExtraInfo' column shows the remote IP-address of the causing the event. This is helpful if a cyber security attack is suspected. The description texts in UAL events follow TS IEC62351-3 conformance standard.

#### 4.2.3.4 Starting and stopping the communication

A command procedure is needed start each instance of IEC 61850 Server. It is recommended to use procedures created by the IET Dataloader, i.e. the START\_61850\_SERVERS:C which calls NCC specific SCL-files START\_61850\_SERVER.SCL. If there are specific reasons not to use those, the procedure below can be used an example (same node number for instance is used in both sides of a HSB pair). The meaning of each parameter is described in [Section 4.2.3.2](#).

```
; IEC61850 server startup
; General configuration, instance for NCC1
#LOCAL EXE_File = "C:\sc\prog\IEC61850_Link\bin\61850_Server.exe"
#LOCAL CONFIG_Dir = "C:\sc\prog\IEC61850_Link\bin\NCC1"
#LOCAL IED_Name = "" ; node specific - defined below

; Node configuration
#LOCAL SRV_NODE = 50
#LOCAL APPLIC = 1
#LOCAL APPLNAME = APL'APPLIC':BNA
#LOCAL STANUM = 910
#LOCAL SYS_NODE_A = 9
#LOCAL SYS_NODE_B = 10
#LOCAL SYS_NODE = SYS:BND

#LOCAL SYS600_ADDR = "127.0.0.1"
; Server configuration
#LOCAL BIND_ADDR = "" ; node specific - defined below
#LOCAL GATEWAY = "0.0.0.0"
#LOCAL MASK = "255.255.0.0"
#LOCAL ETHADAPT = 1
#LOCAL ETHINDEX = 1
#LOCAL ERRORLOG = "True"
#LOCAL IECED = 2
#LOCAL SCLCONF = "False"
#LOCAL TRACEA = "False"
#LOCAL GOENA = "False"
#LOCAL SVENA = "False"
#LOCAL CMDRESP = 15000
#LOCAL DRFILTER = ""
#LOCAL DRSUBDIR = "COMTRADE"
#LOCAL DRREPLACE = "COMTRADE"
#LOCAL DRFOLDER1 = "C:\sc\apl\'APPLNAME'\COM500\NCC1_File_Transfer"
#LOCAL DRFOLDER2 = ""
#LOCAL TLSC = 0
#LOCAL ISOTSAP = "False"
#LOCAL MKDIRS = "True"
```

```

#LOCAL LOGDIR = ".\ISS_LOGS\IEC_logs"
#LOCAL SMVDIR = ".\ISS_LOGS\SMV_cfg"
#LOCAL PERSDIR = ".\ISS_LOGS\pers"
#LOCAL CMDDIR = ".\ISS_LOGS\cmd"

#LOCAL NODE_Config = "c'SRV_NODE' a'APPLIC' d'STANUM' r'SYS_NODE'
p'SYS600_ADDR' f0"; f0
    = ISS_Link.cfg not used

#IF SYS:BND == SYS_NODE_A #THEN #BLOCK
    BIND_ADDR = "10.1.21.1" ; Server listen address for SYS A
    IED_Name = "AA1KF11" ; IED name for SYS A
#BLOCK_END
#ELSE #BLOCK
    BIND_ADDR = "10.1.31.1" ; Server listen address for SYS B
    IED_Name = "AA1KF12" ; IED name for SYS B
#BLOCK_END

@ISS_Config = "-c 'BIND_ADDR' -d 'GATEWAY' -e 'MASK' -f 'ETHADAPT' -g
'ETHINDEX' -h 'ERROR
LOG' -i 'IECED' -l 'SCLCONF' -m 'TRACEA' -n 'GOENA' -o 'SVENA' -t1
'CMDRESP' -q1
'DRFILTER' -q2 'DRSUBDIR' -q3 'DRREPLACE' -q4 'DRFOLDER1' -q5
'DRFOLDER2' -s 'TLSC' -s1
'ISOTSAP' -p 'MKDIRS' -p1 'LOGDIR' -p2 'SMVDIR' -p3 'PERSDIR' -p4
'CMDDIR'"

;x=console_output("'ISS_Config'")

@success = ops_process("'EXE_File' 'CONFIG_Dir' 'IED_Name' 'NODE_Config'
'ISS_Config'", "", "SERVER")
; Enable communication, comment these if called from WD.
#PAUSE 2
#SET STA'STANUM':SIU = 1
#error ignore
#return %success

```

Call the start procedure from APL\_INIT\_1:C of the MAIN application using #EXEC just like procedures created by IET Data Loader should be called. If called from WD, socket listening starts even though Station and Line objects are out of use, this may confuse the clients to connect to a wrong system, therefore it is recommended to start the servers not until main application becomes HOT. Line object is taken into use by COM500i/application when data has been initialized for the first time.

Refer to SYS600 System Configuration manual related to details of system redundancy with COM500i. A separate stopping procedure is required for each instance, too:

```

@INOD = 20
#error continue

#SET NET'INOD':SEX=1 ; command application to exit
@st = status

#if %st==0 #then #block
    @x = console_output("IEC61850 Server node 'INOD' stopped")
#block_end
#else #block
    @x = console_output("IEC61850 Server 'INOD' stop fail, status = 'st'")
#block_end

```

Stopping of each instance should be done from APL\_CLOSE:C procedure of the main application.

Starting and stopping procedures can be called also from test dialog. If the last parameter of the #OPS\_PROCESS call is changed from "SERVER" to "CLIENT" and the procedure is called from test dialog using #DO, a console window for the instance becomes visible. If string 127.0.0.1

has socket..' becomes visible, accessing the attributes described in chapter 'Attribute descriptions' should be possible.



The instance started with #DO from test dialog is executed in the context of the current user. When user logs out, this instance is terminated, too.

#### 4.2.3.5 Verifying the communication

When IEC 61850 Server instance is started and communication is enabled, instance starts listening TCP ports 102 (MMS) and/or 3782 (secure MMS) in IP-address defined using startup parameter '-c'. In case startup parameter '-c' in "ANY", instance listens to all local IP-addresses.



If multiple instances of IEC 61850 Server is started, they cannot listen to all addresses using '-c' setting "ANY"

It is possible to see if local IP-addresses are listened using command 'netstat -a -b |findstr "102" ' or 'netstat -a -b |findstr "3782" ' from a command prompt which is started with administrator rights. If this indicates that listening is not started, check following things:

- 61850\_Server.exe process is running and attribute access to it is possible (error 30014 in attribute access indicates license failure)
- Virus scanner has not quarantined 61850\_Server.exe
- Firewall is not blocking ports 102 and/or 3782
- Executable '61850\_Server.exe' is configured as an allowed app in the Windows firewall

If the listening of mentioned ports are started, TCP connections from remote clients is possible. Node attribute CC (Connection Count) can be used to read the amount of client connections at any time. If CC attribute reading (NETxx:SCC from test dialog) indicates that connection count is continuously 0, the TCP connections may be blocked due to external reasons. Installing a network traffic analyser may show if the connection attempts from remote client are visible in local network interface.

If node attribute CC shows non-zero value, client connections exist. If data is not received correctly, identifying the report control blocks which are working is necessary. Comparing the data models between CCF file given to IEC 61850 Server instance and client in question need to be compared. Note also that multiple NCCs is configured to COM500*i*, the data model may be correct but the startup parameter '-c' defines wrong IP address and the connected instance and model is not as expected by the client.

The usage of node attribute LM Logging Mask may be considered when communication errors are resolved.

### 4.2.4 Attribute descriptions

These chapters describe the attributes of the node, line and station objects. See SYS600 System Objects manual for details how to access communication system objects from SCIL.

#### 4.2.4.1 Node attributes

This chapter describes the attributes of the IEC 61850 Server node. These attributes are accessed using notation NETn:Sat or NODn:Sat where

'n'	The object number (=node number) of the unit, 1..55
'at'	An attribute name

Node attributes define the common properties of the all functions within one node.

Base system attributes for a node are accessed using notation NODn:Bat, see SYS600 System Objects manual for more information. These attributes are same for all types of communication units.

SA	Address of the node
	ACP messaging address of the node, value is 200 + net node number given as argument using definition 'c'.
Data type:	Integer
Value:	200 + node number
Index range:	No indexing
Access:	Read Only

  

DV	Device create
	By writing a value to this attribute, IEC 61850 node creates a device which is accessed using STA:S notation. Given arguments define the number of the STA object and the corresponding iedName within the defined CCF file. The data model used for NCC connection is based on the iedName given here.
Data type:	Integer
Value:	Element 1: STA object number, 1..2047 Element 2: Mode of operation 1=Server Element 3: string, defines iedName within the CCF file
Index range:	No
Access:	Write only
Example:	
	<pre>#SET NET3:SDV=(101, 1, "SYS600_SRV670") ;create STA101 operating as using data model for iedName SY600_SRV670</pre>

  

CC	Connection count
	Value shows how many client connection exists at any time.
Data type:	Integer
Value:	Amount of connected clients, max 8.
Index range:	No indexing
Access:	Read Only

  

TZ	Time Zone
	TZ defines time zone compared to UTC.
Data type:	Integer
Value:	Integer, in minutes If TZ=0, Time conversion to local time and UTC (and opposite) is done automatically according operating system configuration. If TZ<> 0, conversions between local time a UTC is done with TZ difference, positive values are used when local time is ahead from UTC. Possible DST is detected using regional settings of Windows.
Index range:	No indexing
Access:	Read/Write



LM	Logging Mask
	LM defines a bitmask for logging for the whole node. If IEC 61850 Server has been started using "CLIENT" option in 'OPS_PROCESS' call, logging output becomes visible to the console of IEC 61850 Server console. If bit 7 is set, log output is directed to file '\\sc\\prog\\IEC61850_Link\\Trace_NodeXX.txt' where 'XX' is the number of the IEC 61850 Server node. STA object has a corresponding attribute LM which operates as bitmask, too. Setting of bits 1 and 4 is not recommended, output interpretation requires knowledge of the internal functionality. The initial value of this parameter can be given using start-up parameter 'l'. See also line attribute SS for initialization errors.
Data type:	Integer 0..255 (Bitmask)
Default:	0 (no logging)
Value:	Bit 0: LogMaskError. If set, errors are logged Bit 1: LogMaskFlow. If set, callback logging is enabled Bit 3: LogMaskIALData. If set, debug output from data identifiers and types is enabled Bit 4: LogMaskSDL. If set, debug output from SDL transitions is enabled Bit 5: LogMaskSSL. If set, debug output from TLS connections is enabled Bit 7: LogMaskFile. If set, all debug output is written to file '\\sc\\prog\\IEC61850_Link\\NodeLogXX.txt'
Index range:	No indexing
Access:	Read/Write
Example:	<pre>#LOCAL NODE_Config = "c'SRV_NODE' a'APPLIC' d'STANUM' r'SYS_NODE' p'SYS_IP' 1169 f0" ; 1169 = set bits 0,3,5 and 7 of node attr LM</pre>



Bit 7 of attribute LM should be set only temporarily, otherwise all disk space may be consumed.

EX	Node exit
	By writing a value to this attribute, IEC 61850 node closes all connections and exits itself. Usage of this attribute is recommended instead of killing the process. The written value is meaningless.
Data type:	Integer
Value:	1
Index range:	No
Access:	Write only

#### 4.2.4.2 Line attributes

Line attributes are accessed like node attributes but index must be given. At the moment, the given index must always be 1, excluding DC (Diagnostic counters).

IU	In Use
	IU Attribute controls if the connection in use or not. STA objects are in suspended state if line IU is 0 and no data updates nor command are accepted. At the moment, TCP connection may still be established although IU is 0. Setting IU to 1 enables data updates and command reception. In HSB systems, it is recommended to exit the instance in COLD systems instead of setting IU to 0.
Data type:	Integer
Value:	0 = Line is out of use 1 = Line is in use
Index range:	Always 1
Access:	Read/Write

<b>BN</b>	<b>Buffer Num</b>
The values return the amount of free buffers in different internal queues in IEC 61850 Server (Line Layer). Attribute is used only diagnostic purposes.	
Data type:	Integer
Value:	0..20000
Default:	20000 (all buffers free)
Index range:	1..6
	<ol style="list-style-type: none"> <li>1. Free buffers of Command Out queue</li> <li>2. Free buffers of Data Out queue</li> <li>3. Free buffers of Reply Out queue</li> <li>4. Free buffers of Command In queue</li> <li>5. Free buffers of Data In queue</li> <li>6. Free buffers of Reply In queue</li> </ol>
Access:	Read Only

<b>SS</b>	<b>Stack State</b>
This attribute returns the latest state of the internal IEC 61850 protocol stack. In case the start-up of the IEC 61850 Server is abnormal, this value may give extra information about the entered state during initialization. If the initialization has been successful and communication is possible, returned value is 10 = NO_ERROR. If bit 7 node attribute LM (Logging mask) is set as a start-up parameter, the initialization sequence is stored to trace log. Search for string 'DiagInfo'. See description of node attribute LM for more information.	
Data type:	Integer
Value:	0 = (processing, wait) 1 = SYSTEM_TIME 2 = PARSING_CCF 4 = MMS_ACSI 5 = CREATE_MODEL 6 = CLNP 7 = SETUP_GOOSE 8 = BUILD_CALLBACKS 9 = SETUP_RCBS 10 = PROC_IMAGE 11 = CLIENT 12 = TRACKING 13 = CONN_COM_IF 14 = START_SERVICE 100 = CONFIG_ERROR 10 = NO_ERROR
Access:	Read Only

<b>DC</b>	<b>Diagnostic Counters</b>
The values of the diagnostic counters which the IEC 61850 Server unit keeps for the line object. The meaning of the counters are listed below. In case a value is written to some of the indices, all counters are reset to 0.	
Data type:	Integer
Value:	0..2147483647
Table continues on next page	

DC	Diagnostic Counters
Default:	0
Index range:	1..24
	<ol style="list-style-type: none"> <li>1. Number of suspended associations</li> <li>2. Number of suspensions</li> <li>3. Transmitted commands</li> <li>4. Transmitted command replies</li> <li>5. Received commands</li> <li>6. Received command replies</li> <li>7. Received data messages</li> <li>8. Received data items</li> <li>9. Received System Items</li> <li>10. Unknown Objects</li> <li>11. Cmd timeouts</li> <li>12. Line in Cmd buffer overflows</li> <li>13. Line in Data buffer overflows</li> <li>14. Line in Reply buffer overflows</li> <li>15. Dev in Cmd buffer overflows</li> <li>16. Dev in Data buffer overflows</li> <li>17. Dev in Reply buffer overflows</li> <li>18. Command out buffer overflows</li> <li>19. Reply out buffer overflows</li> <li>20. Lost messages</li> <li>21. Transmission fails</li> <li>22. Transmitted IAL Messages</li> </ol>
Access:	Read/Write (only reset)

#### 4.2.4.3 Station attributes

IU	In Use
IU Attribute controls if the connection in use or not. STA objects are in suspended state if line IU is 0 and no data updates nor command are accepted.	
Data type:	Integer
Value:	0 = STA object is out of use 1 = STA object is in use
Index:	No index
Access:	Read/Write

  

DI	Database Initialization
In IEC 61850 Server, local data need to be initialized before communication to remote may begin. Setting DI to 1 indicates that current data values have been updated and communication can be started. This attribute is controlled by the COM500i application.	
Data type:	Integer
Value:	0 = Database for local data is not initialized 1 = Database for local data is initialized
Index:	No index
Access:	Read/Write

## OS Object Status

The current status of the IEC station object. When value 1 is written to this attribute, the station object retransmits its current status to the system message process object.

Data type:	Integer
Value:	0..65535 0 = OK_STATUS
Index:	No index
Access:	Read/Write (write possible only with value 1)

## MI Message Identification

Object address of system messages.

Data type:	Integer
Default value:	1000+Station object number
Index:	No index
Access:	Read/Write

## DC Diagnostic Counters

The values of the diagnostic counters which the IEC 61850 Server unit keeps for the STA:S object. The meaning of the counters are listed below. In case a value is written to some of the indices, all counters are reset to 0.

Data type:	Integer
Value:	0..2147483647
Default:	0
Index range:	1..24
	<ol style="list-style-type: none"> <li>1. Number of suspensions</li> <li>2. Transmitted Data Items</li> <li>3. Transmitted commands</li> <li>4. Transmitted Reply Messages</li> <li>5. Received Data Items</li> <li>6. Received Commands</li> <li>7. Received Reply Messages</li> <li>8. Received Sys Reply Messages</li> <li>9. Received Cmd Confirmations</li> <li>10. Unknown Messages</li> <li>11. Confirmation Timeouts</li> <li>12. Dev Response Timeouts</li> <li>13. Sys Response Timeouts</li> <li>14. Lost Messages</li> <li>15. Received Cmd errors</li> <li>16. Received Data errors</li> <li>17. Transmission Errors</li> <li>18. Transmitted Status Messages</li> <li>19. Sys Reply Errors</li> <li>20. Dev Reply In Buffer overflows</li> <li>21. Dev Data In Buffer overflows</li> <li>22. Dev Command In Buffer overflows</li> <li>23. Removed packed messages</li> <li>24. Sent packed messages</li> </ol>
Access:	Read/Write (only reset)

**LM Logging Mask**

LM defines a bitmask for logging for the STA object in question only. If IEC 61850 Server has been started using "CLIENT" option in 'OPS\_PROCESS' call, logging output becomes visible to the console of IEC 61850 Server console. If bit 7 is set, log output is directed to file '\\sc\\prog\\IEC61850\_Link\\Trace\_NodeXX.txt' where 'XX' is the number of the IEC 61850 Server node. Node object has a corresponding attribute LM which operates as a bitmask, too.

Setting of bits 1 and 4 is not recommended, output interpretation requires knowledge of the internal functionality.

Data type:	Integer 0..255 (Bitmask)
Value:	Bit 0: LogMaskError. If set, errors are logged Bit 1: LogMaskFlow. If set, callback logging is enabled Bit 2: LogMaskDevData. If set, debug out for incoming command is enabled Bit 4: LogMaskSDL. If set, debug output from SDL transitions is enabled Bit 7: LogMaskFile. If set, all debug output is written to file '\\sc\\prog\\IEC61850_Link\\NodeLogXX.txt'
Index range:	No indexing
Access:	Read/Write



Bit 7 of attribute LM should be set only temporarily, otherwise all disk space may be consumed.

**BN Buffer Num**

The values return the amount of free buffers in different internal queues in IEC 61850 Server (Station Layer). Attribute is used only diagnostic purposes.

Data type:	Integer
Value:	0..20000
Default:	20000 (all buffers free)
Index range:	1..3
	1. Free buffers of Data In queue 2. Free buffers of Command In queue 3. Free buffers of Reply In queue
Access:	Read Only

**ST Application Timeout**

The maximum time in seconds that the slave station waits for a reply from the base system when a command is received.

Data type:	Integer, 0..65535
Default value:	5
Index:	No index
Access:	Read/Write

**FT Maximum confirmation timeout**

The maximum time in 10th's seconds that the slave station waits for a confirmation status (write to CF attribute) from the COM500/application when a command from a remote client has been received. In case timeout occurs, command is responded using ACR value 102.

Data type:	Integer, 0..65535
Default value:	120 (12s)
Index:	No index
Access:	Read/Write



## Section 5 Technical description

IEC 61850 protocol is a set of specifications, which details layered substation communication architecture. The International Standard IEC 61850 has been prepared by IEC technical committee 57: Power system control and associated communications. IEC 61850 specifies usage of Manufacturing Message Specification (MMS, ISO 9506) over TCP/IP as communication between the IEC 61850 server and client.

Separate PICS (Protocol Implementation Conformance Statement), PIXIT (Protocol Implementation eXtra Information for Testing), TICS (TISSUES Implementation Conformance Statement) and MICS (Model Implementation Conformance Statement) documents are delivered separately when requested. Contact nearest Hitachi ABB Power Grids representative for inquiry.

IEC 61850 Server in SYS600 product supports Ed.2 is connected to SYS600 base system using CPI interface. The data model used by the instance is loaded from the CCF file which is define as a startup parameter. Each data item in data model is identified using a unique integer value as identifier. The data model visible to the remote client is a subset of all process objects of the system. As the data updates from process devices or from locally updated process objects are coming, data items which are cross-referenced will update the new values in IEC 61850 Server and spontaneous transmission occurs according to IEC 61850 to each connected client.

Correspondingly, control commands received from remote client updates a local process object (BNCC\*), are cross-referenced to actual process devices. When control command is received, it is redirected to process device by updating the cross-referenced output process object.

Process devices may be connected with any protocol, though the common usage is to use IEC 61850 in process direction, too.

### 5.1 Device Communication Attributes

These attributes are used to pass monitor direction data to IEC 61850 Server. Normally, these attributes are accessed only by the COM500/application.

DV	Data Value
DV attribute is a communication attribute used to send data from server to clients(s). It updates the model-based database with new value or quality using given ID as an identifier to object. Object is sent to clients according IEC 61850 communication methods. This attribute is accessed only by the COM500/application.	
Data type:	Vector of integers (ID, VAL, COT, QU, SOT, RT, RM, [OG], [CG])
Value:	ID = Identifier VAL = Value COT = Cause of transmission QU = IEC 61850 value quality (bitmask) SOT = IEC 61850 time quality (bitmask) RT = timestamp without milliseconds RM = timestamp milliseconds OG = (optional) originator (lower byte 'origin.orIdent', high byte 'origin.orCat') CQ = (optional) Quality of Counter (bitmask)
Index:	No index
Access:	Write only

SR	String with Time Tag
SR attribute is a communication attribute used to send a string from server to clients(s). It updates the model- based database with new value or quality using given ID as an identifier to object. The identifier must point to a string data type in model. Object is sent to clients according IEC 61850 communication methods. This attribute is accessed only by the COM5007/application.	
Data type:	Vector of integers (ID, COT, QU, SOT, RT, RM, STR)
Value:	ID = Identifier COT = Cause of transmission QU = IEC 61850 value quality (bitmask) SOT = IEC 61850 time quality (bitmask) RT = timestamp without milliseconds RM = timestamp milliseconds STR = string to be sent
Index:	No index
Access:	Write only

## 5.2 Database interface

IEC 61850 Server is connected to process database when it receives control and setpoint commands from remote control center. The updated process object has its UN attribute equal to STA object number defined for the IEC 61850 Server instance and OA equal to identifier of the item which has been read from the defined CCF file. The process object must exist in the SYS600 application defined using start-up parameter 'a'. Normally, these BNCC\* process objects are created automatically by respective tools. Following table defines the updated attributes with received commands:

Table 4: *Updated attributes of process objects*

Attribute	Value	Description
TY	1..255	Message type indicator from protocol stack
OV	0,1,2, Real	0=off, 1=on (single command), 1=off, 2=on (double command), 1=lower, 2 = higher (regulating step command), Real (Analog setpoint command)
RA	0,1	Execution information of the command. 1= select, 0 = execute
RB	0..255	Qualifier of the command
CT	6,8	Cause of transmission of the command 6=activate, 8=deactivate
OG	0..65535	Originator address of the command (upper byte is Originator, lower byte is OAD Internal address)

## 5.3 Status Codes

The status codes for the IEC 61850 Server are defined in the SYS600 Status Codes manual. Some typical reasons for some of the status codes are also given.

Status codes are sent as system messages which can be received by analog input project objects with a unit number (UN) 0 and an object address (OA) as determined by the MI attribute of the STA object, or alternatively, they are returned as a response to a SCIL command accessing a IEC station object.

## 5.4 Interoperability

IEC 61850 Server in SYS600 product supports Ed.2. Separate PICS (Protocol Implementation Conformance Statement), PIXIT (Protocol Implementation eXtra Information for Testing), TICS (TISSUES Implementation Conformance Statement) and MICS (Model Implementation



Conformance Statement) documents are delivered separately when requested. Contact nearest Hitachi ABB Power Grids representative for inquiry.



# Appendix A    Appendix

None.



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