

# 15.2 IEC 61850 Server

WCC Lite can act as an IEC 61850 server to serve data to remote SCADA systems. For example, WCC Lite can be used to acquire data from various protocols (Modbus, IEC 60870-5-103, etc.), this data can be redirected and propagated further to a single or multiple IEC 61850 clients. IEC 61850 Server supports TCP and TLS connection types. TCP connection can be secured with password authentication.

## Commands


WCC Lite **IEC 61850 Server** implementation defines four command types which are described by their control model:

- **Case 1:** Direct control with normal security (direct-operate);
- **Case 2:** SBO control with normal security (operate-once or operate-many);
- **Case 3:** Direct control with enhanced security (direct-operate);
- **Case 4:** SBO control with enhanced security (operate-once or operate-many).

Normal security commands are considered for execution if the command signal is found in Excel configuration. There aren't any additional checks in command execution in any master protocol.

Enhanced security commands need feedback from the master protocol to either succeed or fail. If feedback is not received within the **command\_ack\_timeout\_ms** timeframe, the command is considered failed.

Command value attributes (e.g. stVal) must be updated separately (if they need to be updated).

 When using SBO commands, select is not routed to the master protocol and select logic is performed only in IEC 61850 Server protocol.

## Configuring data points

To use the IEC 61850 Server in WCC Lite, it has to be configured via an Excel configuration and the data model must be uploaded. This configuration contains two Excel sheets where parameters have to be filled in - Devices and Signals.

If a few devices were to connect to a server using the same virtual port, all of the IP addresses have to be specified on the host field separated by space. That way all of the clients will be able to connect from different IP addresses but using the same port as long as they all have the same subnet address.

### IEC 61850 Server parameters for Devices tab

Parameter	Type	Description	Required	Default value (when not specified)	Range	
					Min	Max
name	string	User-friendly name for a device	Yes			
description	string	Description of a device	No			
device_alias	string	Alphanumeric string to identify a device	Yes			
enable	boolean	Enabling/disabling of a device	No	1	0	1
protocol	string	Protocol to be used	Yes		IEC 61850 Server	
bind_address	string (IP address format)	The IP address of an interface to use with the server	No	0.0.0.0		
host	string (IP address format)	IP address list of allowed IPs (separated with spaces)	Yes			
port	integer	TCP communication port	No	102		

auth	string	Authorization type	Yes		"NONE", "PASSWORD", "TLS"	
password	string	Authorization password for server device	Yes ( for PASSWORD)			
tls_local_certificate	string	Local certificate for TLS connection	Yes (for TLS)			
tls_peer_certificate	string	Certificate authority file for TLS connection	Yes (for TLS)			
tls_private_key	string	A file consisting of the private key for TLS connection	Yes (for TLS)			
ied_name	string	Name of an Intelligent Electronic Device	Yes			
originator	string	Origin identification for the device	No			
model_filename	string	The filename of the server model, without the .server extension	Yes			
command_ack_timeout_ms	integer	Timeframe (ms) in which enhanced security commands must be acknowledged (Default: 3000)	No	3000		
report_buffered_size	integer	Report control blocks buffer size in bytes (Default: 65536)	No	65536		
report_unbuffered_size	integer	Unbuffered report control blocks buffer size in bytes (Default: 65513)	No	65513		

## IEC 61850 Server parameters for Signals tab

Parameter	Type	Description	Required	Default value (when not specified)	Range	
					Min	Max
signal_name	string	User-friendly signal name	Yes			
device_alias	string	Device alias from a Devices tab	Yes			
signal_alias	string	Unique alphanumeric name of the signal to be used	Yes			
enable	boolean	Enabling/disabling of an individual signal	No	1	0	1
log	boolean	Allow signal to be logged. If the <b>log is 0</b> signal will not be logged. If the <b>log is more than 0</b> signal will be logged	No	0		

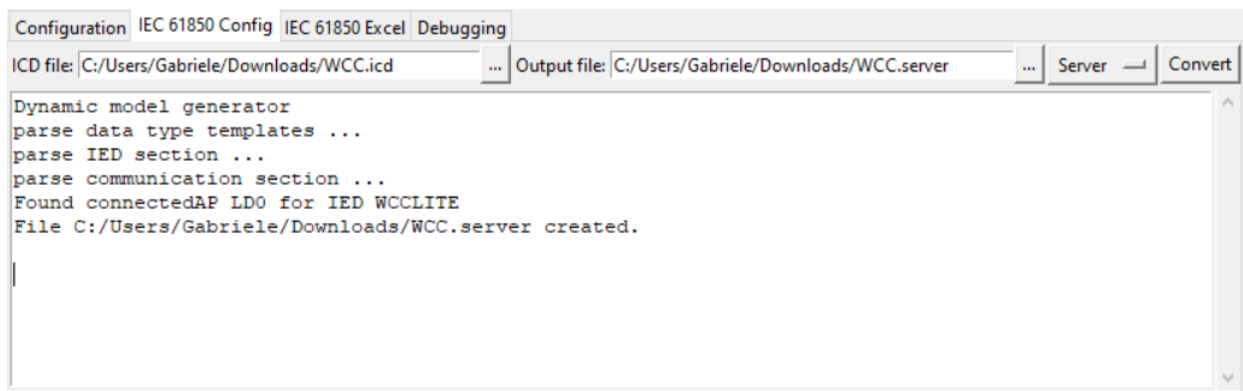
number_type	string	Number format type (BOOLEAN, FLOAT, INT16, etc.)	Yes		BOOLEAN, INT8, INT16, INT32, INT64, INT128, INT8U, INT24U, INT32U, FLOAT32, FLOAT64, ENUMERATED, OCTET STRING 64, OCTET STRING 6, OCTET STRING 8, VISIBLE STRING 32, VISIBLE STRING 64, VISIBLE STRING 65, VISIBLE STRING 129, VISIBLE STRING 255, UNICODE STRING 255, TIMESTAMP, QUALITY, CHECK, CODEDENUM, GENERIC BITSTRING, CONSTRUCTED, ENTRY TIME, PHYCOMADDR, CURRENCY, OPTFLDS, TRGOPS
ld_instance	string	An instance of a logical device	Yes		
ln_class	string	Logical node class type	Yes		
ln_instance	integer	An instance of a logical node	No		
ln_prefix	string	Prefix of logical node string	No		
cdc	string	Common Data Class (CDC) name	Yes		SPS, DPS, INS, ACT, ACD, SEC, MV, CMV, WYE, DEL, SEQ, SPG, ING, ASG, ENS, ENG
data_object	string	Name of a data object in the dataset	Yes		
da_value	string	Name of a data attribute value node	Yes		
da_fc	string	Functional constrain for data object	Yes		ST, MX, CO, SP
control_model	string	Model of output control	Yes (for commands)	read-only	read-only, direct-with-normal-security, sbo-with-normal-security, direct-with-enhanced-security, sbo-with-enhanced-security

## Device status signals

IEC 61850 has an additional signal which can be configured to show communication status. It is used to indicate if the client device has disconnected from the server (WCC Lite). To configure such a signal for the IEC 61850 protocol, job\_todo and tag\_job\_todo fields with string values are required. For the IEC 61850 server required parameters for the status signal will be **signal\_name** **device\_alias**, **signal\_alias**, **number\_type**, **job\_todo** and **tag\_job\_todo**. Job\_todo value must be *device\_status* and for tag\_job\_todo there are 4 variations: communication\_status, device\_running, device\_error, unknown\_error. Each signal has 4 possible values and is based on the same logic. If the signal returns the value of 0, it means an unknown error has appeared, 1 – device or protocol connection is on and working properly, 2 – device is off or protocol is disconnected, 3 – error or service is down.

## Converting and uploading data model

To use the IEC61850 Server protocol in WCC Lite, the user must upload a data model in a specific format (file extension .server). These data models can be converted from SCL files (.icd, .cid or .scd files). To convert a data model, the user must use WCC Excel Utility. There's a separate tab for this operation as shown in the picture below.



The converted file can be uploaded in the WCC Lite web interface, Protocol Hub section. The current model can be also downloaded on the same page as shown in the picture below.

PROTOCOL HUB	STATUS	SYSTEM	SERVICES	NETWORK	USERS	LOGOUT (ROOT)
CONFIGURATION	IMPORTED SIGNALS	EVENT LOG	PROTOCOL CONNECTIONS	SCRIPT-RUNNER		

### Protocol configuration

#### IMPORT PROTOCOL CONFIGURATION

Here you can import Excel configuration file. Up to 1000 signals are allowed. All previous signals will be replaced.

Configuration file:  No file chosen

PLC (IEC-61499) Boot file:  No file chosen

IEC61850 Client model file:  No file chosen

IEC61850 Server model file:  No file chosen

#### DOWNLOAD CONFIGURATION


Current configuration (WCC.xlsx):

Template configurations:

Current IEC 61850 Server model file (WCC.server):

## Debugging an IEC 61850 server application

If the configuration for the IEC 61850 Server is set up, a handler for the protocol will start automatically. If the configuration is missing or contains errors, the protocol will not start. It is done intentionally to decrease unnecessary memory usage.

 If the IEC 61850 Server does not work properly (e.g. no communication between devices, data is corrupted, etc.), a user can launch a debug session from the command line interface and find out why the link is not functioning properly.

 To launch a debugging session, a user should stop `iec61850-server` process and run `iec61850-server` command with respective flags as you can see below:

Step 1: Service must be stopped by entering the following command into the wcc-lite:  
`/etc/init.d/iec61850-server stop`

Step 2: After the service is stopped it must be started with the preferred configuration file (JSON files found in the `/etc/` folder) and a debug level 7:

`iec61850-server -c /etc/iec61850-server/iec61850-server.json -d7`

Additional output forming options described in the table below.

Step 3: Once the problem is diagnosed normal operations can be resumed with the following command:

`/etc/init.d/iec61850-server start`

`-h [--help]` Show help message

```
-c [--config] arg Configuration file location
-V [--version] Show version
-d [--debug] arg Set Debug level
-r [--redis] Show Redis messages
```

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