

# NETCON 500

The cybersecure gateway RTU



Designed for energy generation, transmission and distribution and for the energy intensive industry



# NETCON 500

## The cybersecure gateway RTU

## FEATURES

## Single platform with all-in-one functionality

## Remote terminal unit (RTU)

## Communication concentrator

## Cybersecurity built in

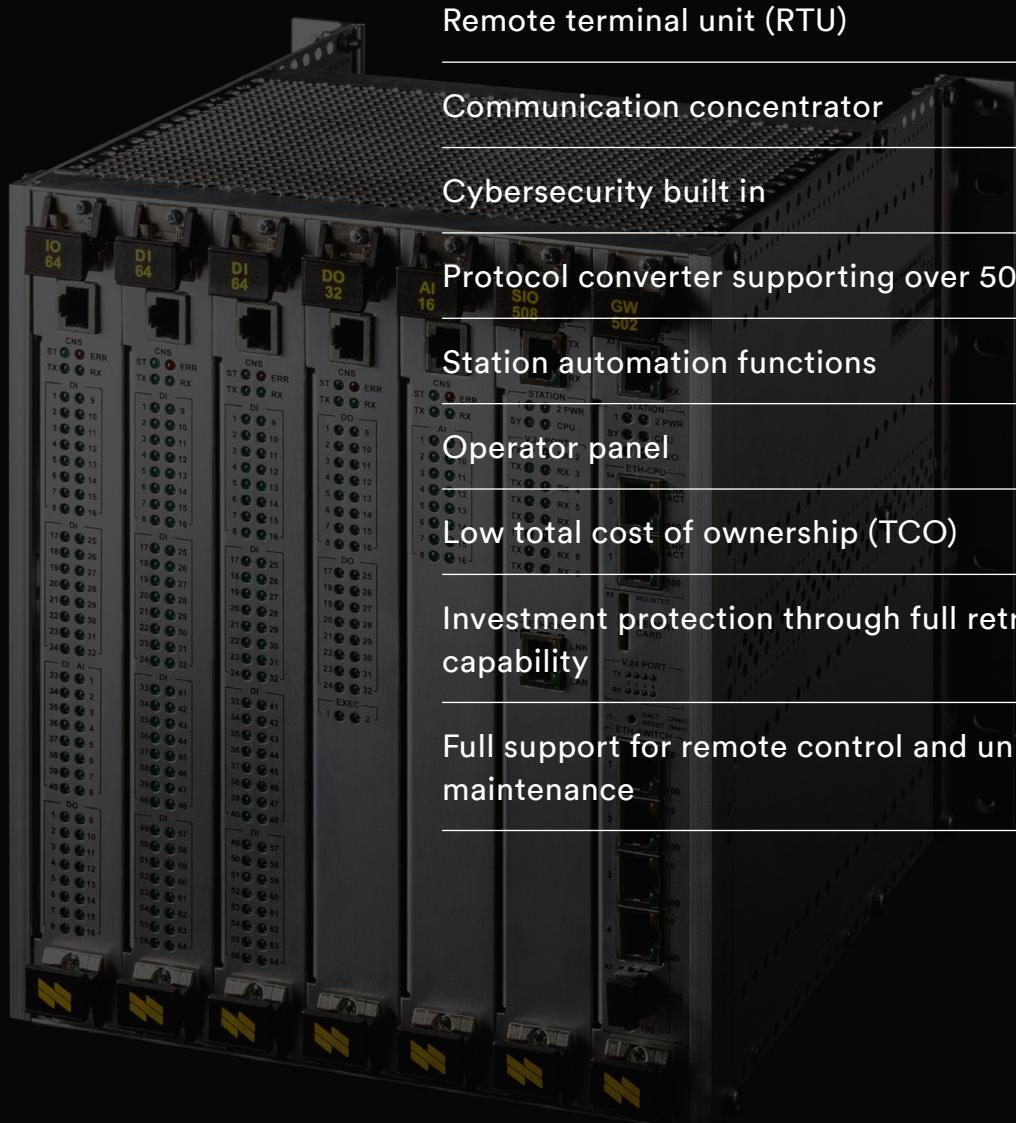
Protocol converter supporting over 50 protocols

## Station automation functions

## Low total cost of ownership (TCO)

## Investment protection through full retrofit capability

Full support for remote control and unit maintenance



# The cybersecure RTU and gateway

**The Netcon 500 is a versatile, standards-based remote terminal unit and control station. Hardware modularity and a rich set of software features make it a very flexible solution.**

## PROCESS CONTROL AT REDUCED COST

The Netcon 500 outstation can control and monitor processes that are distributed over a wide geographical area while also handling on-site automation tasks. The Netcon 500 is suited, for example, to the following applications:

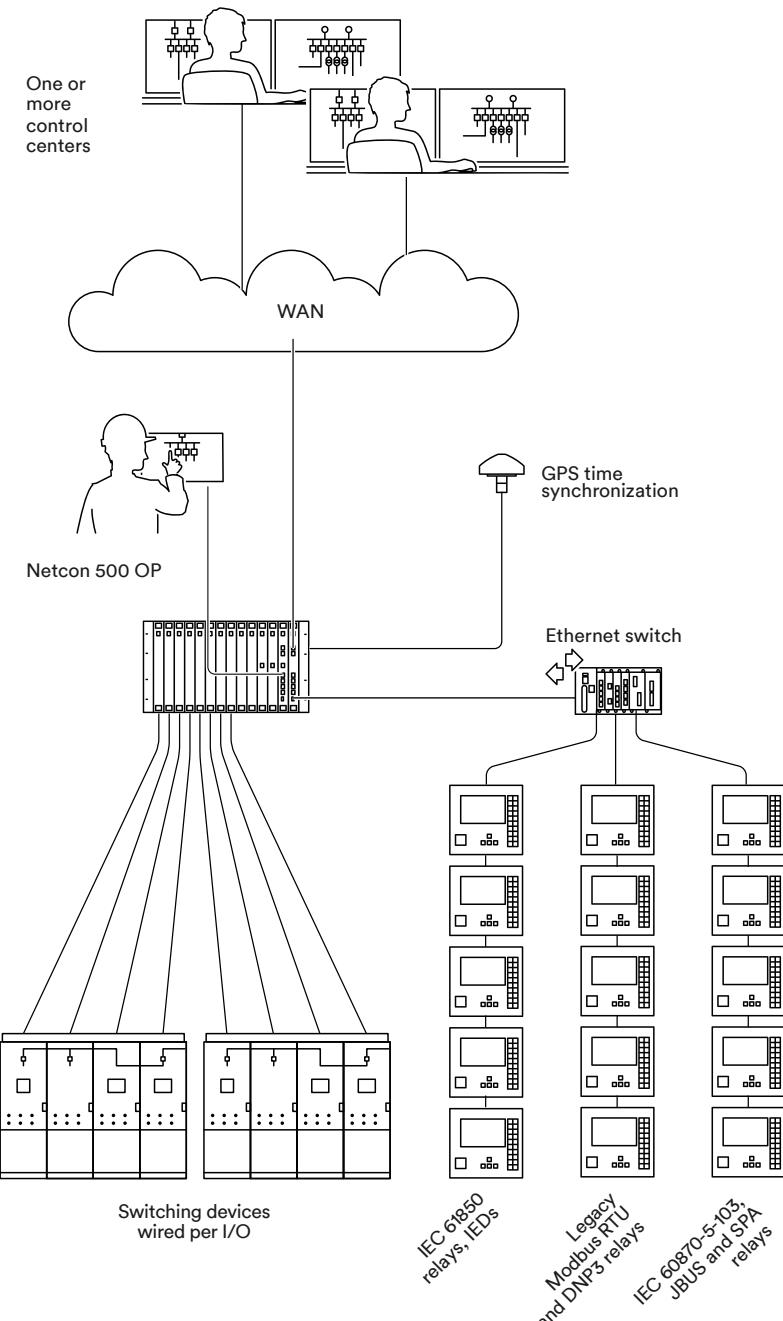
- Power generation substations
- Electric utility substations
- Industrial plant electricity distribution
- Traction power distribution
- District heating power plants and pump stations
- Tasks related to oil and gas pipelines

## Multiple functions combined in one unit

The Netcon 500 outstation combines a modern gateway with a classic remote terminal unit:

- RTU for individually wired I/O
- Communication concentrator
- Protocol converter
- Operator panel (option)
- Station automation
- Programmable logic controller (PLC) functionality

Power automation functions can be configured, ranging from simple alarm generation to automatic start/stop functions, e.g., for generators.



## Investment protection

The total cost of ownership of a Netcon 500 system is kept in check by its compatibility with a wide range of established and emerging technologies. This fact protects your past investments into hardware and software.



The Netcon 500 is an efficient solution thanks to its compliance with standards and its system scalability. Modifications and upgrades are easily made to an existing installation.

The hardware has been designed for trouble-free operation over a long lifetime. Modularity makes its maintenance easy and cost-effective.

The Netcon 500 is highly adaptable to changes in the communication infrastructure. When the connection type and speed change, the Netcon 500 is easily reconfigured to operate according to the changed specifications.

## AVAILABILITY, RUGGEDNESS, SECURITY

Legislation continues to set new requirements for both the monitoring of power quality (and reports thereon) and the minimization of actual service interruptions to customers. Penalty fees are being charged for the violations.

Reliable and timely information is therefore becoming critical to utilities. Netcontrol has a strong track record of offering high-availability, redundant solutions (see p. 8–9). We are constantly following developments in the relevant technology to be able to offer versatile and cost-effective solutions to our customers.

At the same time, cybersecurity is today's requirement number one. Netcontrol has long been ahead of the curve in the move towards open, standard protocols and IP-based utility communication networks – but it has also been a forerunner in the requisite emphasis on cybersecurity (see p. 7).

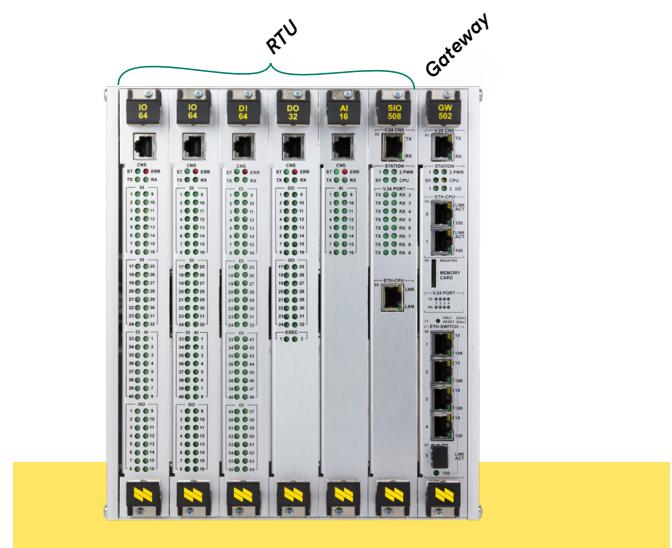
## Accurate time synchronization

Disturbance analysis requires the accurate and high-resolution time stamping of process events. The Netcon 500 RTU I/O has a time resolution of 1 millisecond, and the accuracy is roughly the same when GPS is used for synchronization. NTP is somewhat less accurate; but within a local network, the Netcon 500 can now also use the more accurate PTP.

## Designed for harsh environments

The Netcon 500 has been designed for substation environments with high levels of electric and magnetic interference. It has been thoroughly tested and complies with the latest EMC directives and the IEC 61850-3 standard for substations.

## MAIN PARTS OF THE NETCON 500



The Netcon 500 outstation has three main parts: the Netcon Gateway, the Netcon 500 RTU and the (optional) Netcon 500 Operator Station.

### 1. Netcon 500 gateway

As the main processing unit of the Netcon 500, the GW502 handles the cybersecurity and communications, including protocol conversion. It runs the reliable, resilient and secure Linux OS and the Netcon NFE communication software with a wide selection of protocols (see page 11).

Normally the GW502 also supplies power to the rack modules, although the SIO508 module can power additional racks lacking a GW502. The power supply to these two modules is redundant, and the communication can also use redundant paths with two GW502 modules (see page 8).



## 2. Netcon 500 RTU

The RTU part consists of the traditional process interfaces for wired I/O along with the associated communication services. The individual modules are described on the next spread.

## 3. Netcon 500 OP

The Netcon 500 OP (operator panel) is an advanced HMI that connects to the Netcon 500 over the local network. While the other modules still interface the process and connect to the control center, the Netcon 500 OP performs the process monitoring, control and visualization.

Based on a low-power, fanless, industrial 18.5" touchscreen panel PC, the Netcon 500 OP gives the user a clear overview of:

- The alarms and event history
- The current switching state of the substation
- Measurements and trends

The user interface is highly configurable, as in modern control center systems.



Netcon 500 OP

## NETCON 500 RACKS



Three different sizes of racks are available for the Netcon 500, named after the number of slots (each slot being roughly 30 mm wide):

- S3, S3-B
- S7
- S14

The S14 comes with detachable angles for installation into a standard 19" rack or swing frame. The S7 and S3-B have been designed for attachment to a cabinet wall at the back (with extra long sides to create space for the cables); the S3, to a door or 19" rack from the side.



# Netcon 500 Netcon 500 modules in detail

## Netcon GW502, main processor



- Voltage range: 24...48 V
- Power consumption: < 12 W
- Dual 10/100Base-TX Ethernet
- Ethernet switch: 4 × 10/100Base-TX + 1 × 100Base-FX
- Three V.24 serial ports
- V.24 console port
- Rack bus interface
- V.11 GPS receiver interface

## Serial port server – SIO508



Serial traffic tunneling over IP networks

- One 10 baseT Ethernet port
- Eight V.24 serial ports with handshake, at rear connector/cable interface
- One V.24 console port, RJ45 interface
- Four-channel plastic optical fiber (POF) module, attached to rear connector
- GPS PPS synchronization pulse input

## Analog in – AI16



- 16 differential inputs channels
- Accuracy: 14 bits
- Input range: -22...+22 mA
- Common mode voltage: ±60 V DC

## Digital in – DI64



- 64 DI/PI (8 floating groups of 8 DI/group)
- Positive or negative common
- 24 V DC, 48 V DC or 110 V DC

## Digital out – DO32



- 32 outputs (4 floating groups of 8 outputs/group)
- Load: 24...110 V DC; 0.2 A switching/1 A continuous/3 A peak
- Electronic short circuit protection
- Impedance measurement

## Combined IO – IO64



Analog inputs, digital inputs and digital outputs in one unit:  
a cost-effective solution for small substations

- 40 DI/PI, 16 DO, 8 AI
- 24 V DC, 48 V DC or 110 V DC



# Robust cybersecurity

The Netcon Gateway platform has long been a cybersecurity preference, offering features such as a firewall, virtual private networks (VPN), encryption and authentication. The new GW502 software keeps ahead of the hackers.



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## NEW, SECURE LINUX OS KERNEL

The software uses the latest Linux kernel that offers long-time support. The security-related libraries – OpenSSL (TLS v 1.3), SSH, Lighttpd, IPTables, OpenVPN – are recent versions. Notably, the included SSH and TLS libraries:

- Can use either ECDSA or RSA certificates
- Support the strong cryptographic hash functions sha224, sha256, sha384 and sha512

## IPsec: NEW VPN OPTION

Secure VPN tunneling of traffic through inherently unsecure public networks has been made more versatile with the option to use the **IPsec protocol** suite, instead of OpenVPN, to connect with Linux and PfSense devices.

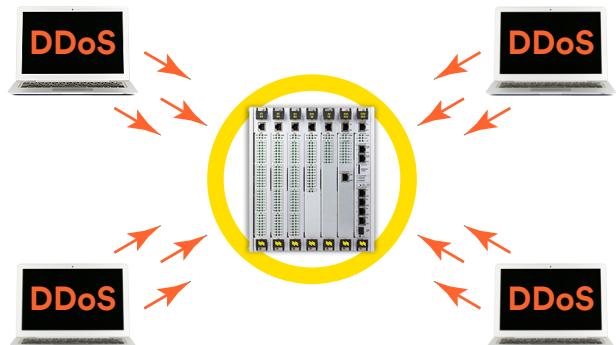
## SECURE BOOT

The software comes with a bootloader supporting **secure boot**:

- The GW502 will only boot if the cryptographic signature of the kernel is correct.
- All software patches will be checked for the correct signature before being installed.

## DEFENSE AGAINST DDoS ATTACKS

The GW502 firewall has been enhanced and tested in-house for **defense against distributed denial of service (DDoS)** attacks.



## COMPREHENSIVE LOGGING

The Linux **Syslog** feature has been implemented, with security event logging turned on by default. It logs events such as:

- Kernel boot and system service messages
- Start, stop and restart of unit
- Logins and logouts, password changes
- Software installs, upgrades and uninstalls

The logs can be transferred to external server, optionally by TLS.

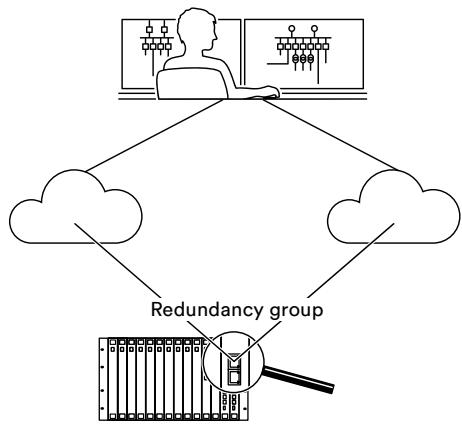


# Versatile redundancy options

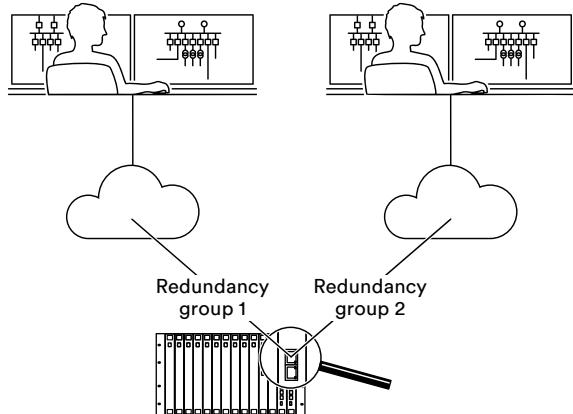
For maximum availability, the Netcon 500 supports various kinds of duplication. Here are three examples.

## 1. COMMUNICATIVE REDUNDANCY THROUGH IEC-104 REDUNDANCY GROUPS

Under edition 2 of the IEC-104 protocol, one Netcon GW502 module may simultaneously connect to the control center system via two different networks. It would then have two “logical connections” within the same “redundancy group”.

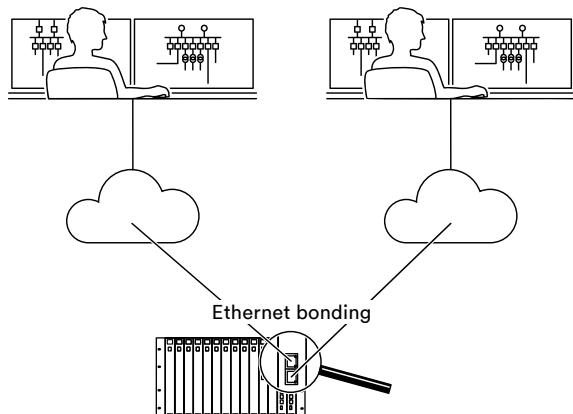


Different redundancy groups, however, can connect to different control centers and handle either the same or different sets of data. For example, a standby control center in its own redundancy group can be allocated a subset of the data for



the main control center, thus being able to perform the most critical functions in case the main control center or the associated network fails.

## 2. COMMUNICATIVE REDUNDANCY THROUGH ETHERNET BONDING



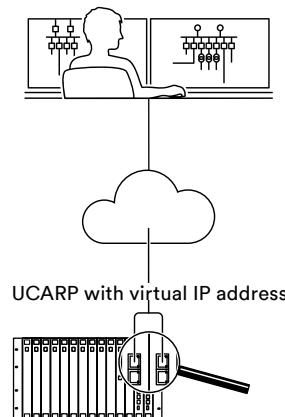
The GW502 also supports the bonding of two Ethernet interfaces into one redundant interface. Each physical interface can then be connected to the control center system via a separate network.

While a load balancing mode is also available, the hot standby mode makes the two networks redundant with another. If the currently used connection fails, a new connection will automatically be established through the other network and will take over the communications.



### 3. LOCAL REDUNDANCY WITH TWO GW502 DEVICES

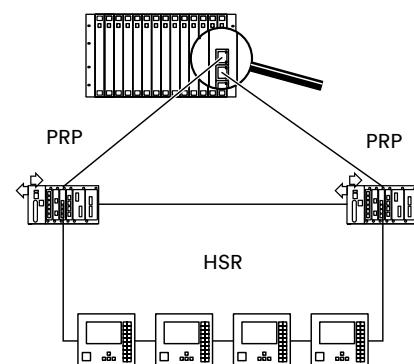
A single Netcon 500 rack may contain two GW502 modules, each being connected to the slave IEDs via its own network or serial line and running its own NFE instance with whatever master and slave protocol drivers are required (the same one in both instances).



Only one of the NFE instances is run at a time and holds a virtual IP address communicating with the control center. The Linux UCARP service monitors its function. If the active instance dies or stops communicating with the slaves, UCARP starts up the other NFE instance and assigns the virtual IP address to it instead.

### 4. LOCAL COMMUNICATIVE REDUNDANCY THROUGH PRP

By means of the Parallel Redundancy Protocol (PRP) driver, a single GW502 module can simultaneously read information from, or send it to, the IEDs through two different Ethernet interfaces, each of which is connected to its own network switch. Each IED then has two paths to the GW502, which guards against failures anyway along one path.



The two switches can also be connected, as in the diagram, to the two ends of a High-availability Seamless Redundancy (HSR) ring, where the nodes pass along information coming from both directions in the ring. In the absence of failures, each device will receive all packages twice but disregards the copy that arrives last.



# Extensive protocol support

## EXTENSIVE CONNECTIVITY

The NFE communication software gives the Netcon 500 extensive connectivity, ranging from classic low-speed telecontrol to modern IP-based protocols.

The Netcon 500 supports, for example, the following standards for communication towards the control center:

- IEC 60870-5-101
- IEC 60870-5-104
- DNP 3.0

The Netcon 500 outstation supports multiple concurrent control-center connections on different media and using different protocols.

The Netcon 500 can also function as an intermediate concentrator station for numerous small outstations and IEDs.

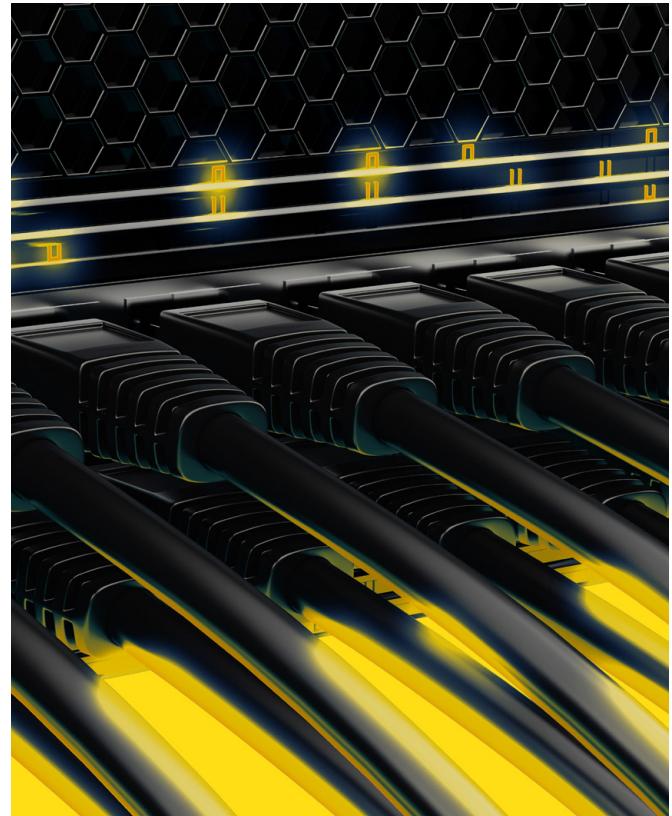
For station level communication, the Netcon 500 supports, for example, the following standards:

- IEC 61850-8-1
- IEC 60870-5-103
- DNP 3.0

Legacy IEDs of various ages and protocols are connected to the Netcon 500 over serial interfaces in a multi-drop or in a point-to-point star configuration.

### IEC 61850-8-1 support

The Netcon 500 outstation supports all versions of the emerging IEC 61850-8-1 standard. Our implementation is open, with proven multi-vendor interoperability. Since the Netcon 500 is capable of acting as a communications gateway and a protocol converter, an IEC 61850 substation equipped with



it can be connected to the control center with any standard protocol, such as IEC 60870-5-104.

### Reap the benefits of IEC 61850-8-1

- Simpler substation structure: IEC 61850 offers a single, uniform method of integrating IEDs.
- Enhanced engineering, implementation, operation and service: savings of time and cost on configuration, commissioning and maintenance
- Reduction in wiring costs: IEC 61850 replaces wires between feeders, control switches and signaling devices.
- Increased reliability: standard Ethernet serves as a uniform real time communication channel for all data.



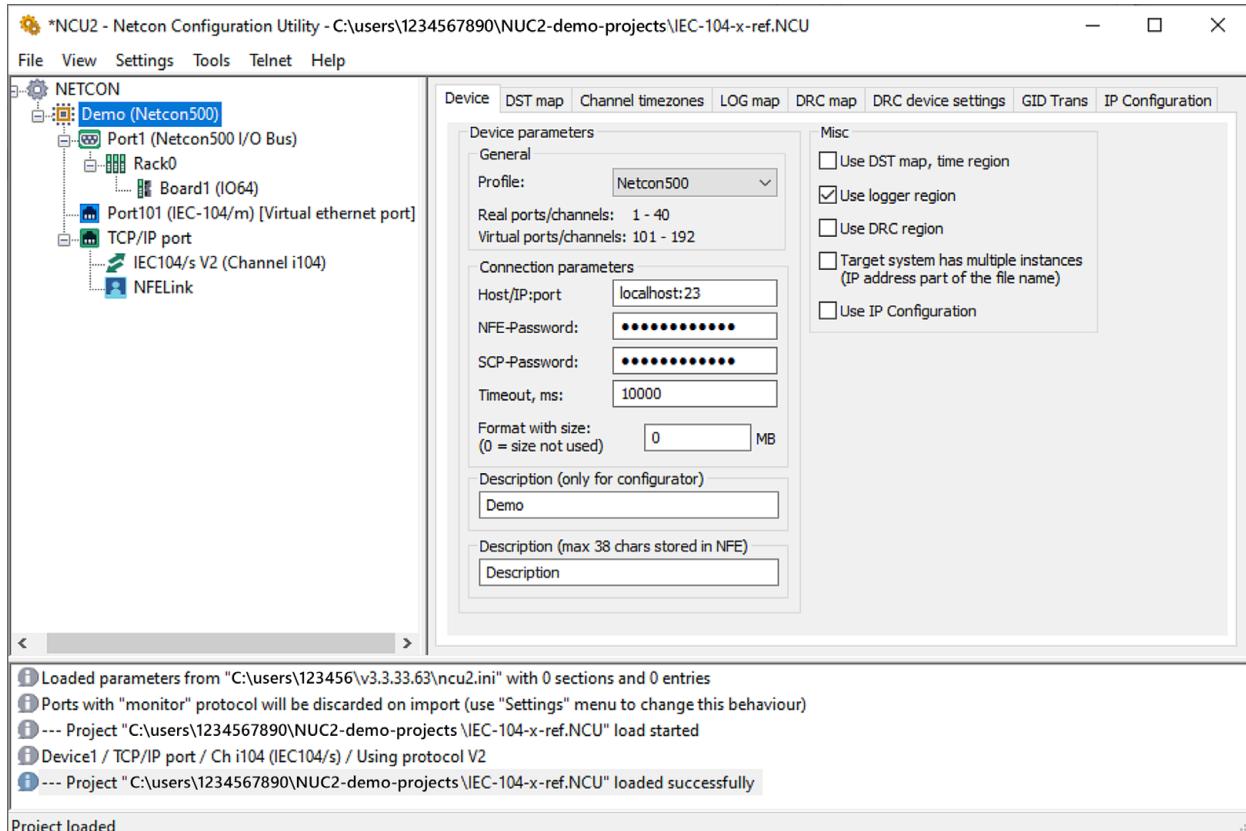
# Netcon 500 protocol support

PROTOCOL	SERIAL	IP	MASTER	SLAVE
IEC 61850-8-1 client, editions 1 & 2		✓	✓	
IEC 61850 server		✓		✓
IEC 60870-5-104		✓	✓	✓
IEC 60870-5-104 with NUC extensions		✓		✓
NFE-link		✓		✓
Modbus serial/TCP	✓	✓	✓	✓
DNP 3.0	✓	✓	✓	✓
IEC 60870-5-101	✓		✓	✓
IEC 60870-5-103	✓		✓	
ADLP80	✓		✓	✓
RP570 & ADLP180	✓		✓	✓
RP570 & ADLP180 modem pool	✓		✓	
ANSI X3.28 (Allen Bradley)	✓		✓	✓
COMLI	✓		✓	✓
Alstom Courier	✓		✓	
Ferranti MKIII	✓			✓
IEC 62056-21	✓	✓	✓	✓
Mobitex	✓		✓	✓
Mobitex radio simulation	✓		✓	
Netcon 8830/8080	✓		✓	
NetLink	✓		✓	✓
System NM	✓		✓	✓
Nortroll	✓		✓	
P&B	✓		✓	
Procol	✓		✓	✓
Sinaut ST1	✓		✓	
Spacom	✓		✓	
Telegyr 065, 102	✓		✓	
Telegyr 800	✓		✓	✓



# Netcon 500 tools

Netcontrol provides a set of user-friendly tools to make the configuration and management of Netcon 500 systems easy and flexible.



## NCU CONFIGURATION TOOL

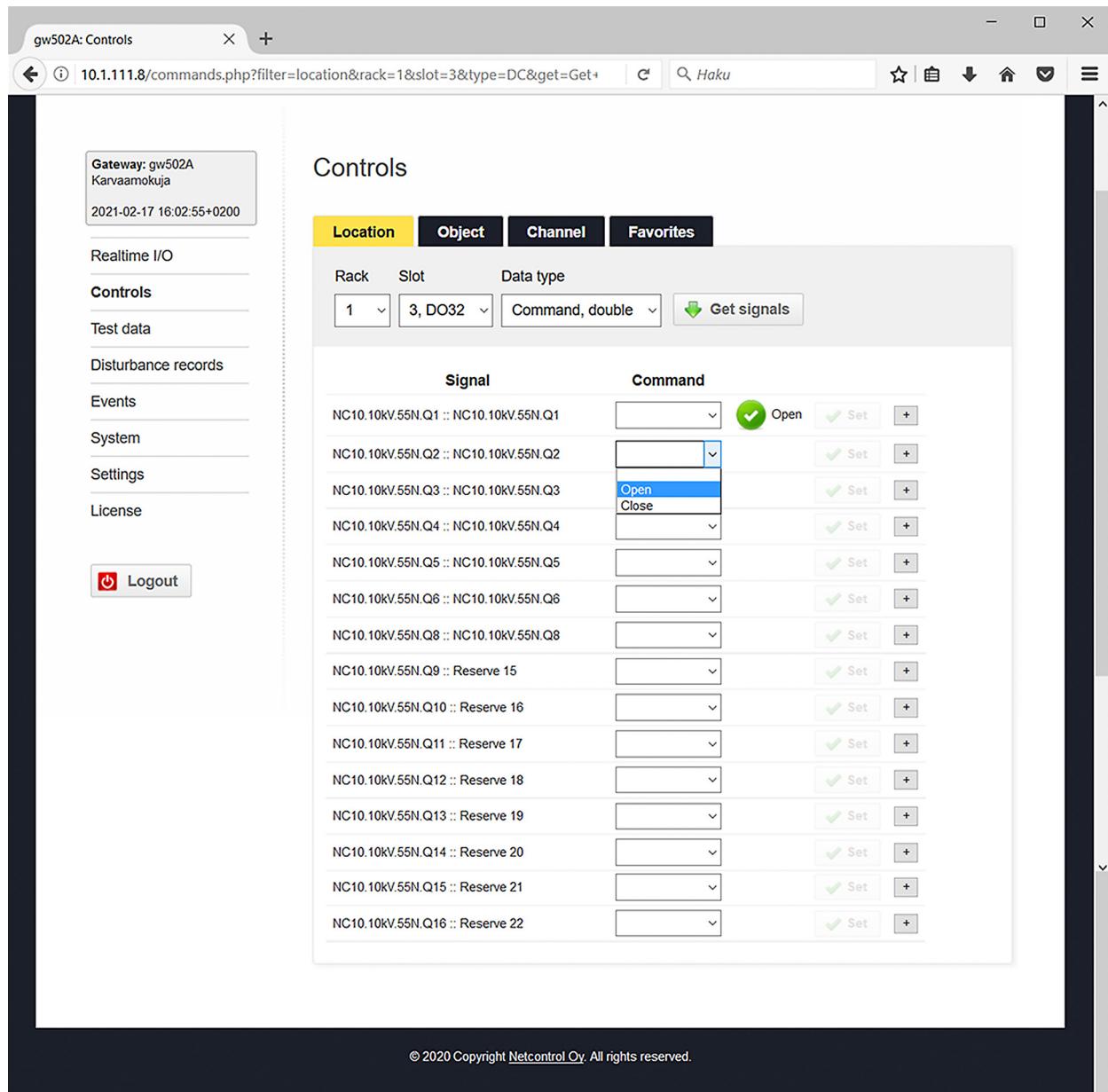
The Netcon 500 can be remotely configured through the NCU2 (Netcon Configuration Utility) tool. Running on the Windows platform, this software has a graphical user interface that presents the parameters in an intuitive tree hierarchy.

NCU2 makes the configuration of NFE – including protocol cross-references – more intuitive and performs checks to prevent errors. Configurations can be downloaded from the Netcon Gateway devices running NFE and uploaded to them as well.

A basic Netcon 500 setup includes the following, configurable through NCU:

- Communication ports
- Master protocols
- Slave protocols
- Process IO units of the Netcon 500
- Cross-references between masters and slaves
- Mirrored data
- Redundancy.





## WEBGUI

The Netcon 500 WebGUI is a browser-based interface for monitoring, commissioning and testing the Netcon 500.

Through WebGUI, a user can locally or remotely see all real-time IO, alarm, event and version information of the Netcon 500 RTU. Alarms can be acknowledged through WebGUI, and the user can also give control commands, for example when commissioning or testing the RTU.

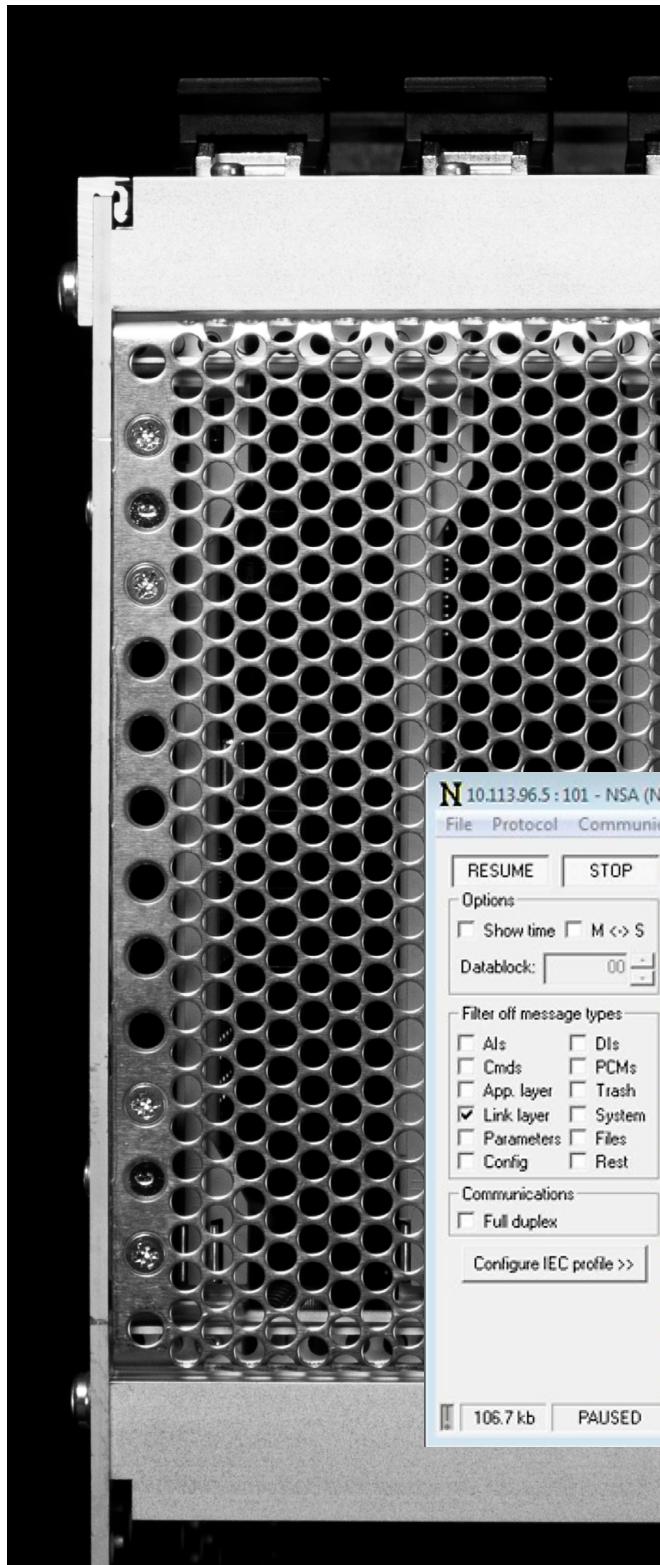
WebGUI includes a user friendly interface for fetching any disturbance records of a certain date from the RTU.

User permissions are divided into three levels: user, operator and administrator. An administrator can restart the NFE software or reboot the entire RTU and make backups of configurations.

The Netcon 500 WebGUI also has a license management interface where new licenses can be applied.



# Netcon 500 tools

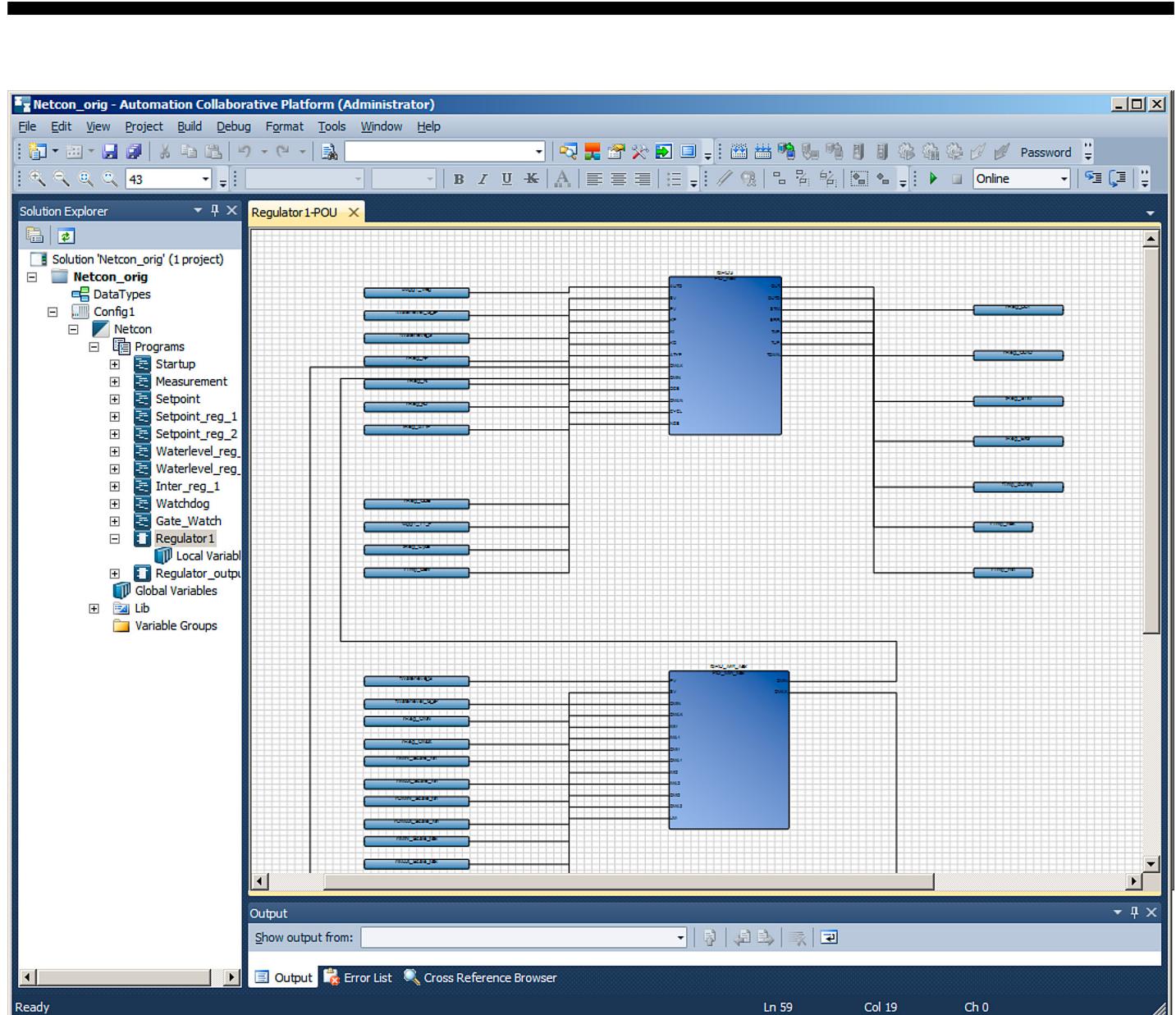


## NETCON SERIAL ANALYZER

The Netcon Serial Analyzer is a tool for troubleshooting serial communications. It can be used to locate protocol problems and verify the correct implementation of different protocols in various devices. NSA is an invaluable tool for someone building systems consisting of devices from different manufacturers. It can monitor transmit and receive lines simultaneously.

NSA consists of a black box and a Windows application program. It requires only one 9-pin RS-232 port on the PC, which makes it usable with laptop computers.





## PLC APPLICATION WORKBENCH

The Netcon 500 has an embedded PLC functionality, Application Workbench, for local applications such as the control of hydropower generation. The integrated PLC eliminates the need for separate stand-alone devices, thus reducing the site complexity.

Application Workbench is a complete programming environment used to develop highly portable applications. It supports six different automation languages: the five IEC 1131-3 languages plus flow chart.



# The cybersecure gateway RTU

## NETCON 500 INVESTMENT PROTECTION

The Netcon 500 gives utilities flexible options for updating their outstations, such as the following:

- Changing the communication protocol for the existing outstation, with corresponding enhancements in functionality
- Replacing the hardware but continuing to use the same protocol
- Adding new hardware modules interfacing an existing rack
- Using adapter modules to connect existing wiring from the process to new RTU technology

A retrofit program can thus be implemented in steps that are easy, quick and economical.

## BENEFITS OF THE NETCON 500

- Low total cost of ownership
- Easy customization
- Ability to retrofit a substation in one day or even less
- Integration of new features and products with legacy systems and protocols
- Easy addition of new protocols and connectivity options with the new range of IEDs

