

A decorative graphic on the left side of the page consists of a cluster of blue and light blue hexagons of various sizes, some overlapping, arranged in a non-uniform pattern.

SmartModem™



Industrial Smart Cellular Modem



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A. Product Overview

SmartModem™ product is a data transceiver based on mobile data infrastructure to transfer data from terminal devices to server as well as from server to terminal devices.

Data transmission devices play an important role in all communication systems. High accuracy, security, stability over long distance, compatible with various standards and type of connection terminals are just some of challenges.

SmartModem™ meets the growing need for wireless data transmission over long distance with high accuracy and good security via GSM/GPRS/EDGE/HSPA telecommunications system.

This device allows connection of multiple devices at unlimited distance for system monitoring and control.

APPLICATIONS

SmartModem™ can be deployed at locations where wireline does not exist to connect devices to WAN network, or used as backup connection for devices that are already connected to the WAN network.

ADVANTAGES

- ◆ **Compatible with various connection standards and a variety of terminal devices:** electrical meters, circuit breakers, monitoring equipment, alarms, etc.
- ◆ **Optimized hardware and software** in design and manufacture
- ◆ **Provides ease of use:** facilitates integration, expansion and adjustment of system to suit customers' needs
- ◆ **Support variety types of connections:** 01 Ethernet port, 02 Serial ports (RS232/RS485), 02 USB ports (for external devices) and MicroSD card (max 32GB) for external storage
- ◆ **Support standard protocol:** Stability-proven ATS SmartIO™ software program, that supports many types of channels (Modbus, IEC101, IEC104, DNP, etc) and is certified by DNV-GL
- ◆ **Support modem management feature:** checking usage data, account status, signal strength, modem status
- ◆ **Satisfy industry standards** for electromagnetic environment, temperature, humidity, smoke, dust

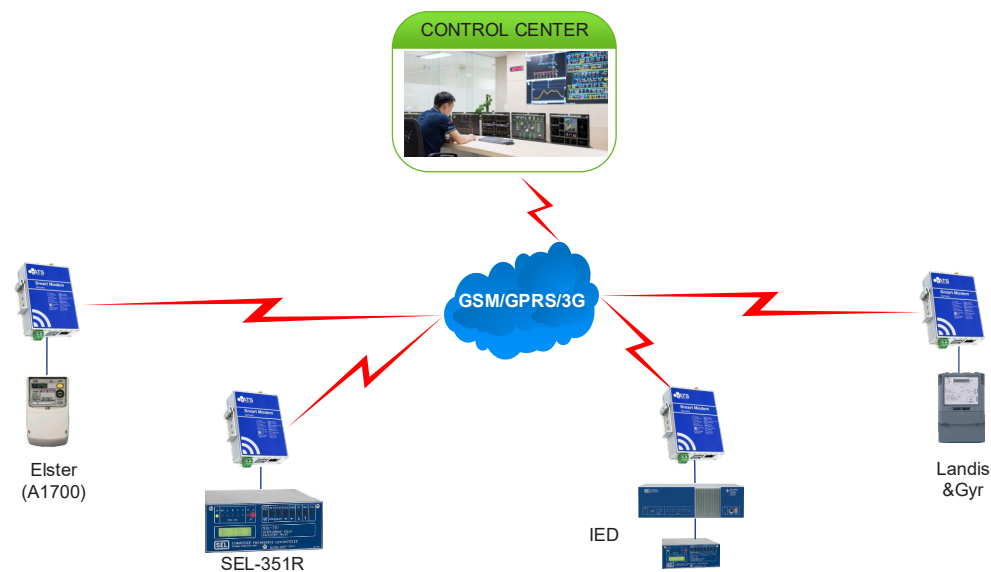


Figure 1. SmartModem™ is used as main connection model

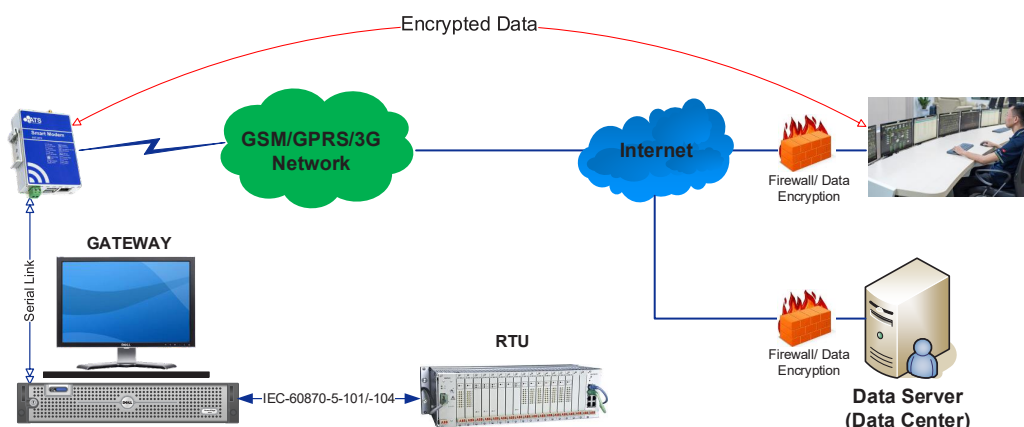


Figure 2. SmartModem™ is used as backup connection for SCADA in substations

1. HARDWARE SPECIFICATIONS

1.1. Hardware design



Figure 3. SmartModem™

DB9 CONNECT				
Mode Port	Rs232	Rs485-2w	Rs485-4w	
PORT1	2: RXD 3: TXD 5: GND	Switch ON 2-3: Data+ 7-8: Data-	2: RX+ 8: RX- 5: GND	3: TX+ 7: TX-
PORT2	1: RXD 4: TXD 5: GND	N/A	1: RX+ 6: RX- 5: GND	4: TX+ 9: TX-

Figure 3. Wiring Connection for Serial Port 1 and 2

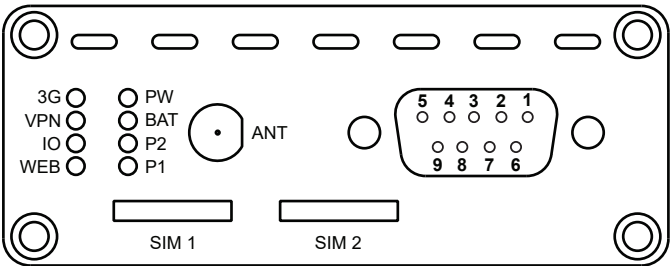


Figure 3. Top view of SmartModem™

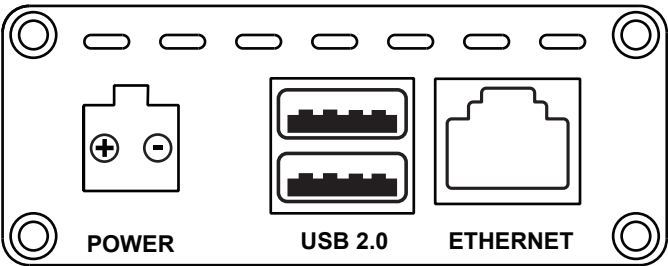


Figure 4. Bottom view of SmartModem™

Main Components of Top Panel:

- ◆ 01 SMA antenna connector,
- ◆ 02 SIM tray (mini SIM 1.8V/3V)
- ◆ 08 LEDs
- ◆ 02 Serial ports

Main Components of Bottom Panel:

- ◆ 01 power input (6-36 VDC)
- ◆ 02 USB 2.0
- ◆ 01 Ethernet port (10/100 Mbps)

B. Technical Highlights

1.2. Power specifications

Power Input

Power supply:	
<i>Voltage Input:</i>	7VDC – 36VDC
<i>Power consumption:</i>	<5W
ESD protection	
EMI filters	

1.3. GSM/GPRS/3G Function

GSM/GPRS/3G General features

3GPP Rel.7 Compliant Protocol Stack	
Dual-Band UMTS (WCDMA/FDD):	900 / 2100 MHz
Dual-Band GSM:	900 / 1800 MHz
Control:	standardized & extended AT commands (Hayes, TS 27.007, 27.005)
Compliance certificates:	EuP, RoHS and REACH EHS5

GSM/GPRS/3G specifications

HSDPA Cat.8 / HSUPA Cat.6 data rates DL:	max. 7.2 Mbps, UL: max. 5.7 Mbps
EDGE Class 12 data rates DL:	max. 237 kbps, UL: max. 237 kbps
GPRS Class 12 data rates DL:	max. 85.6 kbps, UL: max. 85.6 kbps
CSD data transmission:	up to 14.4 kbps
SMS text and PDU mode:	supported
Phonebook:	supported
Basic voice:	supported

Interfaces

Antenna:	GSM/WCDMA
UICC and U/SIM card interface:	1.8 V / 3 V
SIM tray:	Single/Dual SIM options

Approvals

R&TTE, GCF, CE certificate
Type Test Certificate by Vietnam Ministry of Information and Communications

1.4. Center Processor

Processor Features

CPU:	4x ARM Cortex-A53, 1.2GHz
Architecture:	ARM 64bit
RAM:	1GB

Memory

MicroSD card/eMMC:	Max 8GB/32GB Options
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1.5. Network

Ethernet:	10/100Mbps Ethernet port
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1.6. RS-232/485 Specifications

Note: RS-232/485 specification is defined details in CCITT V24, EIA/TIA 574, EIA/TIA-561, ISO 2110.

1.7. USB Interface

USB 2.0: 02 Ports (support external device)

1.8. GSM/GPRS/3G Antenna

General features (typical)

Frequency (MHz):	824~960/1710~2170MHz
Bandwidth (MHz):	90/280
VSWR:	≤2.5
Gain (dBi):	2.5dBi (Zenith)
Input Impedance (Ω):	50
Polarization:	Vertical
Size (mm):	Φ29.5 (Base) × 225 (Height)
Cable Length (m):	1.5
Cable Type:	RG174
Connector:	SMA
Mounting:	Magnet
Housing:	Black
Storage Temperature:	-5°C to +85°C
Operating Temperature:	-45°C to +75°C

Electrical characteristics

RS-232/485 Bus-Pin ESD Protection:	Exceeds ±15 kV Using Human-Body Model (HBM)
Uses level logic High:	(-3V)-> (-12v); Low : (+3v)-> (+12v))
Supply current:	0.3mA – 1mA with no load and power supply 3.3V – 5V
Input resistance:	3-7KOhms
Short-circuit output current:	35 – 60mA
Propagation delay time, low- to high-level output (high- to low-level output):	300ns, test conditions: CL = 150pF
Input capacitance:	less than 2500pF

Other characteristics

DTE/DCE interface:	DB9
Connection:	direct or cross to DTE.
Protocol:	any protocol using RS-232/485 interface (point to point, Modbus,...)
Baud rate:	300 – 250kbit/s.
Transmission error:	0 – 0.8% (dependent of baud rates).
Receive error:	0 – 0.5% (dependent of baud rates).
Data mode:	7-8 bits data, odd, even, no-parity.

B. Technical Highlights

1.9. Enclosure

General features

Material:	Aluminum
Color:	Silver/Gray
Size:	110*80*30(L*W*H mm)

1.10. Assembly and Finishing

Certificates:	ISO 9001:2008, 14001:2004
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1.11. Environment

Climatic Conditions: IEC 62052-21

Temperature:	Section 6.1 in IEC 62052-21 2004 (test methods are referred in the standard)
<i>Specified operating range:</i>	–10 °C to +45 °C
<i>Limit range of operation:</i>	–25 °C to +55 °C
<i>Limit range for storage and transport:</i>	–25 °C to +85 °C
Relative humidity:	Section 6.2 in IEC 62052-21 2004
<i>Annual mean:</i>	<75 %
<i>For 30 days, these days being spread in a natural manner over 1 year:</i>	95 %
<i>Occasionally on other days:</i>	85 %

Electromagnetic Compatibility (EMC)

Electromagnetic Emission:	IEC 61000-6-4 Electromagnetic compatibility (EMC): Generic standards- Emission standard for industrial environments.
Enclosure port – Open area test site or semi-anechoic method:	
<i>30 MHz – 230 MHz:</i>	40 dB(μV/m) Quasi-peak at 10 m (limit)
<i>230 MHz – 1000 MHz:</i>	47 dB(μV/m) Quasi-peak at 10 m (limit)
Low voltage AC mains port:	
<i>0,15 MHz – 0,5 MHz:</i>	79 dB(μV) quasi-peak, 66 dB(μV) average (limit)
<i>0,5 MHz – 30 MHz:</i>	73 dB(μV) quasi-peak, 60 dB(μV) average (limit)
Telecommunications/network port:	
<i>0,15 MHz – 0,5 MHz:</i>	84 dB(μV) – 74 dB(μV) average (limit) 53 dB(μA) – 43 dB(μA) quasi-peak (limit) 40 dB(μA) – 30 dB(μA) average (limit)
<i>0,5 MHz – 30 MHz:</i>	87 dB(μV) quasi-peak (limit) 74 dB(μV) average (limit) 43 dB(μA) quasi-peak (limit) 30 dB(μA) average (limit)
Electromagnetic Immunity:	IEC 61000-6-5 Generic standards – Immunity for power station and substation environments.

2. SOFTWARE SPECIFICATIONS

2.1. Software Structure

Modem management software is installed in central server while device software is installed in SmartModem™.

Modem management software:

- ◆ This server software manages and configures all registered modems in the system. It is an web-based software which is compatible to various browsers (Google Chrome, IE, Firefox, Safari...) under Windows, IOS, Android,...

Device software: installed on Modem and consists of 4 major modules

- ◆ **Module IO:** to facilitate connection with other devices using standards IEC101/ IEC104/ DNP/ FastMessage/ Modbus.
- ◆ **Module 3G:** this is for device setting and APN configuration to maintain connection to 3G ISP .
- ◆ **Module VPN:** for VPN connection from SmartModem™ to VPN Server
- ◆ **Module Organization:** to facilitate user-configuration of the device via Web access

2.2. Device Software:

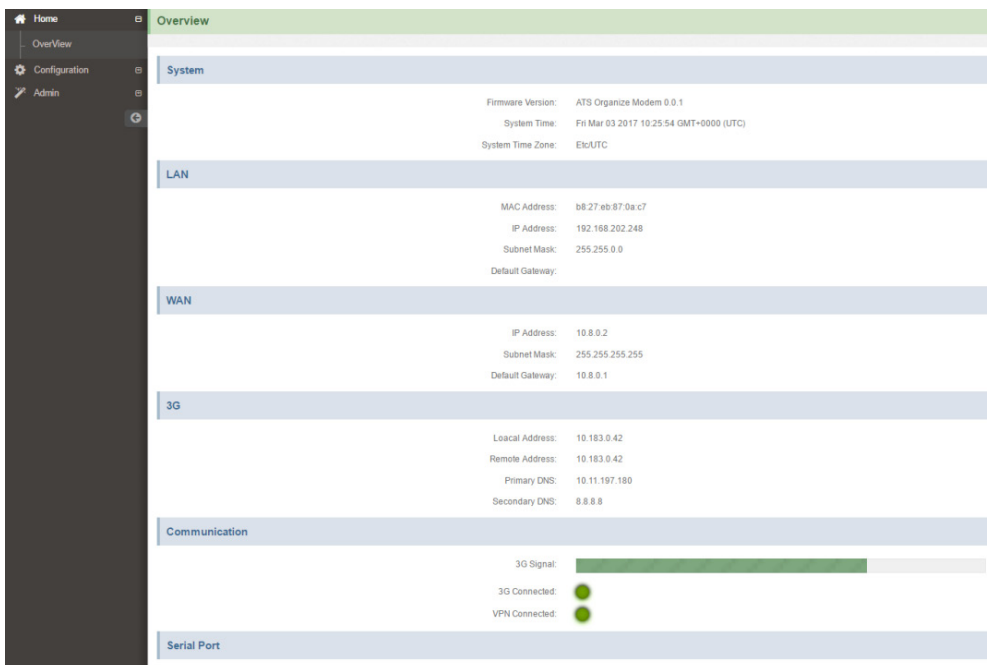


Figure 6. Home Screen on Smart-Modem™ device

After successful login, home screen of SmartModem™ appears with basic configurations: Firmware information, modem time, Ethernet port configurations, WAN configurations, 3G configurations, connection status, serial port configurations.

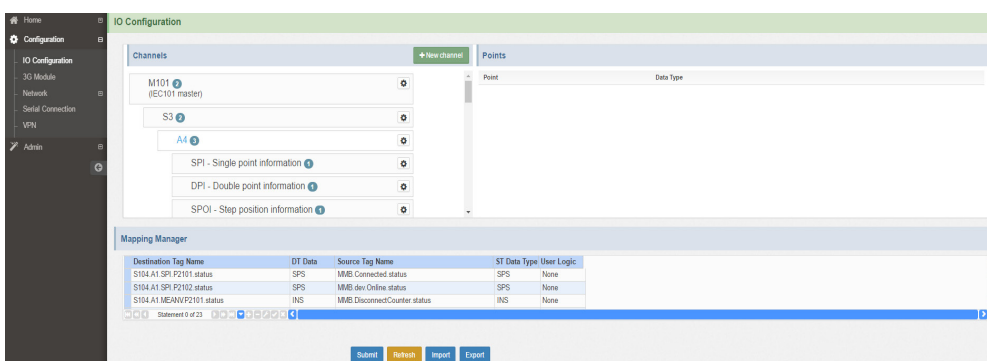


Figure 7. IO Module Configuration

Modbus, SEL, IEC 60870-5-101/104, DNP channels can be managed in IO Module

B. Technical Highlights

The screenshot shows the '3G Configuration' page. On the left is a sidebar menu with 'Home', 'Configuration', 'IO Configuration', '3G Module', 'Network', 'Serial Connection', 'VPN', and 'Admin'. The '3G Module' option is selected. The main content area has a title bar '3G Configuration'. Below it, the 'Sim Manage' section has radio buttons for 'SIM 1 (Enabled)' (selected) and 'SIM 2 (Disabled)', and a checkbox for 'Auto Switch'. A 'Signal' bar shows a green level and the text '26.99/32'. The 'APN' section has a text input field with 'm-evn'. Below that are three more text input fields: 'Select phone to dial 3G:' with '*99#', 'Select user name to dial 3G:' with '{}', and 'Select password to dial 3G:' with '{}'. At the bottom are four buttons: 'Submit', 'Refresh', 'Reset', and 'Diagnostic'.

Figure 8. 3G Module Configuration

Modem can be configured to use Dual SIM Card and set mobile network APN.

The screenshot shows the 'VPN Configuration' page with 'Open VPN' selected. The sidebar menu is the same as in Figure 8, with 'VPN' selected. The main content area has a title bar 'VPN Configuration'. Below it, the 'Open VPN' radio button is selected. There are four text input fields: 'VPN Server Address (Main)' with '10.183.0.41', 'VPN Server Port (Main)' with '1194', 'VPN Server Address (Backup)' with '222.252.25.160', and 'VPN Server Port (Backup)' with '1194'. Below these are 'Common Name' with '000000007c870ac7' and 'Local Gateway' with '10.8.0.1'. There are three 'Browse' buttons for 'Certificate Authority' (ca.crt), 'Certificate' (000000007c870ac7.crt), and 'Key' (000000007c870ac7.key). At the bottom are 'Submit' and 'Reset' buttons.

Figure 9. VPN Module Configuration

Modem can connect to Main and Backup servers using VPN connection.

VPN Protocol can be Open VPN,

or L2TP/IPSec Protocol.

The screenshot shows the 'VPN Configuration' page with 'L2TP/IPSec' selected. The sidebar menu is the same as in Figure 8, with 'VPN' selected. The main content area has a title bar 'VPN Configuration'. Below it, the 'L2TP/IPSec' radio button is selected. There are two text input fields: 'VPN Server Address (Main)' with '10.183.0.41' and 'VPN Server Address (Backup)' with '222.252.25.160'. Below these are 'User Name' and 'Password' text input fields. At the bottom is a 'Pre-Share Key' text input field. At the bottom are 'Submit' and 'Reset' buttons.

Figure 10. Ethernet port Configuration

Ethernet port configuration, including IP address, subnet mask, gateway, port forwarding .

The screenshot shows the 'LAN' configuration page. The sidebar menu is the same as in Figure 8, with 'LAN' selected. The main content area has a title bar 'LAN'. Below it, there are four text input fields: 'MAC Address' with 'b8:27:eb:87:0a:c7', 'IP Address' with '192.168.202.248', 'Subnet Mask' with '255.255.0.0', and 'Gateway' which is empty. At the bottom is a 'Submit' button.

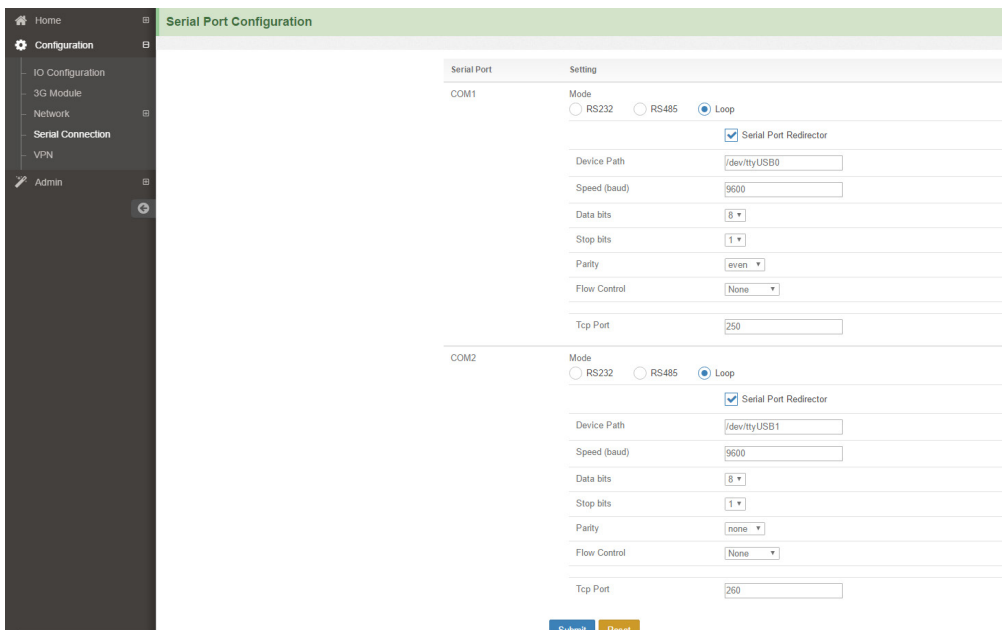


Figure 11. Serial port Configuration

Serial port configuration, including operation mode (RS232, RS485 or Loop) for each port, allow users to redirect data from serial port to TCP port.

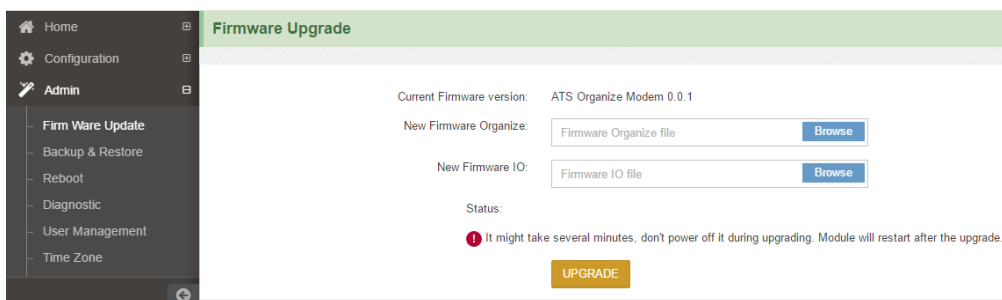


Figure 12. Firmware Upgrade

Settings and firmware can be updated easily using web interface.

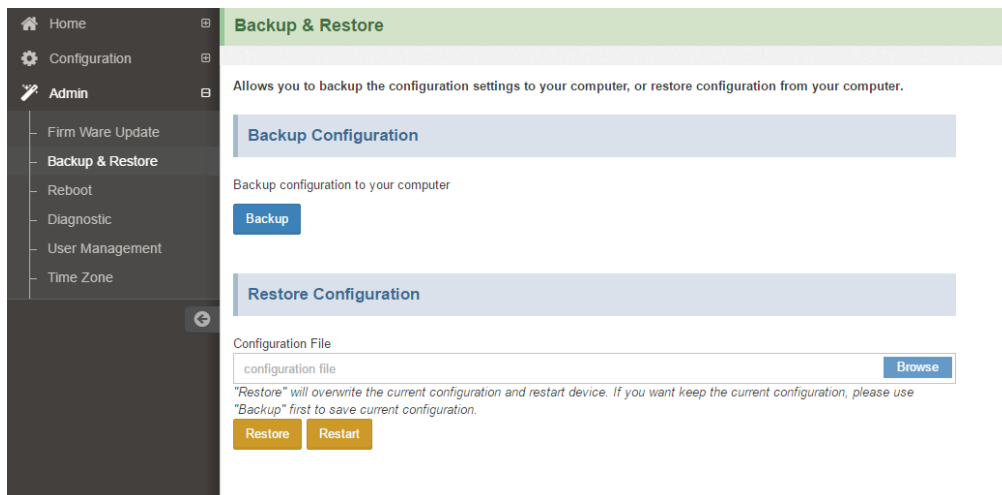


Figure 13. Backup and Restore Firmware

User can backup old settings and restore them later or restore them to other modems.

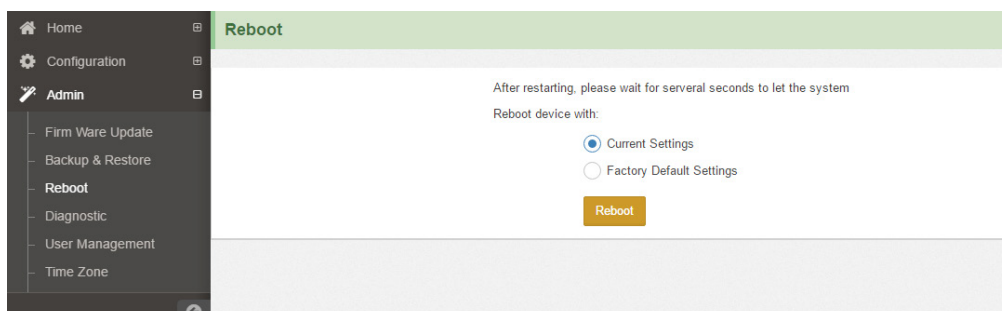


Figure 14. Reboot Modem

Reboot the device with current settings or factory default settings

B. Technical Highlights

Time Stamp	Module Name	Priority	Message
2017-03-06T03:00:03.108Z	Organize3G	2	Signal 3G: 24.99
2017-03-06T02:19:42.033Z	OrganizeVPN	2	VPN communication: online
2017-03-06T02:00:02.451Z	Organize3G	2	Signal 3G: 25.99
2017-03-06T01:00:01.981Z	Organize3G	2	Signal 3G: 25.99
2017-03-06T00:00:01.352Z	Organize3G	2	Signal 3G: 24.99
2017-03-05T23:00:00.891Z	Organize3G	2	Signal 3G: 24.99
2017-03-05T22:00:00.159Z	Organize3G	2	Signal 3G: 24.99
2017-03-05T21:00:09.601Z	Organize3G	2	Signal 3G: 23.99
2017-03-05T20:00:09.013Z	Organize3G	2	Signal 3G: 23.99
2017-03-05T19:00:08.375Z	Organize3G	2	Signal 3G: 23.99

Figure 15. Modem Logging

Comprehensive logging information, including signal strength, temperature, and network status

AT+CSQ

Send Disconnect

AT+CSQ
A
NO CARRIER
AT+CSQ
+CSQ: 25,99
OK

Figure 16. AT Command Tool

User can send AT commands directly to Modem using web interface. AT commands can be used to check signal strength and network status

User Name	Full Name	Email	Password	Enable
admin	Administrator			true

Figure 17. User Management

User account management

Current Time: Mon Mar 06 2017 03:25:26 GMT+0000 (UTC)

Time zone: (GMT) Etc/UTC

Date: Year: 2017 Month: 3 Day: 6 ☐ Edit Date & Time

Time: Hour: 3 Minute: 25 Second: 26

NTP Server: debian.pool.ntp.org iburst

Save

Figure 18. NTP Time Synchronization

Modem realtime clock can be updated by NTP time synchronization mechanism and NTP time server can be configured by user

2.3. Modem management software:

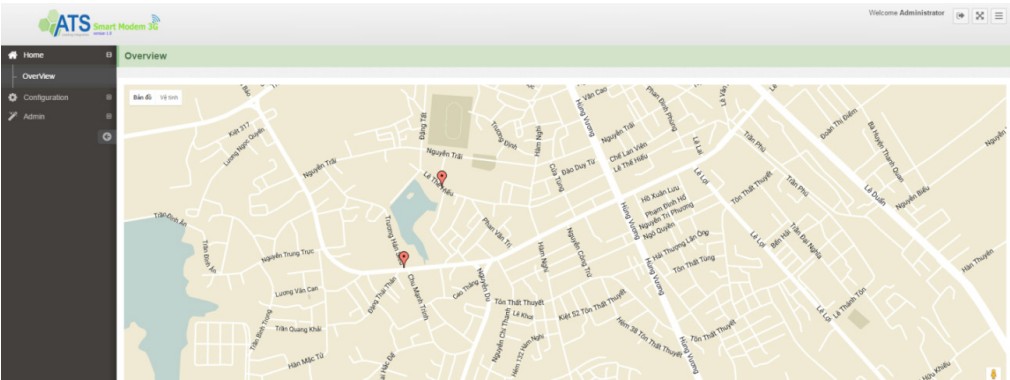


Figure 19. Modem Listing

Modems can be displayed on web interface using geological map.

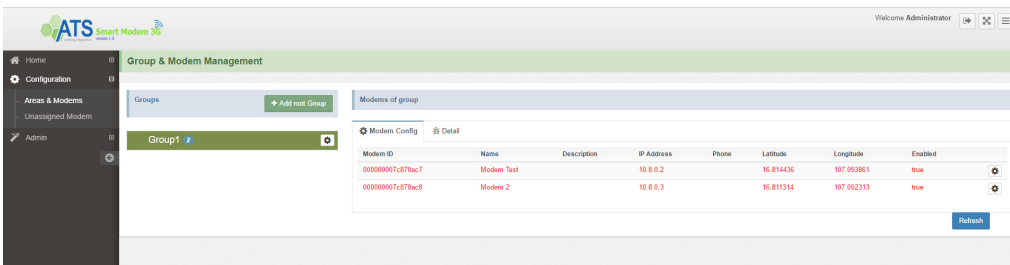


Figure 20. Group and Modem Management

Modems can be grouped and managed in table

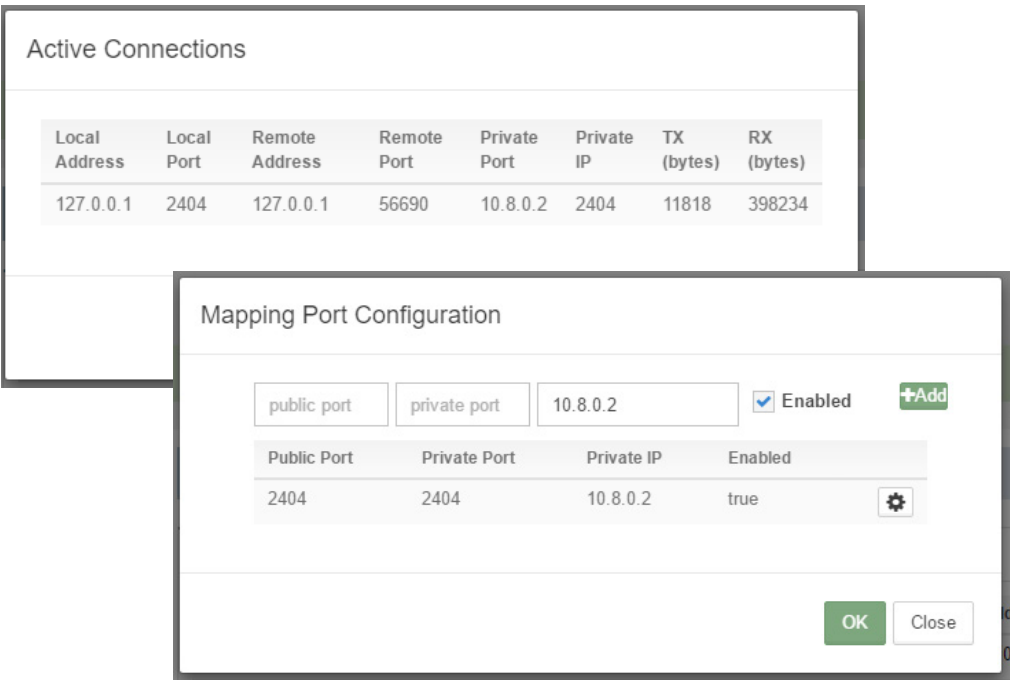


Figure 21. TCP Port forwarding

Mapping TCP port on Modem to TCP port on Server

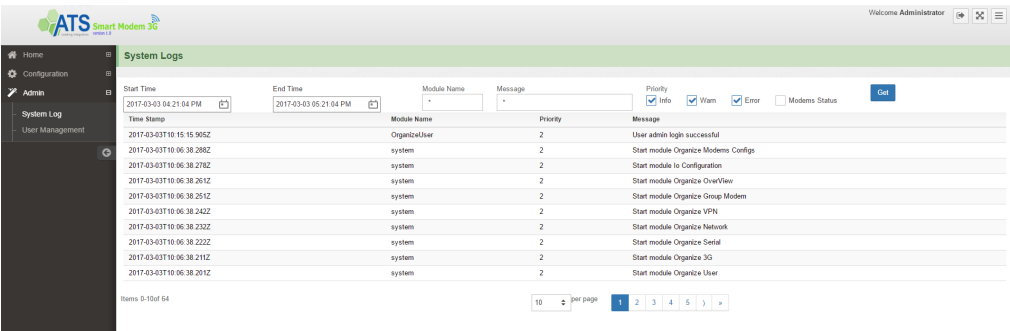


Figure 22. System Log

View configuration logs of Modem

B. Technical Highlights

3. SUPPORTED PROTOCOLS

Protocol implementation is based on ATS SmartIO™ software program.

IEC68070-5-101 Master/Slave

- ◆ Supports unbalanced (only master initiated message) mode of data transfer
- ◆ Supports balanced mode of data transfer
- ◆ Supports multiple sessions and sectors in the same channel
- ◆ Supports link layer types: TCP client, TCP server, Serial (RS232, RS485)
- ◆ Message size restriction
- ◆ Types supported:
 - * Single point information without/with 24/with 56 bit timestamps
 - * Double point information without/with 24/with 56 bit timestamps
 - * Step position information without/with 24/with 56 bit timestamps
 - * Measured value – normalized, scaled, short floating point without/with 24/with 56 bit timestamps
 - * Packed single point information with status change detection
 - * Single commands
 - * Double commands
 - * Regulating step command
 - * Set point commands of various data formats (normalized, scaled, short floating point)
 - * Interrogation commands
 - * Clock synchronization
 - * Reset process command
- ◆ Supported number of channels: 50
- ◆ Supported number of points per channel: 5000

ATS SmartIO™ is embedded in the modem and IEC60870-5-101/104 channel types are certified by DNV-GL for conformance test. ATS SmartIO™ is capable of managing many channels at the same time.

IEC68070-5-104 Master/Slave

- ◆ Supports multiple sectors in the same channel
- ◆ Supports link layer types: TCP client, TCP server
- ◆ Types supported:
 - * Single point information without/with 56 bit timestamps
 - * Double point information without/with 56 bit timestamps
 - * Step position information without/with 56 bit timestamps
 - * Measured value – normalized, scaled, short floating point without/with 56 bit timestamps
 - * Packed single point information with status change detection
 - * Single commands without/with 56 bit timestamps
 - * Double commands without/with 56 bit timestamps
 - * Regulating step command without/with 56 bit timestamps
 - * Set point commands of various data formats (normalized, scaled, short floating point) without/with 56 bit timestamps
 - * Interrogation commands
 - * Clock synchronization
 - * Reset process command
- ◆ Supported number of channels: 50
- ◆ Supported number of points per channel: 5000

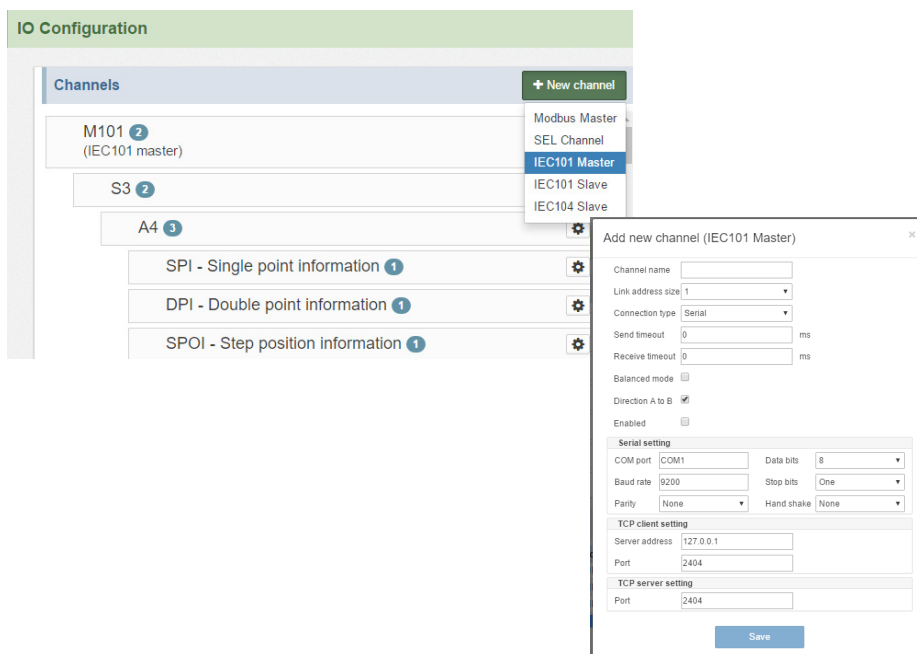


Figure 23. IEC68070-5-101 Chanel Configuration

DNP 3.0

- ◆ Connection type: Serial, TCP
- ◆ Support multidrop connection
- ◆ Supported data types:
 - * Binary Input
 - * Binary Output
 - * Analog Input
 - * Analog Output
 - * Counter (Running, Frozen)
- ◆ Support unsolicited report
- ◆ Support Direct Operate And Select-Operate

Modbus Master/Slave

- ◆ Supports multiple devices in the same channel
- ◆ Supports link layer types: TCP client, TCP server, serial
- ◆ Supports modbus types: RTU, TCP
- ◆ Function codes supported: FC1, FC2, FC3, FC4, FC5, FC6, FC15, FC16
- ◆ Data types supported:
 - * Boolean
 - * 16-bit, 32-bit integer
 - * Bit fields in integers
 - * Floating point IEEE 754

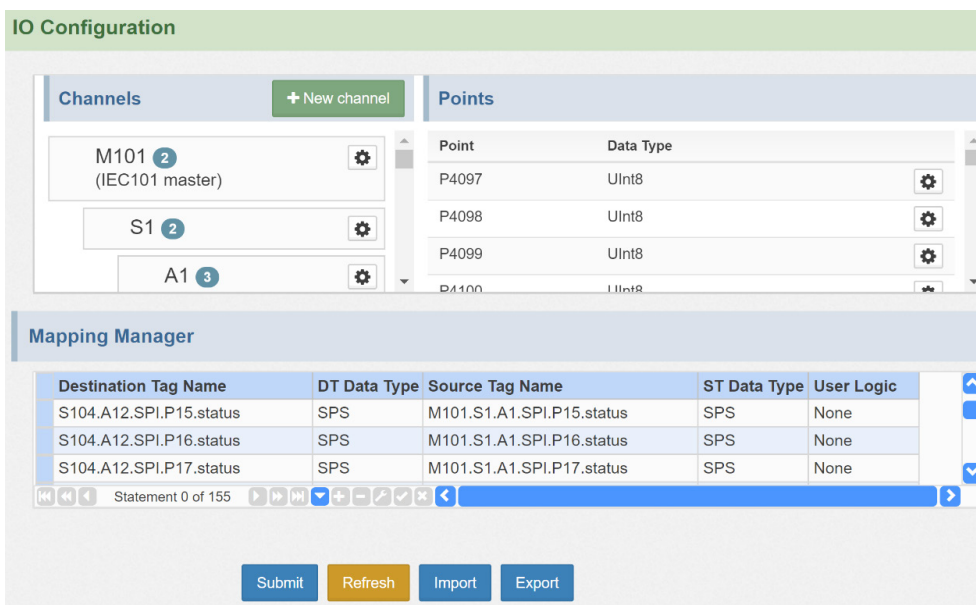


Figure 24. Protocol mapping

Data and control commands can be mapped between all types of channels.

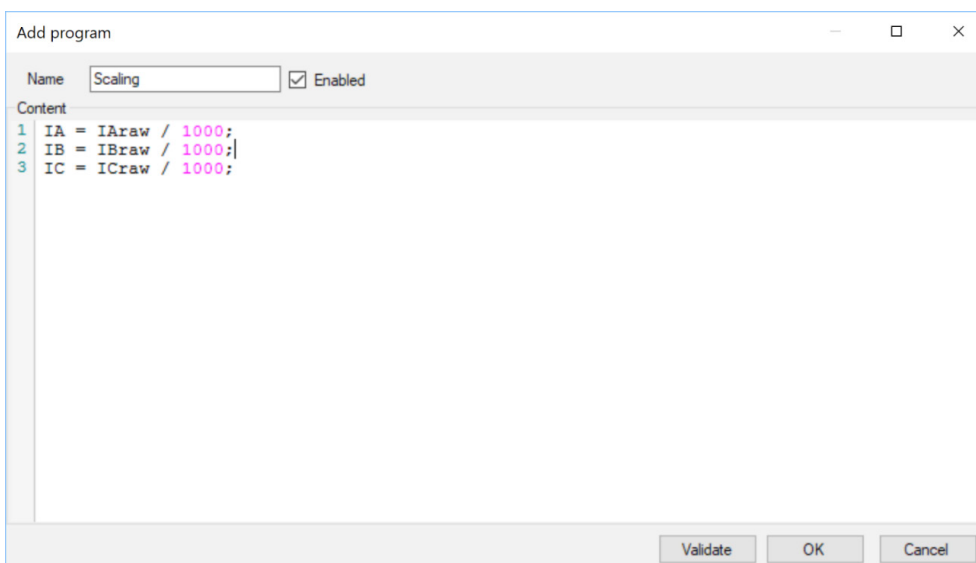


Figure 25. Custom data calculation

User can define custom function to calculate new data based on data received from device.

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