The Security Hardening Guide for the MGate 5000 Series

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Released on March 26, 2021

About Moxa

Moxa is a leading provider of edge connectivity, industrial computing, and network infrastructure solutions for enabling connectivity for the Industrial Internet of Things (IIoT). With over 30 years of industry experience, Moxa has connected more than 57 million devices worldwide and has a distribution and service network that reaches customers in more than 70 countries. Moxa delivers lasting business value by empowering industries with reliable networks and sincere service. Information about Moxa's solutions is available at www.moxa.com.

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1. Introduction

This document provides guidelines on how to configure and secure the MGate 5000 Series. The recommended steps in this document should be considered as best practices for security in most applications. It is highly recommended that you review and test the configurations thoroughly before implementing them in your production system in order to ensure that your application is not negatively impacted.

2. General System InformationBasic Information About the Device

Model	Function	Operating	Firmware	
		System	Version	
MGate 5101 Series	PROFIBUS-to-Modbus TCP Gateway	Linux	Version v2.2	
MGate 5102 Series	PROFIBUS-to-PROFINET Gateway	Linux	Version v2.3	
MGate 5103 Series	Modbus RTU/ASCII/EtherNet/IP-to-PROFINET	Limon	Version v2.2	
MGate 5103 Series	Gateway	Linux		
MGate 5105 Series	Modbus RTU/ASCII/TCP-to-EtherNet/IP	Linux	Version v4.3	
MGate 5105 Series	Gateway	Linux		
MGate 5109 Series	Modbus RTU/ASCII/TCP-to-DNP3 serial/TCP	Linux	Version v2.3	
MGate 5109 Series	Gateway	Lillux		
MGate 5111 Series	Modbus/PROFINET/EtherNet/IP-to-PROFIBUS	Linux	Version v1.3	
MGate 5111 Series	Gateway	LIIIUX		
MGate 5114 Series	Modbus RTU/ASCII/TCP/IEC101-to-IEC104	Linux	Version v1.3	
MGate 3114 Series	Gateway	LIIIUX	version v1.3	
MCata F110 Cavina	CAN-J1939-to-	Limon	Varaian v2 2	
MGate 5118 Series	Modbus/PROFINET/EtherNet/IP Gateway	Linux	Version v2.2	
MGate W5108/W5208	IEEE 802.11 a/b/g/n wireless Modbus/DNP3	Limon		
Series	Gateway	Linux	Version v2.4	

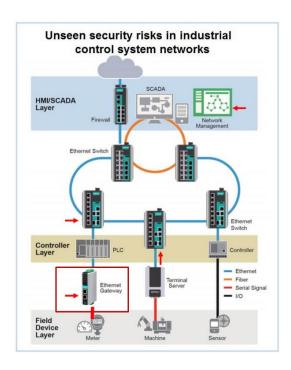
The MGate 5000 Series is a protocol gateway specifically designed to allow industrial devices to be directly accessed from a network. Thus, legacy fieldbus devices can be transformed into different protocols, which can be monitored and controlled from any network location or even the Internet.

To harden the security of this proprietary operating system, the open source HTTPS library, openSSL v1.1.1b, is also included and periodically reviewed for cybersecurity enhancement.

2.2. Deployment of the Device

You should deploy the MGate 5000 Series behind a secure firewall network that has sufficient security features in place to ensure that networks are safe from internal and external threats.

Make sure that the physical protection of the MGate devices and/or the system meets the security needs of your application. Depending on the environment and the threat situation, the form of protection can vary significantly.



3. Configuration and Hardening Information

For security reasons, account and password protection is enabled by default, so you must provide the correct account and password to unlock the device before entering the web console of the gateway.

The default account and password are **admin** and **moxa** (both in lowercase letters), respectively. Once you are successfully logged in, a pop-up notification will remind you to change the password to ensure a higher level of security.



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3.1. TCP/UDP Ports and Recommended Services

Please refer to the table below for all the ports, protocols, and services that are used to communicate between the MGate 5000 Series and other devices.

Service Name	Option	Default Setting	Туре	Port Number	Description
DSCI	Frable/Disable	Fachle	TCP	4900	For Mayo utility communication
(Moxa Command)	Enable/Disable	Enable	UDP	4800	For Moxa utility communication
DNS client	Enable/Disable	Disable	UDP	53	Processing DNS and WINS
DNS client	Lilable, Disable	Disable	UDP	33	(Client) data
SNMP agent	Enable/Disable	Enable	UDP	161	SNMP handling routine
HTTP server	Enable/Disable	Enable	TCP	80	Web console
HTTPS server	Enable/Disable	Enable	TCP	443	Secured web console
Telnet server	Enable/Disable	Disable	TCP	23	Telnet console
					The DHCP client needs to acquire
DHCP client	Enable/Disable	Disable	UDP	68	the system IP address from the server
Contactions	Fachle (Disable	Disable	LIDD	E14	Sending the system logs to the
Syslog client	Enable/Disable	Disable	UDP	514	remote syslog server
Email client	Enable/Disable	Disable	TCD	25	Sending system/config event
Email client	Enable/Disable	Disable	TCP	25	notifications
SNMP trap client	Enable/Disable	Disable	UDP	162	Sending system/config event
Siving trap client	Enable/Disable	Disable	ODF	102	notifications
					Network time protocol to
NTP client	Enable/Disable	Disable	UDP	123	synchronize system time from
					the server
Modbus TCP				502,	502 for Modbus communication;
client/server	Enable/Disable	Enable	TCP	7502	7502 for priority Modbus
Cherry Server				7302	communication
					2222 for EtherNet/IP implicit
EtherNet/IP	Enable/Disable	Enable	TCP,	2222,	messaging
Etherweyn	Lilable/ Disable	Lilable	UDP	44818	44818 for EtherNet/IP explicit
					messaging
PROFINET	Enable/Disable	Enable	UDP	34963	34963 for PROFINET protocol
THOT INET	Eliabic, Disable	LIIUDIE	001	3 1303	communication
DNP3	Enable/Disable	Enable	TCP,	20000	20000 for DNP3 protocol
			UDP		communication
IEC-104	Enable/Disable	Enable	ТСР	2404	2404 for IEC-104 protocol
					communication

For security reasons, you should consider disabling unused services. After initial setup, use services with stronger security for data communication. Refer to the table below for the suggested settings.

Service Name	Suggested Setting	Туре	Port Number	Security Remark
DSCI	Disable	TCP	4900	Disable this service as it is not commonly used
(Moxa Command)	Disable	UDP	4800	Disable this service as it is not commonly used
DNS client	Disable	UDP	53	Disable this service as it is not commonly used
SNMP agent	Disable	UDP	161	Managing the MGate via HTTPS console will be more secure
HTTP server	Disable	ТСР	80	Disable HTTP to prevent plain text transmission
HTTPS server	Enable	ТСР	443	Encrypted data channel with trusted certificate for MGate configuration
Telnet server	Disable	TCP	23	Disable this service as it is not commonly used
DHCP client	Disable	UDP	68	Assign an IP address manually for the device
Syslog client	Enable	UDP	514	A service for sending important system events for a diagnosis of the MGate's status
Email client	Enable	ТСР	25	A service for sending important system events for a diagnosis of the MGate's status
SNMP trap client	Enable	UDP	162	A service for sending important system events for a diagnosis of the MGate's status
NTP client	Disable	UDP	123	Disable this service as it is not commonly used
Modbus TCP	Enable	TCP	502,	Make sure you add your Modbus devices' IP
client/server			7502	addresses to the "Accessible IP list"
EtherNet/IP	Enable	TCP,	2222,	2222 for EtherNet/IP implicit messaging;
		UDP	44818	44818 for EtherNet/IP explicit messaging
PROFINET	Enable	UDP	34963	34963 for PROFINET protocol communication
DNP3	Enable	TCP,	20000	20000 for DNP3 protocol communication
		UDP		
IEC-104	Enable	TCP	2404	2404 for IEC-104 protocol communication

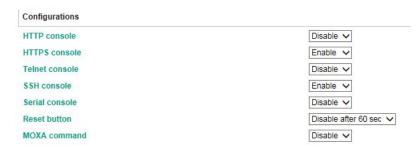
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• For console services, we recommend the following:

НТТР	Disable
HTTPS	Enable
Telnet	Disable
Moxa Command	Disable

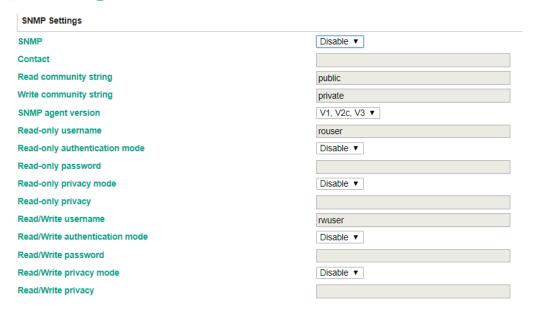
To enable or disable these services, log in to the HTTP/HTTPS console and select
 System Management → Misc. Settings → Console Settings.

Console Settings



To disable the SNMP agent service, log in to the HTTP/HTTPS console and select
 System Management → SNMP Agent, then select Disable for SNMP.

SNMP Agent



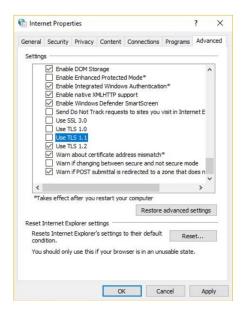
To disable the NTP service, log in to the HTTP/HTTPS console, select Basic
 Settings, and keep the Time server setting empty. This will disable the NTP service.



Note: For each instruction above, click the **Submit** button to save your changes, then restart the MGate device so the new settings will take effect.

3.2. HTTPS and SSL Certificates

HTTPS is an encrypted communication channel. As TLS v1.1 or lower has severe vulnerabilities that can easily be hacked, MGate devices use TLS v1.2 for HTTPS to ensure data transmissions are secured. Make sure your browser has TLS v1.2 enabled.



In order to use HTTPS console without a certificate warning appearing, you need to import a trusted certificate issued by a third-party certificate authority.

Log in to the HTTP/HTTPS console and select System Management → Certificate.
 You can generate an up-to-date valid certificate by importing a third-party trusted
 SSL certificate or generating the "MGate self-signed" certificate.

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Behavior of the SSL Certificate on an MGate Device

- MGate devices can auto-generate a self-signed SSL certificate. It is recommended that you import SSL certificates that are either certified by a trusted third-party Certificate Authority (CA) or by an organization's CA.
- The length of the MGate device's self-signed private keys is 1,024 bits, which should be compatible with most applications. Some applications may need a longer key, such as 2,048 bits, which would require importing a third-party certificate. Please note that longer keys will mean browsing the web console will be slower due to the increased complexity of encrypting and decrypting communicated data.

MGate Self-signed Certificate

If a certificate has expired, you can regenerate the MGate self-signed certificate with the following steps.

- Step 1. Delete the current SSL certificate issued by the MGate device.
- Step 2. Enable the NTP server and set up the time zone and local time.
- Step 3. After restarting the device, the MGate self-signed certificate will be regenerated with a new expiration date.

Importing a Third-party Trusted SSL Certificate

Importing the third-party trusted SSL certificate can improve security. To generate the SSL certificate through a third party, follow these steps:

- Step 1. Create a certification authority (Root CA), such as Microsoft AD
 Certificate Service (https://mizitechinfo.wordpress.com/2014/07/19/step-by-step-installing-certificate-authority-on-windows-server-2012-r2/)
- Step 2. Find a tool to issue a certificate signing request (CSR) file. You can get one from a third-party CA company such as DigiCert (https://www.digicert.com/easy-csr/openssl.htm).
- Step 3. Submit the CSR file to a public certification authority to get a signed certificate.
- Step 4. Import the certificate to the MGate device. Please note that MGate devices only accept certificates using a ".pem" format.

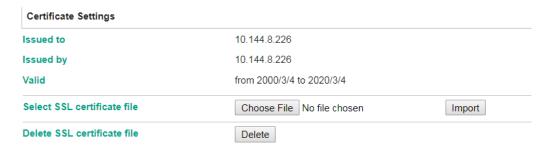
Note: The maximum supported key length for MGate devices is 2,048 bits.

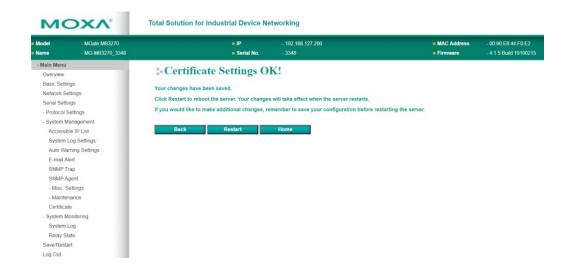
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Here are some well-known third-party CA (Certificate Authority) companies for your reference (https://en.wikipedia.org/wiki/Certificate authority):

- IdenTrust (<u>https://www.identrust.com/</u>)
- DigiCert (https://www.digicert.com/)
- Comodo Cybersecurity (https://www.comodo.com/)
- GoDaddy (https://www.godaddy.com/)
- Verisign (<u>https://www.verisign.com/</u>)

Certificate





3.3. Account Management

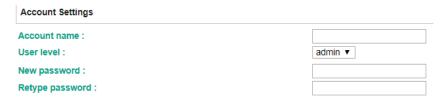
- The MGate 5000 Series provides two different user levels, admin and user, with a
 maximum of 16 accounts. With an administrator account, you can access and
 modify all settings through the web console. With the user account, you can only
 view settings.
- The default administrator account is admin, with the default password moxa. To manage accounts, log in to the web console and select System Management → Misc. Settings → Account Management. To change the password of an existing account, double-click the name of the account. You can change the password on the page that opens.

* Account Management



To add a new account, log in to the HTTP/HTTPS console and select System
 Management → Misc. Settings → Account Management. Click the Add button,
 then fill in the Account name, User level, New password, and Retype
 password to generate a new account.

*Account Management



Note: We suggest you manage your device with another "administrator level" account instead of using the default "admin" account, as it is commonly used by embedded systems. Once the new administrator level account has been created, it is suggested that the original "admin" account should be monitored for security reasons to prevent brute-force attacks.

 To improve security, the login password policy and account login failure lockout can be configured. To configure them, log in to the HTTP/HTTPS console and select
 System Management → Misc. Settings → Login Password Policy.

Login Password Policy

Account Password Policy		
Minimum length	4	(4 ~ 16)
✓ Enable password complexity strength check		
✓ At least one digit(0~9)		
✓ At least one special character: ~!@#\$%^&* ;;,,<>□{}()		
	90	(90 ~ 180 days)
Account Login Failure Lockout		
☑ Enable		
Retry failure threshold	5	(1 ~ 10 time)
Lockout time	5	(1 ~ 60 min)

You should adjust the password policy to require more complex passwords. For example, set the **Minimum length** to 16, enable all password complexity strength checks, and enable the **Password lifetime** options. Also, to avoid brute-force attack, it's suggested that you enable the **Account login failure lockout** feature.

For some system security requirements, a warning message may need to be displayed to all users attempting to log in to the device. To add a login message, log in to the HTTP/HTTPS console and select System Management → Misc. Settings → Notification Message, and enter a Login Message to use.



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3.4. Accessible IP List

• The MGate 5000 Series can limit access to specific host IP addresses to prevent unauthorized access to the gateway. If a host's IP address is in the accessible IP list, then the host will be allowed to access the MGate 5000 Series. To configure this, log in to the HTTP/HTTPS console and select System Management → Accessible IP List. The different restrictions are listed in the table below (the checkbox Apply additional restrictions can only be activated if Activate the accessible IP list is activated).

***** Accessible IP List

	•	nmunications are NOT allowed for the IPs NOT on the list) vices are NOT allowed for the IPs NOT on the list)	
Index	Active	IP	NetMask
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Activate the	Apply additional	IPs on the list	IPs NOT on the list
accessible IP list	restrictions	(Active checked)	(Active NOT checked)
v		All protocol	Protocol communication is
		communication and	not allowed, but services*
		services* are allowed.	are still allowed.
v	v	All protocol	All services* are not
		communication and	allowed.
		services* are allowed.	

^{*} HTTP, HTTPS, TELNET, SSL, SNMP, SMTP, DNS, NTP, DSU

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- You may add a specific address or range of addresses by using a combination of an IP address and a netmask as follows:
 - To allow access to a specific IP address: Enter the IP address in the corresponding field, then enter 255.255.255.255 for the netmask.
 - **To allow access to hosts on a specific subnet:** For both the IP address and netmask, use 0 for the last digit (e.g., "192.168.1.0" and "255.255.255.0").
 - To allow access to all IP addresses: Make sure that Enable the checkbox for the accessible IP list is not checked.

Additional configuration examples are shown in the following table:

Desired IP Range	IP Address Field	Netmask Field
Any host	Disable	Enable
192.168.1.120	192.168.1.120	255.255.255.255
192.168.1.1 to 192.168.1.254	192.168.1.0	255.255.255.0
192.168.1.1 to 192.168.255.254	192.168.0.0	255.255.0.0
192.168.1.1 to 192.168.1.126	192.168.1.0	255.255.255.128
192.168.1.129 to 192.168.1.254	192.168.1.128	255.255.255.128



Ensure that the IP address of the PC you are using to access the web console is in the Accessible IP List.

3.5. Logging and Auditing

 These are the events that will be recorded by the MGate 5000 Series. The SD card access failure event and protocol events vary for the different MGate 5000 models.

Event Group	Summary
System	System cold start, system warm start, SD card access failure
Network	DHCP/BOOTP gets IP/renew, NTP connect failed, IP conflict, Network link down
Configuration	Login failed, IP changed, Password changed, Firmware upgraded, SSL Certificate imported, Configuration imported/exported, Configuration changed, Clear event logged
Protocol	Protocol communication logs

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To configure this setting, log in to the HTTP/HTTPS console and select System
 Management → System Log Settings. Then, enable the Local Log for recording
 on the MGate 5000 device and/or Syslog for keeping records on a server. You
 should enable system log settings to record all important system events to monitor
 device status and check for security issues.

System Log Settings Local Log System **~** System cold start. System warm start. SD card access failure Network **~** DHCP/BOOTP get IP/renew, NTP connect fail, IP conflict, Network link down **✓** Login fail, IP changed, Password changed, Firmware upgrade, SSL certificate import, Config import, Config export, Configuration change, Clear event log ~ **~** ~ EtherNet/IP ~ EtherNet/IP communication logs **✓ Modbus TCP ✓** Modbus TCP communication logs **~ ~** Azure communication logs **✓ ~** MQTT Raw **✓ ✓** MQTT Raw communication logs Alibaba Cloud ~ **~** Alibaba Cloud communication logs **Local Log Settings** Enable log capacity warning at 0 Warning by: ✓ SNMP Trap ✓ E-mail Event log oversize action : Overwrite The Oldest Event Log V Syslog Settings Syslog server IP Syslog server port 514

To view events in the system log, log in to the HTTP/HTTPS console and select

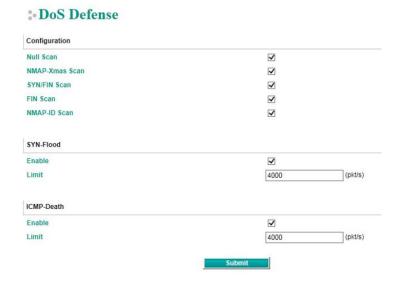
System Monitoring → System Log.



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3.6. DoS Defense

You can enable and configure a number of features to enable DoS Defense in order to protect against denial-of-service (DoS) attacks.



4. Patching/Upgrades

4.1. Patch Management Plan

With regard to patch management, Moxa in general releases version enhancement with thorough release notes annually.

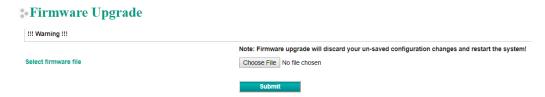
4.2. Firmware Upgrades

The process for upgrading firmware is as follows:

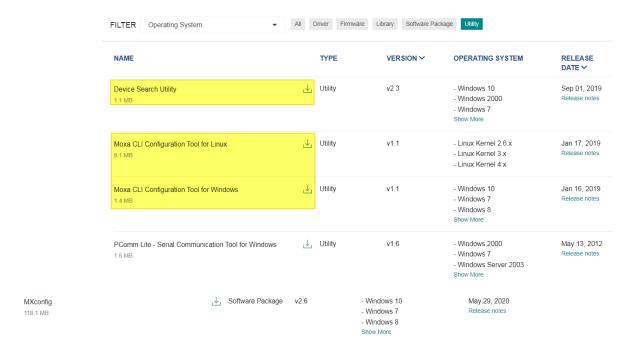
- Download the latest firmware for your MGate device from the Moxa website:
 - Firmware for the MGate 5101 Series:
 https://www.moxa.com/en/products/industrial-edge-connectivity/protocol-gateways/modbus-tcp-gateways/mgate-5101-pbm-mn-series#resources
 - Firmware for the MGate 5102 Series:
 https://www.moxa.com/en/products/industrial-edge-connectivity/protocol-gateways/profinet-gateways/mgate-5102-pbm-pn-series
 - Firmware for the MGate 5103 Series:
 https://www.moxa.com/en/products/industrial-edge-connectivity/protocol-gateways/mgate-5103-series#resources
 - Firmware for the MGate 5105 Series:
 https://www.moxa.com/en/products/industrial-edge-connectivity/protocol-gateways/mgate-5105-mb-eip-series#resources
 - Firmware for the MGate 5109 Series:
 https://www.moxa.com/en/products/industrial-edge-connectivity/protocol-gateways/modbus-tcp-gateways/mgate-5109-series#resources
 - Firmware for the MGate 5111 Series:
 https://www.moxa.com/en/products/industrial-edge-connectivity/protocol-gateways/modbus-tcp-gateways/mgate-5111-series#resources
 - Firmware for the MGate 5114 Series:
 https://www.moxa.com/en/products/industrial-edge-connectivity/protocol-gateways/modbus-tcp-gateways/mgate-5114-series#resources
 - Firmware for the MGate 5118 Series:
 https://www.moxa.com/en/products/industrial-edge-connectivity/protocol-gateways/modbus-tcp-gateways/mgate-5118-series#resources
 - Firmware for the MGate W5108/W5208 Series:
 https://www.moxa.com/en/products/industrial-edge-connectivity/protocol-gateways/mgate-w5108-w5208-series#resources

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Log in to the HTTP/HTTPS console and select System Management →
 Maintenance → Firmware Upgrade. Click the Choose File button to select the proper firmware and click Submit to upgrade the firmware.



 If you want to upgrade the firmware for multiple units, then download the utility Device Search Utility (DSU) or MXconfig for a GUI interface, or the Moxa CLI Configuration Tool for a CLI interface.



5. Security Information and Vulnerability Feedback

As the adoption of the Industrial IoT (IIoT) continues to grow rapidly, security has become one of our top priorities. The Moxa Cyber Security Response Team (CSRT) takes a proactive approach to protect our products from security vulnerabilities and help our customers better manage security risks.

You can find the latest Moxa security information

here: https://www.moxa.com/en/support/product-support/security-advisory