Connect to Azure IoT Hub with the MGate 5105 Industrial Protocol Gateway

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MGate 5105 to Azure Cloud

1. Introduction

The MGate 5105 performs easy protocol conversions between Modbus RTU/ASCII, Modbus TCP, and EtherNet/IP protocols. From Firmware Version 4.0, it can support data that is collected from these fieldbus protocol devices and pushed to a cloud server. The cloud server could be Microsoft Azure, Alibaba Cloud, or MQTT Broker.

This document demonstrates how to use the MGate 5105 that connects to the Microsoft Azure IoT Hub and publishes fieldbus data messages to this IoT Hub or receives messages from it.

2. System Topology

Figure 1 illustrates the system topology. PC1 runs Modbus Slave tool to act as a Modbus RTU device. It connects to the MGate 5105's Port 1. The MGate 5105 acts as an Azure IoT device and connects to Azure IoT Hub. PC2 runs Device Explorer to monitor Azure IoT devices in the IoT Hub.



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3. Prerequisites

3.1 Modbus Slave Tool

<u>Modbus Slave</u> is a very popular Modbus slave simulator for testing and debugging of your modbus devices, which support Modbus RTU/ASCII and Modbus TCP/IP.

Download from website: http://www.modbustools.com/download.html

3.2 Device Explorer

The Device Explorer is the gadget released by Azure to monitor "Azure IoT Hub" service. You can download a prebuilt version of the Device Explorer application. The latest release can be found at the following website:

https://github.com/Azure/azure-iot-sdk-csharp/releases/tag/2019-1-4

3.3 Create Azure IoT Hub and Device

- Use Microsoft user account to log in to Azure Portal Azure Portal website: <u>https://portal.azure.com</u>
- 2. Create a New IoT Hub: New → Internet of Things → IoT Hub



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When a new IoT Hub is created, click it to create a new IoT Device: Explorers → IoT device → Add.



4. MGate 5105 Settings

Log in to MGate 5105's web console, then do the following settings:

4.1 Protocol Conversion

Under "Protocol Conversion" settings, we choose "Azure Device" as Role 1. In the fieldbus site, we can choose the following protocols: Modbus RTU/ASCII Slave, Modbus TCP Server, or EtherNet/IP Adapter, and multiple combinations are allowed for settings in Role 2. In this demonstration, we choose "Modbus RTU/ASCII Slave".

Set as below:



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4.2 Modbus RTU Master Settings

- 1. In the "Modbus RTU/ASCII Master Settings" web page, under Mode, we choose "RTU" and keep the "Master Settings" as the default setting.
- 2. Add a "Read1" modbus command to send a function code 03, quantity as 1 command, Endian Swap as Byte. Its "Poll interval" is 1000 ms.
- 3. Add a "Write1" modbus command to send a function code 06 command, Endian Swap as Byte. Its command "Trigger" is by "Data Change".

Set as below:

Role		Master	Master						
Mode	RTU 🔻								
Master Settings									
Initial delay		0		(0 - 30000 ms)					
Max. retry		3		(0 - 5)					
Response timeout		1000		(10 - 120000 ms)					
Inter-frame delay		0		(10 - 500 ms, 0: default) (10 - 500 ms, 0: default)					
Inter-character timeou	t	0							
Modbus Commands									
		🔂 Ad	d 🛷 Edit	🖆 Clone 🍵 Del	ete 🗘 Move				
Index Name Slav	e ID Function	Address / Quantity	Trigger	Poll Interval	Endian Swap				

Index	Name	Slave ID	Function	Address / Quantity	Trigger	Poll Interval	Endian Swap
1	Read1	1	3	Read address 0, Quantity 1	Cyclic	1000	Byte
2	Write1	1	16	Write address 0, Quantity 1	Data Change	N/A	Byte

4.3 Azure Device Settings

1. Device connection string:

In the Basic Settings \rightarrow Device connection string, you must fill in your IoT device connection string. It can be found at "IoT Device details" within Azure Portal as below:

Home > PenchunHub - IoT devices > Device details									
Device details		Ŕ							
Rave Message to device 🌾 Di	irect method 🗄 Device twin 🕂 Add module identity 🤇 Regenerate keys	U Refrest							
Device Id 👩	MGate5105								
Primary key 🚯	i4sJeh2RXd91CjKa8+6pDix9EC7bNYrs+tr5wUy3on8=								
Secondary key 🚯	cpDMo69CGEo+QpzKKXmc5UhRaVzaPylCW30SKWPgDWk=								
Connection string (primary key) 🚯	HostName=PenchunHub.azure-devices.net;DeviceId=MGate5105;SharedAccessKey=i4sJ	eh2							
Connection string (secondary key) 🕤	HostName=PenchunHub.azure-devices.net;DeviceId=MGate5105;SharedAccessKey=cpD	Mo							

Set as below:

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Role	Device
Basic Settings	
Device connection string	HostName=PenchunHub.azure-devices.net;DeviceId=MGate5105;Sha

2. Device-to-cloud Messages:

Click the **Add** button to create a Device-to-cloud Message, then click it to edit message settings.

Device-to-cloud Messages

	🕀 Add	🖋 Edit	🕸 Delete
Message ID			

In "Pair Settings", we click "Message ID" to edit its Name as "Read1".

Pair Settings					
		🔂 Add	🖍 Edit	Clone	🛍 Delete
Туре	Message	D			
Message ID	Name	msalD			
Message Version		mogio			
Gateway ID	Value	Read1			
Date Time				е	
Tag Status Monitoring		01/			
Conditional User Information		Cancel			

Click "Date Time" to enable "dateTime" padding in the message.

Pair Settings				
		🔂 Add 🛛 🕜 Edit	E Clone	🗴 Delete
Туре	Date Time			
Message ID	Pair	Enable T		
Message Version	1 un	Encore		
Gateway ID	Name	dateTime		
Date Time	Value	Example: 1990-01-		
Tag Status Monitoring		02T03:04:05+06:00		
Conditional User Information				
Constant User Information		OK		
		ouncer		

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Click **Add** → **Module** to create a new module.

Pair Settings

	C Add	1	Edit	🖹 Clone	🏛 Delete
Туре	Module		Name		
Message ID	Тау)	msgID		
Message Version			msgVe	r	
Gateway ID			gwlD		
Date Time			dateTi	ne	
Tag Status Monitoring			validTa	g	

Select "ModuleR1" under Name.

Module		
Name	ModuleR1	
	OK	
	Cancel	
		·

Choose "ModuleR1", then click Add → Tag.

	🔂 Add	ð	Edit	🖹 Clone	並 Delete
Туре	Module		Name		
Message ID	🛛 🔌 Tag		msgID		
Message Version			msgVer		
Gateway ID			gwlD		
Date Time			dateTim	e	
Tag Status Monitoring			validTag		
- Module			Module	२१	

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Data unit Uint16 ▼ Unit quantity 1 Endian swap None ▼	Name	TagR1
Unit quantity 1 Endian swap None	Data unit	Uint16 🔻
Endian swap None V	Unit quantity	1
	Endian swap	None •
Onchange trigger Enable V	Onchange trigger	Enable •
Trigger deadband 0	Trigger deadband	0

3. Cloud-to-device Messages:

Click the **Add** button to create a Cloud-to-device message and then click it to edit message settings.

Cloud-to-device Messages			
	C Add	🖋 Edit	並 Delete
Message ID			

In "Pair Settings", we click "Message ID" to edit its Name as "Write1".

	Message ID
Message ID	Name msgID
Pair Settings	Value Write1
Туре	OK Cancel
Message ID	

Click Add → Module to create a new module.

Pair Settings					
	🗘 Add	ø	Edit	Clone	🗴 Delete
Туре	Module		Name		
Message ID	Tag		msgID		
Message Version			msgVe	r	
Gateway ID			gwlD		

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Select "ModuleW1" as Name.

Module		
Name	ModuleW1	
ОК	Ca	incel

Choose ModuleW1 and then click $Add \rightarrow Tag$.

	🗘 Add	🖋 Edit	💼 Clone	並 Delete
Туре	Module	e lame		
Message ID	JhnTag	nsgID		
Message Version		rnsgVer		
Gateway ID		gwlD		
- Module		ModuleW1		

Create a Protocol Tag as below:

Protocol Tag	
Name	TagW1
Data unit	Uint16 ▼
Unit quantity	1
Endian swap	None •
OK	
OK	Cancel

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4.4 I/O Data Mapping

When the protocol settings are done, you just need one more step of I/O Data mapping for protocol configuration. You can click the **Make a proposal** button for auto mapping in both the **Azure IoT Hub** \rightarrow **Fieldbus Slave** direction and **Azure IoT Hub** \leftarrow **Fieldbus Slave** direction.

I/O Data Mapping

	Data flow direction	Azure	IoT Hub> Fieldbus S	Slave ▼	
Mapping address arrangeme	ent Make	a propo	sal!		
	write			write	
Your device : Azure IoT Hub	Role 1 of MGate 5105-ME EIP : Azure _{Device}	3-	Role 2 of MGate 51 EIP : Fieldbus <u>Master</u>	105-MB-	Your device : Fieldbus <mark>Slave</mark>
Name Write1.ModuleW1.Ta	Internal Address Data S agW1 <mark>N/A N/A</mark> 2	ize	Protocol Name Unselected Unselect	e Internal Ado ted <mark>N/A N/</mark>	dress Data Size
The mapping result is	as below:				
	vrite		W	i te	© 円
Your device : Azure IoT Hub	Role 1 of MGate 5105-MB- EIP : Azure Device	R E F	cole 2 of MGate 5105-M IP : 'ieldbus _{Master}	ИВ-	Your device : Fieldbus <mark>Slave</mark>
Name Write1.Mod <mark>ul</mark> eW1.TagW	Internal Address Data Size /1 01 2	M	Protocol lodbus RTU/ASCII Mas	Name Interr ter Write1 0	al Address Data Size
	Pread		re	Pad	
Your device : Azure IoT Hub	Role 1 of MGate 5105-MB- EIP : Azure Device		Role 2 of MGate 5105- EIP : Fieldbus <u>Master</u>	MB-	Your device : Fieldbus Slave
Name Read1.ModuleR1.Tag	Internal Address Data Size	: N	Protocol Modbus RTU/ASCII Mas	Name Inter ster Read1 0	nal Address Data Size

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4.5 Serial Settings

Serial Port1 connects to Modbus RTU device, so you must set the serial parameters of Port1.

Set as below:

Serial Settings

Port	Baud rate	Parity	Data bit	Stop bit	Flow control	FIFO	Interface	RTS on delay	RTS off delay
1	115200 🔻	Even •	8 🔻	1 🔻	None •	Enable 🔻	RS-232 V	0	0

5. Modbus Slave Tool Settings

PC1 runs **Modbus Slave tool** and connects to MGate 5105's Serial Port. Add the Modbus definition below:

S Modbus Slave - Mbslave1
File Edit Connection Setup Display
D 🚅 🖬 🚳 🗂 🗏 👜 🤋 🕅
Mbslave1
ID = 1: F = 03
00000
0 0

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6. Device Explorer Settings

PC2 runs Device Explorer. In Configuration Tab, fill in IoT Hub Connection String.

Device Explorer Twin	
Configuration Management Data Messages To Device Call Method on Device	
Connection Information	
IoT Hub Connection String:	
HostName=PenchunHub.azure- devices.net;SharedAccessKeyName=iothubowner;SharedAccessKey=977788666668666666666666666666666666666	
Protocol Gateway HostName:	
Update	

This string can be found under "IoT Hub Shared access policies" in Azure Portal as below:

PenchunHub - Shared acc	ess policies		Penchunhub
	+ Add		
🕺 Overview 🔺			Access policy name
Activity log	IoT Hub uses permissions to grant access to each IoT hu	b endpoint. Permissions limit the access to an IoT	Parmissions
Access control (IAM)			Registry read 🕦
🗬 Tags	✓ Search to filter items		Registry write
🗲 Events	POLICY	PERMISSIONS	Service connect 🚯
Settings	iothubowner	registry write, service connec	V Device connect 🚯
Shared access policies	service	service connect	
O Pricing and scale	device	device connect	
Operations monitoring	registryRead	registry read	Shared access keys Primary key
E IP Filter	registryReadWrite	reuistry write	3Wobilqlqgtls9xxI4+/kuWVPFQ7UB
🯓 Certificates			on3P67ArYEUmIkfh+p02yRBzLJX+M
🕒 Built-in endpoints			Connection string—primary key n
·			HostName=PenchunHub.azure-devi 🌓
Properties			Connection string—secondary key A

After filling in the IoT Hub Connection String, click "Update" and it will connect to Azure IoT Hub.

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In Data Tab, choose your IoT Device from Device ID dropdown list. Then click "Monitor" to monitor Device-to-cloud message.

Device Explorer Tw	in	
Configuration Ma	nagement Data Messages To Device Call Method on Device	
Monitoring		
Event Hub:	PenchunHub	
Device ID:	MGate5105	•
Start Time:	03/06/2019 13:16:39	
Consumer G	aroup: \$Default Enable	
Monito	Cancel Clear	Show s

7. Communication Test

7.1 Device-to-cloud message

Set Device-to-cloud message Trigger as "no cyclic sending" and "by specific tag change":

Trigger		
Cyclic sending intervals	0	(1000 - 86400000 ms, 0 for disable)
Tag changes	Specify individu	ual tag settings ▼

Name	TagR1
Data unit	Uint16 🔻
Unit quantity	1
Endian swap	None 🔻
Onchange trigger	Enable 🔻
Trigger deadband	0

To enable Onchange trigger with Trigger deadband to 0 on TagR1.

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So when the MGate 5105 gets Modbus RTU device Register0's value changed, it triggers to publish message to IoT Hub.

Now, you can try to update Modbus RegisterO's value to 1. In Device Explorer's Event Hub Data, it gets TagR1's value shown as 1 and with dateTime padding.

Event Hub Data	
Receiving events 2019-03-26 4:06:24 PM> Device: [MGate5105], Data: {" <mark>TagR1</mark> ": <mark>] }"date Time"."2019-03-26T16:04:13+08:0</mark>	{"msgID":"Read1","msgVer":"1.0","gwID":"MGateAzure","ModuleR1' <mark>}}</mark>]

7.2 Cloud-to-device message

Device Explorer can be used to send messages to device. You can follow below steps:

1. Click Cloud-to-device message "View JSON" button.

Pair Settings

	🔂 Add	P Edit	💼 Clone	🖞 Delete
Туре		Name		
Message ID		msgID		
Message Version		msgVer		
Gateway ID		gwlD		
- Module		ModuleW1		
Protocol Tag		TagW1		



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Copy Cloud-to-device message JSON format:

JSON View	
{	
"msgID": "Write1",	
"msgVer": "1.0",	
"gwID": "MGateAzure"	,
"ModuleW1": {	
"TagW1": 0	
}	
}	
Conv	Cancel

2. The copied message has a lot of space and line feed. We can use tool to compact it. Below is a free online tool:

https://jsonformatter.org/json-minify

Paste the message on the left side column, then click "Minify JSON". It will show a compact JSON format message on the right side column. Click "Copy to Clipboard".



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3. Paste it on the Message field of Device Explorer, and modify TagW1 value to 5, then click "Send".

🖳 Device Ex	plorer T	Twin		
Configura	ation M	Management Data Messages To Device Call Method on Device		
Send M	Messag	ige to Device:		
loT H	lub:	PenchunHub		
Devid	ce ID:	MGate5105		
Mess	sage:	{"msgID":"Write1","msgVer":"1.0","gwID":"MGateAzure","ModuleW1":{"TagW1" <mark>:5</mark> }}		
		Add Time Stamp Monitor Feedback Endpoint		
Prope	erties:			
	Key	Value		
*				
	Se	Send Clear		

4. Check Modbus Slave tool that Register0's value is updated to 5.

2	Mbslave1 📃 🗉 💌	
ID = 1: F = 03		
	00000	
0	5	