GOOSE TO MQTT BRIDGE

USING MQTT FOR GOOSE APPLICATION STAGING

Revision 0.9



Systems Integration Specialists Company, Inc. 6605 19½ Mile Road, Sterling Heights, MI 48314-9921, U.S.A. Tel: +1-586-254-0020, Fax: +1-586-254-0053 E-Mail: <u>support@sisconet.com</u>, URL: <u>www.sisconet.com</u>

> © SISCO, Inc. 2017 All Rights Reserved by: Date

COPYRIGHT NOTICE

© COPYRIGHT 1999-2014 SYSTEMS INTEGRATION SPECIALISTS COMPANY INC. ALL RIGHTS RESERVED.

THIS DOCUMENT IS PROVIDED UNDER LICENSE TO AUTHORIZED LICENSEES ONLY. NO PART OF THIS DOCUMENT MAY BE COPIED OR DISTRIBUTED, TRANSMITTED, TRANSCRIBED, STORED IN A RETRIEVAL SYSTEM, OR TRANSLATED INTO ANY HUMAN OR COMPUTER LANGUAGE, IN ANY FORM OR BY ANY MEANS, ELECTRONIC, MECHANICAL, MAGNETIC, MANUAL, OR OTHERWISE, DISCLOSED TO THIRD PARTIES, EXCEPT AS ALLOWED IN THE LICENSE AGREEMENT, WITHOUT THE EXPRESS WRITTEN CONSENT OF SYSTEMS INTEGRATION SPECIALISTS COMPANY INCORPORATED, 6605 19½ MILE ROAD, STERLING HEIGHTS, MI, 48314, U.S.A.

DISCLAIMER

SYSTEMS INTEGRATION SPECIALISTS COMPANY, INC. MAKES NO REPRESENTATION OR WARRANTIES WITH RESPECT TO THE CONTENTS OF THIS MANUAL AND SPECIFICALLY DISCLAIMS ANY IMPLIED WARRANTIES OF MERCHANTABILITY OF FITNESS FOR ANY PARTICULAR PURPOSE. FURTHER, SYSTEMS INTEGRATION SPECIALISTS COMPANY, INC. RESERVES THE RIGHT TO REVISE THIS PUBLICATION AND TO MAKE CHANGES IN IT FROM TIME TO TIME WITHOUT OBLIGATION OF SYSTEMS INTEGRATION SPECIALISTS COMPANY, INC. TO NOTIFY ANY PERSON OR ORGANIZATION OF SUCH REVISION OR CHANGES.

INTRODUCTION AND THEORY

The GOOSE to MQTT Bridge was developed out of a need to support the integration of a GOOSE application amongst participating companies located around the globe. The first thought was to utilize some internal technology to convert Layer 2 GOOSE to an encapsulation over TCP/IP. However, this would have required a TCP "message broker" to be created and hosted by a company infrastructure. The MQTT broker that has been tested is Mosquito.

MQTT is an publish/subscribe message exchange technology that is the equivalent to encapsulation of a payload in TCP.

The use of MQTT is may be restricted to individuals that have a username/password accounts for the MQTT broker. However, for the purposes of the IOP staging, Triangle Microworks has staged a Mosquito MQTT broker

located at: 45.20.211.173.

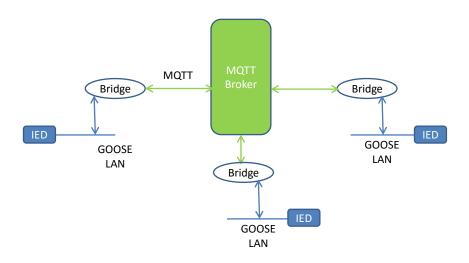


Figure 1: Architecture of GOOSE Exchange using Bridge

Figure 1 depicts the high level architectural view of the use of a broker by the GOOSE to MQTT Bridges. Instances of the bridge are connected to a GOOSE Local Area Network (LAN) through an Ethernet Network Interface Card (NIC). The bridge subscribes to ALL Layer 2 GOOSE messages all the LAN and then encapsulates the GOOSE messages in MQTT and sends the message to the connected broker. The broker then distributes the messages to the other MQTT clients connected to the broker who have subscribed to a specific topic. The bridges that receive the messages distributed by the broker de-encapsulate the GOOSE messages and transmit the messages onto the GOOSE LAN. The bridges are bi-directional (e.g. send and receive GOOSE messages), but will not receive messages that they transmit.

How does an MQTT broker know which messages to send to which clients? This is based upon a specified MQTT topic. Applications that need GOOSE exchanges need to subscribe and publish to the same topic. In order to allow multiple interactions (e.g. staging of different parts of the application simultaneously) different topics should be used. A separate GOOSE/MQTT bridge instance is needed per topic.

CONTENTS

Introduction and Theory	3
Installation	5
Pre-Requisites	5
Choosing a Topic Name	5
Execution	5
Understanding the Interface	8

INSTALLATION

The installation is a *.zip. Unzip the contents into a directory.

PRE-REQUISITES

Prior to using the GOOSE to MQTT Bridge, the following should be performed:

- The participants will need to choose a name for the topic and provide that name to the users that will be using the Bridge to access the broker (see page 5).
- Each Bridge requires at least one Ethernet NIC and access to the Internet.

CHOOSING A TOPIC NAME

The Bridge attempts to isolate the chosen set of integrated applications from other integration streams. In order to accomplish this isolation, the Bridge encapsulates the name chosen GOOSE Group Name (e.g. MQTT topic) .As an example "foo".

EXECUTION

This section will detail the general execution pattern for the bridge.

• Execute the GOOSEtoMQTT executable.

This should result in a display similar to the following:

± GOO	🗄 GOOSE to MQTT Bridge									
File	ile MQTT Login About									
	IP Address	Adapter Name	Description	Adapter Name	~					
•	169.254.54.250	Wireless Network	Intel(R) Centrino(R) Advanced-N 6205	\Device\NPF_{DCEBE7CD-9A33-40BC-BB21-398CF3575D9E}	_					
	169.254.212.190	Local Area Conn	Microsoft Wi-Fi Direct Virtual Adapter	\Device\NPF_{174357AF-EF4C-4BBB-AA0F-2EE16A6F4EE4}	-					
	169.254.157.140	Local Area Conn	Microsoft Hosted Network Virtual Adapter	\Device\NPF_{6DF65EF3-EC02-4642-B62B-BEDD22860E31}						
	192.168.2.11	Local Area Conn	Intel(R) 82579LM Gigabit Network Connection	\Device\NPF {49235763-13DC-4B53-9EA8-92FFF497EB56}	$\overline{}$					
Sent: Rece Error	ived:	T packets	LAN GOOSE packets LAN GOOSE Received: LAN GOOSE Sent: Reset Sta	Bridge Component Status GOOSE Interface Status: MQTT Status: GOOSE Group Name: GOOSE Group Name: Join GOOSE Group tistics V Output Ethemet P Rvd Ethemet						

 Select the appropriate Ethernet Interface that is attached to the GOOSE LAN. This is accomplished by selecting the row of the appropriate NIC. A selection will be indicated by the row being highlighted in "green".

疌 GC	OOSE to MQTT Bridge	e								-		×
File	ile MQTT Login About											
	IP Address	Adapter Name	Description		Adapter Name							^
	169.254.157.140	Local Area Conn	Microsoft Hosted Network Virtua	al Adapter	\Device\NPF_{6D	F65EF3-EC02-4642-B62B-BEDD22	860E31}					
►	192.168.2.11	Local Area Conn	Intel(R) 82579LM Gigabit Netwo	ork Connection	\Device\NPF_{492	35763-13DC-4B53-9EA8-92FFF49	7EB56}					=
	192.168.136.1	VMware Network	VMware Virtual Ethernet Adapte	er for VMnet1	\Device\NPF_{814	A2C1E-2B49-4B44-AE3E-8545630	C97978}					
	192.168.56.1	VMware Network	VMware Virtual Ethernet Adapte	er for VMnet8	\Device\NPF {0B	065E32-604D-4542-8BAD-461A96	1A9584}					~
Brid	lge Statistics					Bridge Component Status						
	MQT	T packets	LAN GOOSE packets			GOOSE Interface Status:	Open and Read	y				
Ser	nt:		LAN GOOSE Received:									
Rer	ceived:		LAN GOOSE Sent							Inin COOS	E Group	
Err	rors:		241 00002 0011.			GOOSE Group Marine.				3011 0003	E Group	
Nu	m OOD:			Reset Sta	atistics	✓ Output Ethemet ✓ F	xd Ethernet	Enable OOD Detect		Ect	no MQTT	
Ser Rec Err	Ige Statistics MQT nt: ceived: rors:		LAN GOOSE packets			Bridge Component Status GOOSE Interface Status: MQTT Status: GOOSE Group Name:	Open and Read			Join GOOS		

• Select MQTT Login which will result in a login screen into which the GMAIL username and password can be entered.

🖳 MQTTLogin		-		×
MQTT UserName				
Password				
HostIP:				
	Show Password	Log	in	

The UserName must be unique amongst the other clients connected to the broker. This name is used to make sure that messages issued by a particular client are not re-published to the GOOSE LAN. If the broker requires a password, then the password must be entered and match the configuration of the MQTT broker. If the broker does not require a password, then any value can be entered. Both the UserName and Password must have values.

Once the user name and password is entered, select "Login".

It may take up to 50 seconds to achieve a login. Upon a successful login, the Login button will turn "green". If the login is not successful, a dialog box will be displayed.

0	<i>i</i>	0			
🖳 MQTTLogin			-		×
MQTT UserName	sisco				
Password	•]			
HostIP:	192.168.2.81]			
		Show Password	Logged	In	
			_		

Upon successful login, close the login dialog and this will result in the XMPP status box becoming "green".

≇e G	OOSE to MQTT E	Bridge			- 🗆 X
File	MQTT Login	About			
	IP Address	Adapter Name	Description	Adapter Name	
	169.254.157.1	140 Local Area Conn	Microsoft Hosted Network Virtual Adapter	\Device\NPF_{6DF65EF3-EC02-4642-B62B-BEDD22860E31}	
►	192.168.2.11	Local Area Conn	Intel(R) 82579LM Gigabit Network Connection	\Device\NPF_{49235763-13DC-4B53-9EA8-92FFF497EB56}	
	192.168.136.1	1 VMware Network	VMware Virtual Ethernet Adapter for VMnet1	\Device\NPF_{814A2C1E-2B49-4B44-AE3E-854563C97978}	
	192.168.56.1	VMware Network	VMware Virtual Ethernet Adapter for VMnet8	\Device\NPF {0BD65E32-604D-4542-8BAD-461A961A9584}	~
Brid	dge Statistics			Bridge Component Status	
	_	MQTT packets	LAN GOOSE packets	GOOSE Interface Status: Open and Ready	
Se	nt:		LAN GOOSE Received:	MQTT Status; 192.168.2.81 OK	
Re	ceived:		LAN GOOSE Sent:	GOOSE Group Name:	GOOSE Group
Er	TOIS:				
Nu	um OOD:		Reset St	atistics V Output Ethemet V Rxd Ethemet Enable OOD Detect	Echo MQTT
	_				- I.
		Select a	n Ethernet internace to be used	as a GOOSE Intenace.	

• The user should then enter the GOOSE Group Name (MQTT Topic).

₹te GC	OSE to MQTT	Bridge				x
File	MQTT Logir	About				
Piridg Sen Rec	IP Address 169.254.157 192.168.2.1 192.168.56. ge Statistics t: zeived:	Adapter Name .140 Local Area Conn 1 Local Area Conn .1 VMware Network	Description Microsoft Hosted Network Virtual Adapter Intel(R) 82579LM Gigabit Network Connection VMware Virtual Ethemet Adapter for VMnet1 VMware Virtual Ethemet Adapter for VMnet8 LAN GOOSE packets LAN GOOSE Received: LAN GOOSE Sent:	\Device\WPF_{814A2C1E-2849-4844-AE3E-854563C97978} \Device\WPF_{08D65E32-604D-4542-88AD-461A961A9584} Bidge Component Status GOOSE Interface Status: Open and Ready MQTT_Status: 192.168.2.810K	in GOOSE Group	
	ors: n OOD:	0	Reset S	tatistics 🔽 Output Ethemet 🗹 Rvd Ethemet 🗌 Enable OOD Detect	Echo MQTT	

UNDERSTANDING THE INTERFACE

聖 GO	OSE to MQT	r Bridge									-		×
File	MQTT Logi	n Abo	ut										
	IP Address		Adapter Name	Description		Adapter Name							
	169.254.15	7.140 L	Local Area Conn	Microsoft Hosted Network Virtu	ual Adapter	\Device\NPF_{6	F65EF3-EC02-4642-B62B-BE	DD22860E31}					
►	192.168.2.1	1 L	Local Area Conn	Intel(R) 82579LM Gigabit Netw	ork Connection	\Device\NPF_{4	235763-13DC-4B53-9EA8-92	FF497EB56}					=
	192.168.13	6.1 N	/Mware Network	VMware Virtual Ethernet Adapt	erfor VMnet1	\Device\NPF_{8	4A2C1E-2B49-4B44-AE3E-85	4563C97978}					
	192.168.56	1 \	/Mware Network	VMware Virtual Ethernet Adapt	erfor VMnet8	\Device\NPF {0	BD65E32-604D-4542-8BAD-46	1A961A9584}					~
Bridg	ge Statistics						Bridge Component Status						
		MQTT	packets	LAN GOOSE packets			GOOSE Interface S	Open an	id Ready				
Sent	t:	381		LAN GOOSE Received:	381		MQTT Status:	192,168	.2.81 OK				
Rec	eived:	0		LAN GOOSE Sent:	0		GOOSE Group Nam	e; foo			Join GOO	GE Group	1
Епо	ors:	0											1
Nun	n OOD:				Reset Sta	atistics	 Output Ethemet 	Rxd Ethernet	Enable	OOD Detect	Ec	ho MQTT	

The interface has a couple of options:

- Echo MQTT: This is provided in order to do MQTT performance test. If checked, the Bridge will echo back the received MQTT packet (e.g. encapsulated GOOSE). This option should only be used when there are only two (2) Bridges connected to the broker in a given GOOSE Group.
- Rxd Ethernet: If checked, the Bridge will process GOOSE messages received on the selected NIC.
- Output Ethernet: If checked, the Bridge will transmit the received GOOSE message (e.g. encapsulated in MQTT) and publish it onto the selected Ethernet.
- Reset Statistics: If selected, it will reset the statistics that are being updated.

The statistics include:

- LAN GOOSE Received: This is the number of the GOOSE packets received from the selected Ethernet NIC.
- MQTT packets Sent: This represents the number of encapsulated GOOSE messages that are sent to the broker via MQTT. This number should track closely with the number displayed in LAN GOOSE Received.
- MQTT packets Received: This represents the number of MQTT packets received from the broker that contain an encapsulated GOOSE message.
- LAN GOOSE Sent: This represents the number of GOOSE messages published by the Bridge onto the selected Ethernet LAN. This number should closely track the value of MQTT packets Received.
- Errors: Number of MQTT packets received that contain error information.