

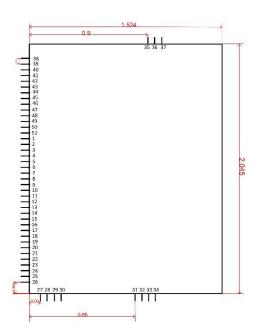
# Smart Cellular Module

#### 1.0 Device Overview:

The SCM-1 is a small form factor, low power cellular cloudbased module, it provides verity of analog and digital functionality. It has been designed with LTE Category-M1 and NB-IoT cellular technologies. LTE Category-M1and NB-IoT are low-power wide area (LPWA) cellular technologies, both are specifically designed for the Internet of Things (IoT) and machine-to-machine (M2M) communications.

### Features

- Supports LTE Cat. -M1 and NB-IoT technologies.
- Low Power
- Small form factor (1.524"X2.045")
- Better coverage than regular cellular networks.
- Has the priority over other cellular networks



## Applications:

- Measuring and controlling systems
- Industrial applications
- Smart lighting control
- Smart irrigation system
- Gas leak detection



#### 2.0 Pin Assignments:

This part shows pin assignments of the SCM-1. It has 37 pins with different functions which are shown in the figure and the table below.

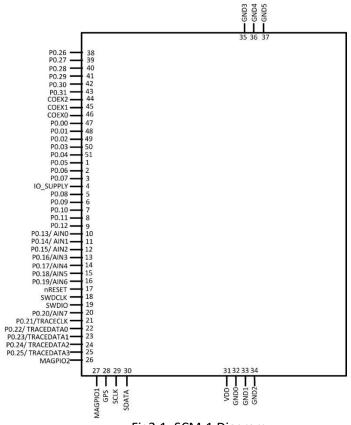


Fig2.1: SCM-1	Diagram
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#### Table1: Pin Assignments

#	Pin name	Function	Description
1	P0.05	Digital I/O (SoC)	General purpose I/O
2	P0.06	Digital I/O (SoC)	General purpose I/O
3	P0.07	Digital I/O (SoC)	General purpose I/O
4	IO_SUPPLY	Power	Reserved for Nordic use
5	P0.08	Digital I/O (SoC)	General purpose I/O
6	P0.09	Digital I/O (SoC)	General purpose I/O
7	P0.10	Digital I/O (SoC)	General purpose I/O
8	P0.11	Digital I/O (SoC)	General purpose I/O
9	P0.12	Digital I/O (SoC)	General purpose I/O
10	P0.13/ AIN0	Digital I/O (SoC)/ Analog	General purpose I/O/ Analog input
		input	
11	P0.14/ AIN1	Digital I/O (SoC)/ Analog	General purpose I/O/ Analog input
		input	

12		Digital 1/0 (SoC)/ Apolog	Conoral numero 1/0/ Analog input
12	P0.15/ AIN2	Digital I/O (SoC)/ Analog input	General purpose I/O/ Analog input
13	P0.16/AIN3	Digital I/O (SoC)/ Analog	General purpose I/O/ Analog input
13	F0.10/AIN5	input	
14	P0.17/AIN4	Digital I/O (SoC)/ Analog	General purpose I/O/ Analog input
±.	10.1771.111	input	
15	P0.18/AIN5	Digital I/O (SoC)/ Analog	General purpose I/O/ Analog input
		input	
16	P0.19/AIN6	Digital I/O (SoC)/ Analog	General purpose I/O/ Analog input
		input	
17	nRESET	Digital I/O (SoC)	System reset
18	SWDCLK	Digital input	Serial wire debug clock input for debug and
			programming
19	SWDIO	Digital I/O	Serial wire debug I/O for debug and
			programming
20	P0.20/AIN7	Digital I/O (SoC)/ Analog	General purpose I/O/ Analog input
		input	
21	P0.21/TRACECLK	Digital I/O (SoC)/ Trace	General purpose I/O/ Trace buffer clock
		clock	(optional).
22	P0.22/	Digital I/O (SoC)/ Trace	General purpose I/O/Trace buffer TRACEDATA
	TRACEDATA0	data	[0] (optional).
23	P0.23/TRACEDATA1	Digital I/O (SoC)/ Trace	General purpose I/O /Trace buffer TRACEDATA
24	P0.24/	data	[1] (optional)
24	TRACEDATA2	Digital I/O (SoC)/ Trace data	General purpose I/O/ Trace buffer TRACEDATA [2] (optional).
25	P0.25/	Digital I/O (SoC)/ Trace	General purpose I/O/ Trace buffer TRACEDATA
25	TRACEDATA3	data	[3] (optional).
26	MAGPIO2	Digital I/O (SoC)	Reserved for Nordic use
27	MAGPIO1	Digital I/O (SoC)	Reserved for Nordic use
28	GPS	RF	GPS receiver input
29	SCLK	Digital I/O (SoC)	Reserved for Nordic use
30	SDATA	Digital I/O (SoC)	Reserved for Nordic use
31	VDD	Power	Supply voltage
32	GND0	Power	Ground
33	GND1	Power	Ground
34	GND2	Power	Ground
35	GND3	Power	Ground
36	GND4	Power	Ground
37	GND5	Power	Ground
38	P0.26	Digital I/O (SoC)	General purpose I/O
39	P0.27	Digital I/O (SoC)	General purpose I/O
40	P0.28	Digital I/O (SoC)	General purpose I/O
41	P0.29	Digital I/O (SoC)	General purpose I/O
42	P0.30	Digital I/O (SoC)	General purpose I/O

43	P0.31	Digital I/O (SoC)	General purpose I/O
44	COEX2	Digital I/O (SoC)	Coexistence interface
45	COEX1	Digital I/O (SoC)	Coexistence interface
46	COEX0	Digital I/O (SoC)	Coexistence interface
47	P0.00	Digital I/O (SoC)	General purpose I/O
48	P0.01	Digital I/O (SoC)	General purpose I/O
49	P0.02	Digital I/O (SoC)	General purpose I/O
50	P0.03	Digital I/O (SoC)	General purpose I/O
51	P0.04	Digital I/O (SoC)	General purpose I/O

#### 3.0 Dimensions and Footprint:

Figure 2 shows the dimensions and footprint of the SCM-1.

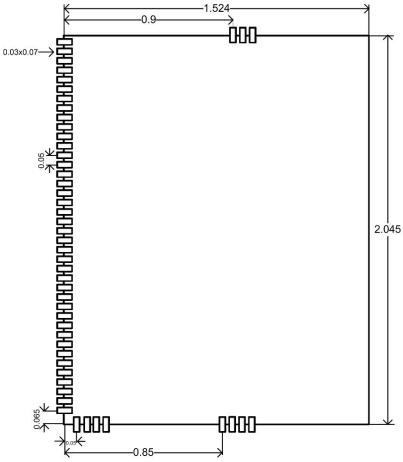


Fig3.1: SCM-1 Dimensions and footprint

### 4.0 Technical and Environmental Specifications:

Tables 4.1 and 4.2 show the environmental and technical specifications for the SCM-1.

#### 4.1Recommended Operation Conditions

Symbol	Parameter	Notes	Min.	Nom.	Max.	Units
VDD	Battery input voltage	<ul> <li>Including voltage drop, ripple and spikes.</li> <li>RF 3GPP compliancy requires 3.3 V.</li> </ul>	3.0	3.8	5.5	V
GPIOH	GPIO high level voltage				VDD_GPIO	V
MAGPIOH	MAGPIO high level voltage			1.8	1.8	V
ТА	Operating temperature		-40	25	85	°C

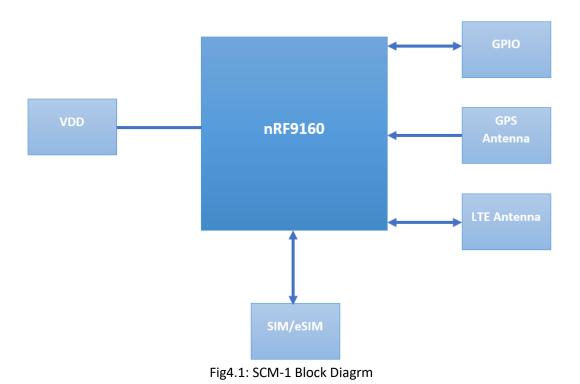
Table2: Recommended Operation Conditions

#### 4.2 Absolute Maximum Ratings

Table3: Absolute Ratings

	Min.	Max.	Unit
VDD	-0.3	5.5	V
Storage temperature	-40	125	°C
Moisture Sensitivity		2	
Level (MSL)			

#### 4.3 Block Diagram



#### 5.0 Software configuration:

This section is a detailed introduction to the software configuration including development tools and coding.

#### 5.1 Getting Started

Requirements:

- SCM-1
- nRF9160 DK
- Windows, macOS or Linux PC
- nanoSIM card supporting LTE-Cat.M1
- microUSB cable

Header Pin (SCM-1)	Function	DK Connection
1	3.3V	VTG
2	SWDIO	SWDIO
3	SWCLK	SWDCLK
4	P1.00	SWO
5	RESET	RESET
6	GND	GNDDET

#### 5.2 Development Tools

To get started with nRF DK and the SCM-1 install the **nRF connect for desktop**.

- 1- Go to Nordic Semiconductor Website. Click <u>here</u>
- 2- Click on Software and tools. Products News  $\vee$ About us  $\vee$ NORDIC Applicatio Software and tools Development kits Software + Bluetooth softwar Thread software + Zigbee software ANT software 802.15.4 software 4 Development tools + Reference designs + Modules and other 3rd-party +

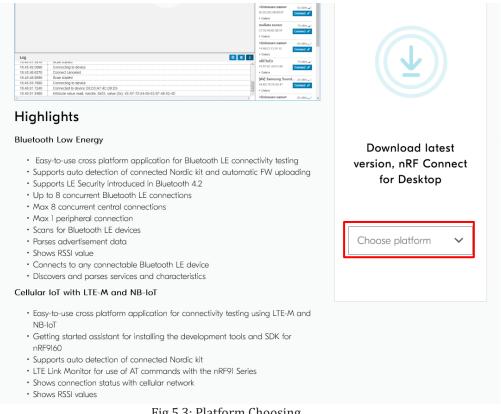
Fig5.1: Software and Tools

3- Click on Development Tools and choose **nRF Connect for Desktop**.

NORDIC	Software and tools		Featured development tools
	Development kits	+	nRF Sniffer for 802.15.4
	Software	+	SEGGER Embedded Studio
	Bluetooth software	+	nRF Connect for Desktop
	Thread software	+	nRF Connect for Mobile
conn	Zigbee software	+	nRF Connect for Cloud
	ANT software	+	IDEs and toolchains
	802.15.4 software	+	Test and evaluation software
	Development tools	-	Mobile apps
	Reference designs	+	Cloud development
MAN SA	Modules and other 3rd-party	+	
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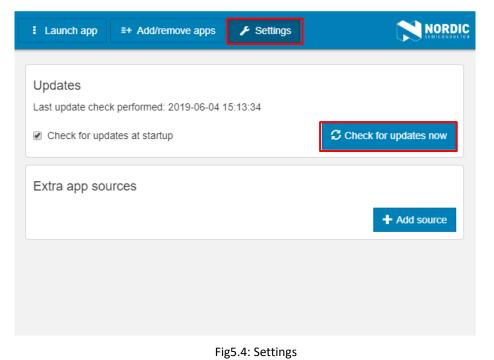
Fig5.2: nRF Connect for Desktop

4- Choose your platform, Download and Run the latest version of nRF Connect for Desktop.



#### Fig 5.3: Platform Choosing

5- After you download it on your desktop go to **Settings** and **check for updates**.



6- Go to Add/Remove Apps, Install Getting Started Assistant and Programmer.

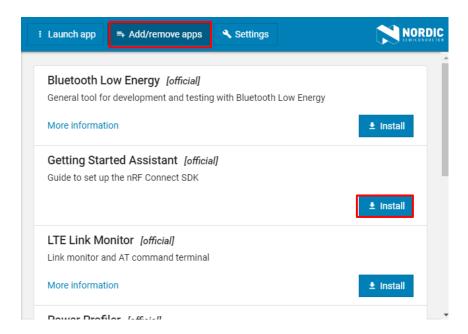


Fig 5.5: Getting Started Assistant

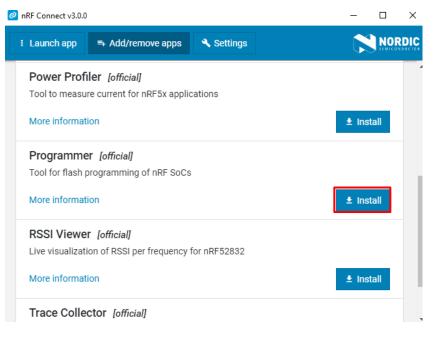


Fig 5.6: Programmer Install

7- Go to launch app, and launch Getting Started Assistant.

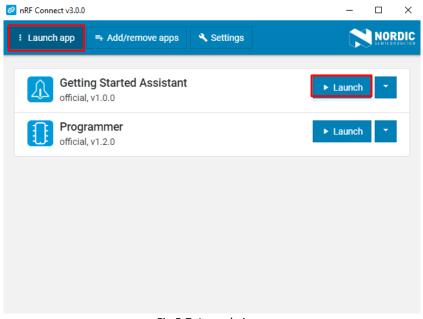
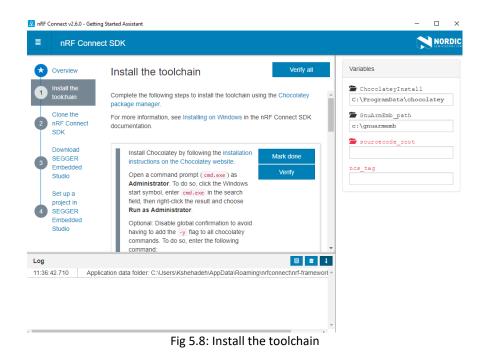


Fig 5.7: Launch Apps

8- Follow the steps from 1 to 4 to finish installation.



9- The first step starts with opening your **Command Prompt**, make a right click, and choose **Run as administrator**.

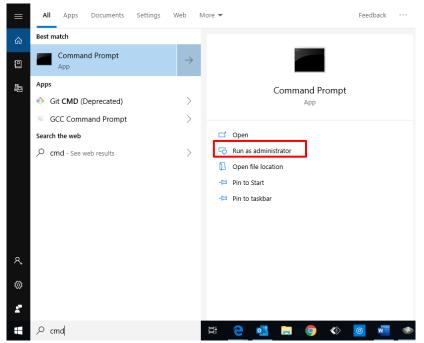


Fig 5.9: Command Prompt

10- Enter commands as described.

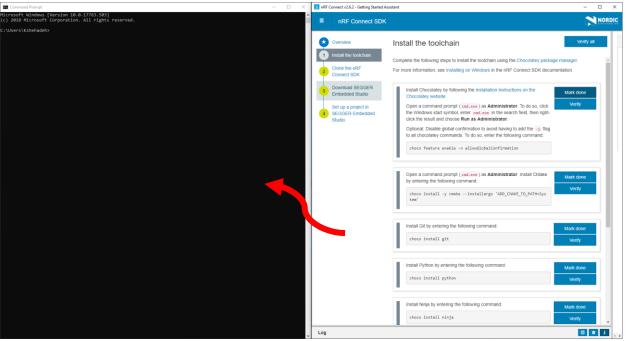


Fig 5.10: Installing Steps

Note: At the end of **Step 1** create a new folder **(c: \gnuarmemb)** and install GNU ARM Embedded toolchain into it as mentioned.

### 11- Verify all commands in step one and move to the next step.

≡	nRF Connect SDK	
	Overview	Clone the nRF Connect SDK
2	Clone the nRF Connect SDK	The nRF Connect SDK consists of four GitHub repositories. To set up the nRF Connect SDK, you must clone these repositories and install the required Python modules. If you intend to contribute directly to any of the repositories, you need to fork the repositories. For more information, see Forking the nRF Connect SDK repositories in the nRF Connect SDK documentation.
4	Embedded Studio Set up a project in SEGGER Embedded Studio	To manage the combination of repositories and versions, the nRF       Mark done         Connect SDK uses west.       Verify         Install it by entering the following command:       Verify         pip3 install west       Install west
		Initialize west and clone the nRF Connect SDK manifest repository mrf : Note: If you already cloned the nRF Connect SDK repositories and want to continue using these clones, skip this step and see Updating your existing clones to use west instead. cd <sourcecode_root> mkdir ncs cd ncs west init -m https://github.com/NordicPlayground/fw-nrfconn ect-nrf west update</sourcecode_root>
		Decide if you want to work with a tagged release of the nRF Connect SDK or with the latest state of development. Note: The latest state is not necessarily tested. For a higher degree of

Fig 5.11: Verify Commands

12- In **step 3** be sure to download the Segger Embedded Studio using the link attached in step 3.

🚨 nRF C	onnect v3.0.0 - Getting Started Assistant	
=	nRF Connect SDK	
¢	Overview	Download SEGGER Embedded Studio
1	Install the toolchain	The recommended way of building and programming an nRF Connect SDK sample is to use the Nordic Edition of the SEGGER
2	Clone the nRF Connect SDK	Embedded Studio (SES) IDE. SEGGER Embedded Studio is free of charge for use with Nordic Semiconductor devices.
3	Download SEGGER Embedded Studio	
4	Set up a project in SEGGER Embedded Studio	Download SEGGER Embedded Studio from the following links:     Mark not done       • Windows X86     • Windows X64
		Extract SEGGER Embedded Studio to your preferred folder. Mark not done

- Fig 5.12: Segger Embedded Studio in Step 3
- 13- After downloading and extracting Segger Embedded Studio files (Step 3) go to **bin**, make a shortcut of **Segger Embedded Studio** and move it to your desktop.

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word 🖈	📧 emSim.exe		7.	/10/2019 12:	54 PM	Applicatio	n		8,954						
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14- Open the Segger Studio and complete the next two steps as described.

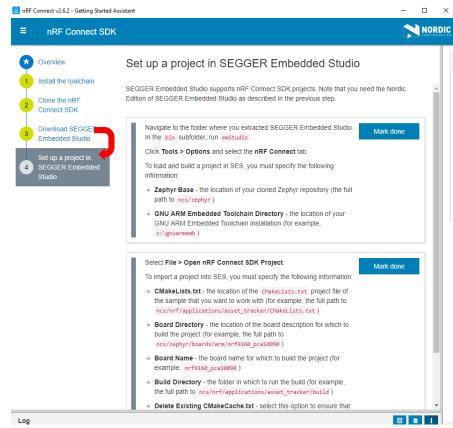


Fig 5.14: Installation Steps

15- Open SEGGER Embedded Studio which was installed in step 3.

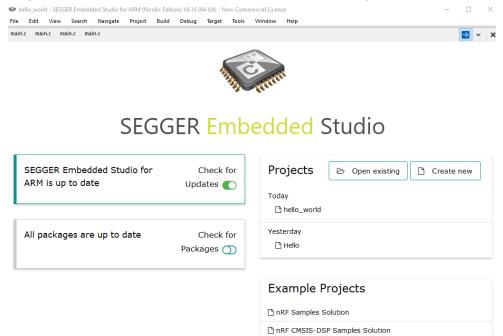


Fig 5.15:Segger Embedded Studio

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16- As mentioned in **Step 4** click **Tools > Options** and select the **nRF Connect** tab.

Fig 5.16: Project Setup

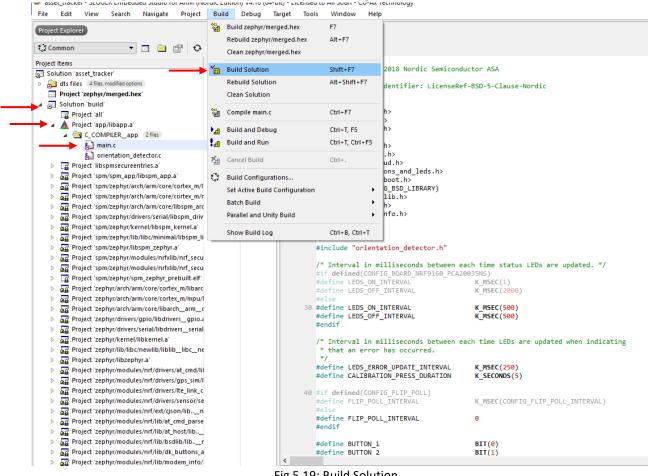
#### 17- Go to File > Open nRF connect SDK project.

File	Edit View Search N	avigate Project Bu	uild Debug Target Tools	Window Help		
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					Projects	

Fig 5.17:Open nRF Project

18- Set CMakeLists.txt, Board Directory, Board Name and Build Directory. Notice that you will be able to run this program only before erasing your nRF9160 or reprogram it.

SEGGER Embedded Studio		×
nRF Connect Options		
CMakeLists.txt		
C:/ncs/nrf/applications/asset_tracker/CMakeLists.txt		
Board Directory		
C:/ncs/zephyr/boards/arm/nrf9160_pca10090		
Board Name		
nrf9160_pca10090ns	<u> </u>	
Build Directory		
C:/ncs/nrf/applications/asset_tracker/build_nrf9160_pca1	0090ns	
Clean Build Directory		
	OK Canc	el
Fig 5.18:	Connect Options	



19- Plug the nRF9160 DK to your computer and go to Build > Build Solution

Fig 5.19: Build Solution

The sample will be compiled when you click Build Solution, but the nRF9160 board will not be programmed yet.

20- Before start programming you need to update **Modem Firmware**. Go back to <u>Nordic</u> <u>semiconductor</u> website > Software and tools >Development kits>nRF9160 DK.

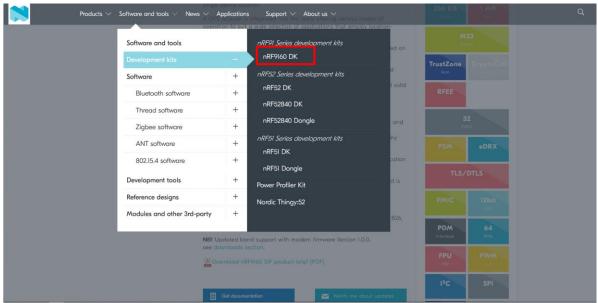


Fig 5.20: Modem Update

#### 21- Download the latest version of the Modem Firmware.

Feature Brief	LTE Modern images are Features:	precompiled binaries, signed and	encrypted by Nordic Semicon	ductor.				
for nRF9160 LTE-M/NB- IoT/GPS Modem firmware	Precompiled binary, signed and encrypted     Update modern PV via PC tool nFC Connect for Desktop     Society bool with image auto-uniteristation							
$\longrightarrow$								
	LTE Rel-I3 Cot-MI (I							
	LTE Rel-13 Cot-NB1     Tange R helf durates		00)					
	<ul> <li>Type B helf dupler (HD), frequency dvision dupler (PDD)</li> <li>Cot+Mi operation is enabled on E-UTRA Bonds 1, 2, 3, 4, 5, 18, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28 and 66.</li> <li>Cot+NB operation is enabled on E-UTRA Bonds 1, 2, 3, 4, 5, 8, 12, 13, 14, 17, 18, 20, 25, 26, 28 and 66.</li> </ul>							
	<ul> <li>Power saving</li> </ul>							
	Power Sove Mod							
	<ul> <li>Idle-DRX and Ca</li> </ul>							
	<ul> <li>Independent clo</li> </ul>	ck and sleep state control						
	<ul> <li>Interface to Applica</li> </ul>	tion CPU						
	<ul> <li>AT-command Intelligence</li> </ul>	erface for control						
	<ul> <li>Socket Interface</li> </ul>	for Data						
	<ul> <li>Modern producti</li> </ul>							
		er bond Configurability with limite						
		DTLS(1.2) and TCP/UDP/IPV4/IPV	6 Dual Stack					
	-	nd Cloud credentials						
	SMS PDU Mode							
		ipport enables small upgrade ima < and remote provisioning via Bea	-					
	<ul> <li>eSIM support</li> </ul>	c and remote provisioning via bea	rei independeni Prolocoi					
		r during LTE PSM mode						
		interval and continuous tracking	modes					
	Note: it is not possible	to downgrade to previous modern	firmware releases after apply	ing this upgrade.				
	This release is aligned	with v1.0 of nRF91 AT command a	eference guide.					
	Selected version	n	-					
nRF9160 LTE-	1.0.0			Download file				
M/NB-IoT/GPS	mfw_nrf9160_1.0.0	lzio						
Modem	mm_n1900_000			Older version				
Firmware								
and Modem DFU Tool								

Fig 5.21: Modem Firmware Download

22- Go back to the nRF Connect, click launch other App to launch Programmer.

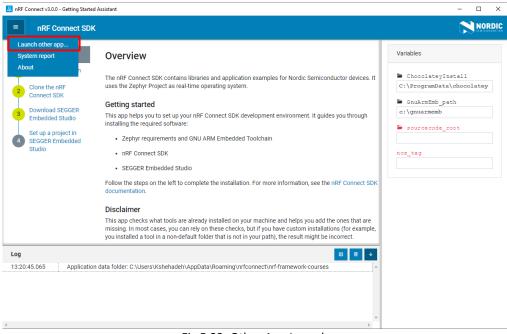
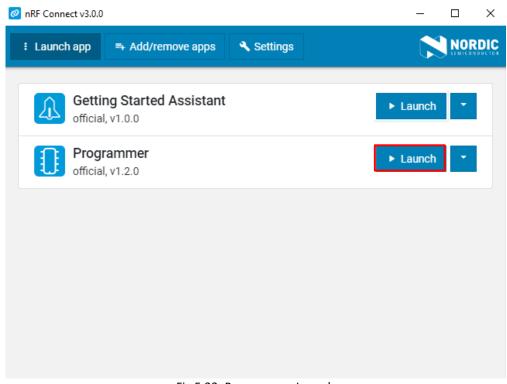
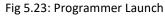


Fig 5.22: Other App Launch

#### 23- Launch Programmer.





24- Select your device and update modem firmware when its ready (The nRF9160 has to be connected to your computer).

nRF Connect v3.0.0 - Programmer		- 0
■ No devices available ▼ ●		
		File
	Device Memory Layout	
		add HEX file 🕶
		C Reload files
		<ul> <li>Clear files</li> </ul>
		Device
		Erase all
		✓ Erase & write
		💾 Save as file
		Reset
	Connect a device to display memory contents Drag & Drap & Drap & Drap a Drap a Drap a Drap one or more HEX files here	
		✓ Write
		C Read
		Auto read memory
		Cellular Modem
9 i:13:24.983 Application data f	older: C.:Ubers/V.Shehadeh/UppData/Roaming/urfconnect/programmer	Update modem
		File
Select	a modern firmware sip file X	
	⇒ ⇒ ↑ ↓ → This PC → Devenloads v   Ø   Search Downloads P	🖿 Add HEX file 🔻
	mitet ▼ Newfolder	C Reload files
	Dropbox Dr. files,AE,Apprentice,02,Animation,U 11/28/2018.336 PM File folder	<ul> <li>Clear files</li> </ul>
	L3877001         1/22/2019 34.04         Fielder           Theoremy Interventions         1/22/2019 700 1A.04         File folder           The ACC 2017 Modewide KE staf (17.3p)         1/22/2019 700 1A.04         File folder	
	D Objects AECC2017_MotionGFX_EstTaip 11/30/2018.319 PM Compresed (20pm. 612,617 KB	Device
	Destop         Inteldedestbade, AM, Moleck, vill, yww bV/01915 L291 M.         Compressed (opp	Erase all
	Downlads         ImmonPH900023biphs (1):app         6/3/2/019 18/31 AM         Compressed (pip_m)         2,055 33           Motic         ImmonPH900023biphs2bipha2ip         6/7/2019 3324 PM         Compressed (pip_m)         2,055 33	<ul> <li>Erase &amp; write</li> </ul>
	Pictures         It tablepress.13.1.2 pp         12/3/2018 13:22 PM         Compressed Lipp	Save as file
	Local Disk (C)	
	μ ARK (β) BRK (F) ✓ HEX files here	Reset
	File name Open Cancel	✓ Write
	Upen Cancel	C Read
		Auto read memory
		Cellular Modem
og		<ul> <li>Update modem</li> </ul>
8:29:26.566 Model: Unknown	ou. model	*
8:29:26.566 RAM: 256KiB. 8:29:26.566 Flash: 1024KiB in	i pages of 4KiB.	
18:29:27.360 Device type is un 18:29:27.360 Please check dev	known. It may be a new version of product from Nordic Semiconductor. vice list supported by nrfprog.	
08:29:28.440 Reading device n	on-volatile memory. This may take a few seconds.	*

Fig 5.24: Modem firmware Update

25- Open the modem firmware zip file and click write.

ganize 🔻 New folder				Ƴ Ö Se	earch Downloads		
Janize + New Iolder						•	
Visio ^ r	Name	Date modified	Туре	Size			
Dropbox	Ex_Files_AE_Apprentice_02_Animation_U	11/28/2018 3:36 PM	File folder				
	L33977-001	1/22/2019 7:43 AM	File folder				
OneDrive	Recovery Instructions	1/22/2019 7:03 AM	File folder				
This PC	AECC2017_MotionGFX_EssT (1).zip	12/6/2018 2:18 PM	Compressed (zipp	612,617 KB			
3D Objects	AECC2017_MotionGFX_EssT.zip	11/30/2018 3:19 PM	Compressed (zipp	612,617 KB			
Desktop	EmbeddedStudio_ARM_Nordic_v416_win	6/6/2019 12:39 PM	Compressed (zipp	206,908 KB			
	EmbeddedStudio_ARM_Nordic_v418_win	7/3/2019 1:52 PM	Compressed (zipp	230,401 KB			
Documents	🔢 mfwnrf9160100.zip	7/3/2019 1:48 PM	Compressed (zipp	2,861 KB			
Downloads	📱 mfwnrf916007029alpha (1).zip	6/24/2019 10:37 AM	Compressed (zipp	2,865 KB			
Music	🔢 mfwnrf916007029alpha.zip	6/7/2019 3:24 PM	Compressed (zipp	2,865 KB			
Pictures	🔢 tablepress.1.9.1.zip	12/3/2018 12:32 PM	Compressed (zipp	311 KB			
Videos	hingy91_pilot_v0.2.0.zip	7/8/2019 9:41 AM	Compressed (zipp	18,089 KB			
Local Disk (C:)							
Network							
File name	e			~ N	Modem firmware	zip file (*.zi	p
				[	Open	Cance	el

Note: To activate your eSIM attached with the nRF9061 Dev kit follow the direction <u>here</u> (nordicsemi.com/ GetStarted)

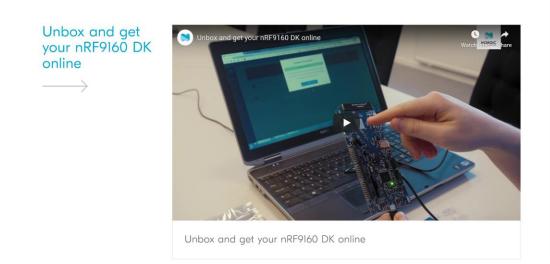


Fig 5.26: Getting Started Video

#### 26- After updating the firmware go back to Segger Studio, select Target > Connect J-Link

asset\_tracker - SEGGER Embedded Studio for ARM (Nordic Edition) V4.18 (64-bit) - Licensed to Ali Soufi - Co-Ax Technology

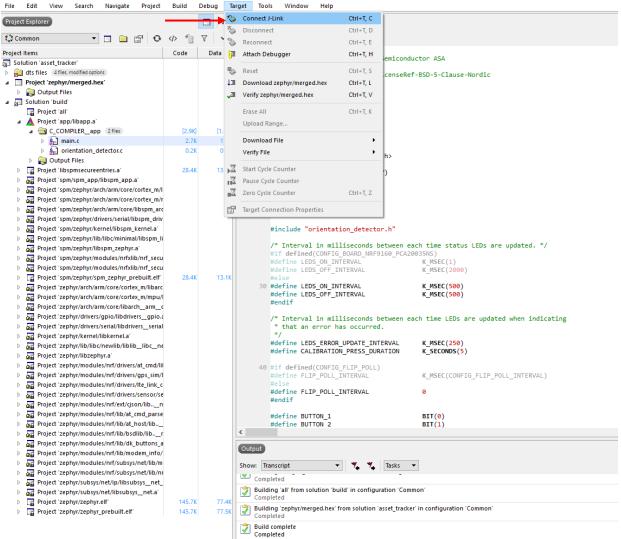
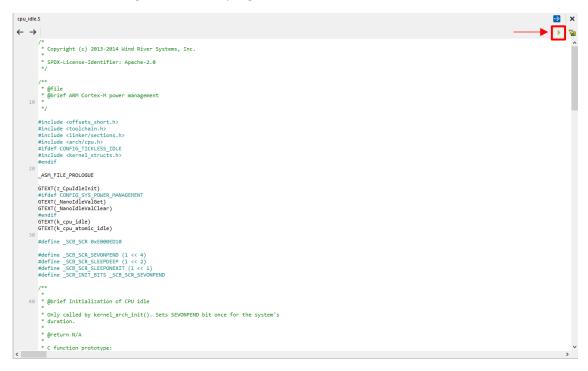


Fig 5.27: Connect J-Link



27- Click on the green arrow to program the board



28- After the board programs press it again to run the program.

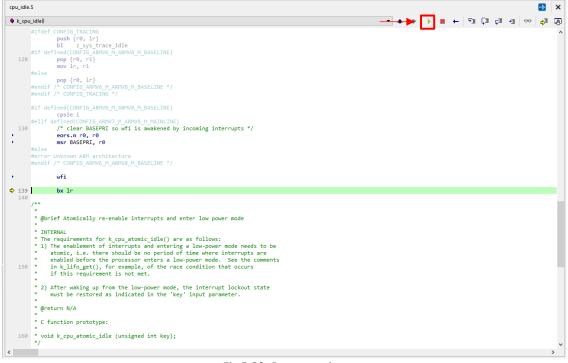


Fig 5.29: Programming

- 29- To connect your nRF9160 to the the nRF Connect for Cloud follow the directions here.
- 30- To monitor your program, you need to have a console application. We are using **Tera Term**. in case you don't have a console application you can download Tera Term by clicking <u>here</u>.

#### 31- Go to Tera Term



#### Fig 5.30: Tera Term

VT	COM1	1 - Tera	Term VT				_	$\times$
File	Edit	Setup	Control	Window	Help			
		Т	erminal					^
		v	Vindow					
		F	ont					
		К	eyboard					
		S	erial port					
		P	roxy					
		S	SH					
		S	SH Authen	tication				
		S	SH Forward	ding				
		S	SH KeyGer	nerator				
		Т	CP/IP					
		G	ieneral					
		А	dditional s	settings				~
		S	ave setup					
		R	lestore setu	ıp				
		S	etup direct	tory				
		L	oad key m	ар				

32- Go to **Setup**>>**Serial Port** and set your serial port settings, to figure the correct port between the 3 serial ports, try all of them and message will appear when it's right port.

1	OM1 Edit	1 - Tera Setup	Tera	Term: Serial port setup	•			×	] _	×
				Port:	COM11	$\sim$	ОК	1		^
				Speed:	115200	~				
				Data:	8 bit	~	Cancel			
				Parity:	none	~		_		
				Stop bits:	1 bit	~	Help			
				Flow control:	none	~				
				Transmit delay 0 msec/		m:	sec/line			~

Fig 5.31: Serial Port Setup

To program SCM-1 you need to connect SCM-1 to the nRF9160. Connect the **p1** header on the cellular module to the NORDIC Nrf9160 development kit **p15** header. When power is applied to the module you will be able to program and debug, as if it were the onboard chip.



Fig5.32: SCM-1

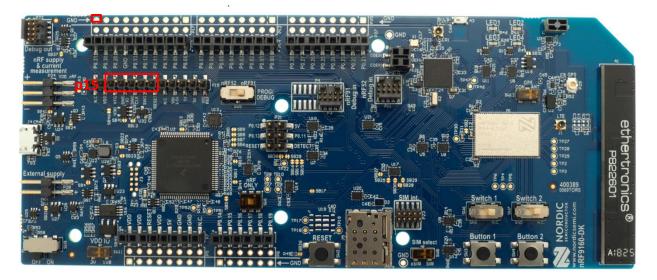


Fig5.33: nRF9160 DK

#### 5.3 Programming

#### Examples and tutorials:

The following code is a simple sample (GPIO configuration). It toggles two LEDs and one other pin within a delay of 1 sec.

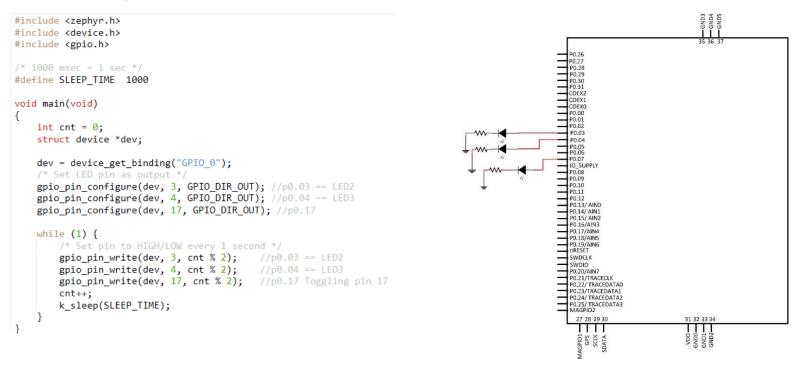


Fig 5.34: Simple sample with the SCM-1 wiring diagram

nRF connect DK provides samples that shows the use of different features.

#### General Zephyr Samples

Organize 🔻 New fol	der					
word	^	Date modified	Туре	Size	0	
word	boards	6/6/2019 12:26 PM	File folder	SIZE		
o Creative Cloud Fil	cmake	6/6/2019 12:31 PM	File folder			
😻 Dropbox	doc	6/6/2019 12:31 PM	File folder			
	drivers	6/6/2019 12:26 PM	File folder			
lene OneDrive	dts	6/6/2019 12:31 PM	File folder			
This PC	ext	6/6/2019 12:31 PM	File folder			
3D Objects	include	6/6/2019 12:32 PM	File folder			
· ·	kernel	6/6/2019 12:32 PM	File folder			
Desktop	lib	6/6/2019 12:27 PM	File folder			
Documents	misc	6/6/2019 12:27 PM	File folder			
🚽 Downloads	→ samples	6/6/2019 12:27 PM	File folder			
👌 Music	scripts	6/6/2019 12:55 PM	File folder			
Pictures	soc	6/6/2019 12:32 PM	File folder			
🐺 Videos	subsys	6/6/2019 12:27 PM	File folder			
Local Disk (C:)	tests	6/6/2019 12:27 PM	File folder			
×	CMakeLists	6/6/2019 12:31 PM	Text Document	55 KB		
	name: CMakeLists	0/0/2013 12:31 PW	Text Document		keLists.txt	

Fig 5.35: General Samples

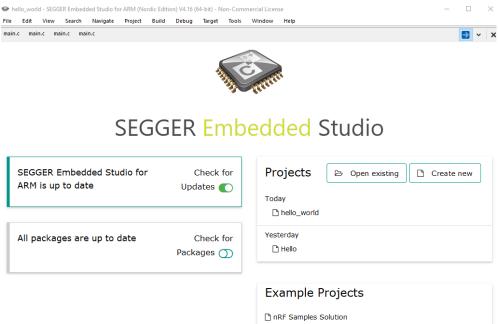
#### nRF Specific Samples Locate CMakeLists.txt $\times$ ← → ~ ↑ → This PC → Local Disk (C:) → ncs → nrf ✓ ひ Search nrf م Organize 🔻 New folder == **-**? word ~ Name Date modified Туре Size applications 6/6/2019 12:31 PM File folder o Creative Cloud Fil boards 6/6/2019 12:24 PM File folder 😻 Dropbox cmake 6/6/2019 12:31 PM File folder 6/6/2019 12:31 PM doc File folder lene One Drive drivers 6/6/2019 12:31 PM File folder 💻 This PC ext 6/6/2019 12:24 PM File folder 🧊 3D Objects include 6/6/2019 12:31 PM File folder 📃 Desktop lib 6/6/2019 12:24 PM File folder samples 6/10/2019 1:47 PM File folder Docume scripts 6/6/2019 12:31 PM File folder 🕹 Downloads subsys 6/6/2019 12:31 PM File folder 👌 Music tests 6/6/2019 12:24 PM File folder Pictures 6/6/2019 12:24 PM File folder zephyr 📕 Videos CMakeLists 6/6/2019 12:24 PM Text Document 1 KB Local Disk (C:) File name: CMakeLists CMakeLists.txt $\sim$ Open Cancel

Fig 5.36: Specific Samples

#### MQTT Simple Sample:

The MQTT simple sample is one of the Nordic specific examples. To open and test this sample using Segger Studio follow the directions.

1- Open SEGGER Embedded Studio.



#### Fig 5.37 Segger Embedded Studio Dashboard

nRF CMSIS-DSP Samples Solution

#### 2- Go to File > Open nRF connect SDK project.

File	Edit View Search Na	wigate Project Bu	uild Debug Target Tools	Window Help			
	New					🔁 💉	•
	New Blank File	Ctrl+K, Ctrl+N		_			
2	Open	Ctrl+O	14	32			
	Open File From Solution	Alt+Shift+O					
	Open Studio Folder	•		softer.			
×	Close	Ctrl+F4		Mar			
1	New Project	Ctrl+Shift+N					
Ĵ	Open Solution	Ctrl+Shift+O					
Ŧ	Open nRF Connect SDK Project		GER Emb	addad '	Studio		
	Import Project	• •		euueu .	Studio		
Ľ۵	Close Solution						
	-						
	Save	Ctrl+S					
	Save Save As	Ctrl+S Ctrl+K, A	Check for	Projects	Doen existing	Create new	ן
	Save As Save Copy Of As	Ctrl+K, A Ctrl+K, Y		Projects	🕞 Open existing	Create new	]
	Save As Save Copy Of As Save And Close	Ctrl+K, A Ctrl+K, Y Ctrl+K, D	Check for Updates 🌔		🕞 Open existing	Create new	
	Save As Save Copy Of As	Ctrl+K, A Ctrl+K, Y		Today	> Open existing	Create new	]
	Save As Save Copy Of As Save And Close	Ctrl+K, A Ctrl+K, Y Ctrl+K, D			Den existing	Create new	]
	Save As Save Copy Of As Save And Close Save All	Ctrl+K, A Ctrl+K, Y Ctrl+K, D Ctrl+Shift+S		Today Today	🕞 Open existing	Create new	]
<b>1</b>	Save As Save Copy Of As Save And Close Save All Source Control	Ctrl+K, A Ctrl+K, Y Ctrl+K, D Ctrl+Shift+S		Today	🕞 Open existing	Create new	]
	Save As Save Copy Of As Save And Close Save All Source Control Page Setup	Ctrl+K, A Ctrl+K, Y Ctrl+K, D Ctrl+Shift+S Ctrl+K, Shift+P	Updates <b>(</b>	Today Today	Den existing	Create new	
	Save As Save Copy Of As Save And Close Save All Source Control Page Setup Print Preview	Ctrl+K, A Ctrl+K, Y Ctrl+K, D Ctrl+Shift+S Ctrl+K, Shift+P Ctrl+K, Shift+P	Updates C	Today C hello_world Yesterday	Den existing	Create new	
	Save As Save Copy Of As Save And Close Save All Source Control Page Setup Print Preview Print	Ctrl+K, A Ctrl+K, Y Ctrl+K, D Ctrl+Snift+S Ctrl+K, Shift+P Ctrl+K, Ctrl+P Ctrl+K, Ctrl+P	Updates C	Today C hello_world Yesterday	Den existing	Create new	

3- Set CMakeLists.txt, Board Directory, Board Name and Build Directory.

SEGGER Embedded Studio		
nRF Connect Options		
CMakeLists.txt		
C:/ncs/nrf/samples/nrf9160/mqtt_simple/CMakeLists.txt		
Board Directory		
C:/ncs/zephyr/boards/arm/nrf9160_pca10090		
Board Name		
nrf9160_pca10090ns	•	
Build Directory		

Clean Build Directory

OK Cancel

#### Fig 5.39: nRF Connect Options

mqtt\_simple - SEGGER Embedded Studio for ARM (Nordic Edition) V4.18 (64-bit) - Licensed to Ali Soufi - Co-Ax Technology
File Edit View Search Navigate Project Build Debug Target Tools Window Help

🕻 Common 👻 🗔	🗀 🗊	0 >	$\leftarrow \rightarrow$
roject Items	Code	Data	/*
Solution 'mqtt_simple'	couc	Dutu	* Copyright (c) 2018 Nordic Semiconductor ASA
dts files 4 files, modified options			* * SPDX-License-Identifier: LicenseRef-BSD-5-Clause-Nordic
Project 'zephyr/merged.hex'			*/
Solution 'build'			
Project 'all'			<pre>#include <zephyr.h></zephyr.h></pre>
Project 'app/libapp.a'			<pre>#include <stdio.h> #include <uart.h></uart.h></stdio.h></pre>
C_COMPILER_app 1	[1.0K]	[1.4K]	<pre>#include <uart.n> 10 #include <string.h></string.h></uart.n></pre>
Main.c	1.0K	-0.0K	to wincide (set ingits)
Dutput Files			<pre>#include <net mqtt.h=""></net></pre>
Project 'libspmsecureentrie	28.4K	13.1K	<pre>#include <net socket.h=""></net></pre>
Project 'spm/spm_app/libs			<pre>#include <lte_lc.h></lte_lc.h></pre>
Project 'spm/zephyr/arch/a			/* Buffers for MQTT client. */
Project 'spm/zephyr/arch/a			<pre>static u8_t rx_buffer[CONFIG_MQTT_MESSAGE_BUFFER_SIZE];</pre>
Project 'spm/zephyr/arch/a			<pre>static u8_t tx_buffer[CONFIG_MQTT_MESSAGE_BUFFER_SIZE];</pre>
Project 'spm/zephyr/driver:			<pre>static u8_t payload_buf[CONFIG_MQTT_PAYLOAD_BUFFER_SIZE];</pre>
Project 'spm/zephyr/kernel			<pre>20 /* The mgtt client struct */</pre>
Project 'spm/zephyr/lib/lib			static struct mqtt client client;
Project 'spm/zephyr/libspm			······,
Project 'spm/zephyr/modu'			/* MQTT Broker details. */
Project 'spm/zephyr/modu'			<pre>static struct sockaddr_storage broker;</pre>
Project 'spm/zephyr/spm_z	28.4K	13.1K	/* Connected flag */
Project 'zephyr/arch/arm/ce			static bool connected;
Project 'zephyr/arch/arm/ce			
Project 'zephyr/arch/arm/ce			30 /* File descriptor */
Project 'zephyr/drivers/gpi			31 static struct pollfd fds;
Project 'zephyr/drivers/seri			<pre>#if defined(CONFIG_BSD_LIBRARY)</pre>
Project 'zephyr/kernel/libk			
Project 'zephyr/lib/libc/mir			/**@brief Recoverable BSD library error. */
Project 'zephyr/libzephyr.a			<pre>void bsd_recoverable_error_handler(uint32_t err)</pre>
Project 'zephyr/modules/n			{
Project 'zephyr/modules/n			<pre>printk("bsdlib recoverable error: %u\n", err); }</pre>
Project 'zephyr/modules/n			40
Project 'zephyr/modules/n			/**@brief Irrecoverable BSD library error. */
Project 'zephyr/subsys/net,			<pre>void bsd_irrecoverable_error_handler(uint32_t err)</pre>
Project 'zephyr/subsys/net,			{
Project 'zephyr/subsys/net,			<pre>printk("bsdlib irrecoverable error: %u\n", err);</pre>
Project 'zephyr/zephyr.elf'	87.3K	40.2K	_ASSERT_NO_MSG(false);
Project 'zephyr/zephyr_pre	87.3K	40.3K	
			٢

4- To set the broker, broker port, client id, subscribe topic and publish topic go to **Project**>>**Configure nRF Connect SDK Project** 

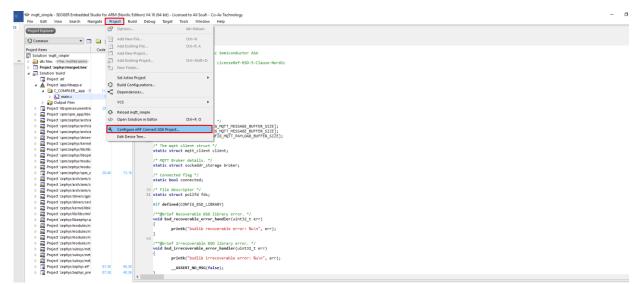


Fig 5.41: Configure nRF Connect SDK Project

SEGGER Embedded Studio		×
Configure nRF Connect SDK Project		Filter
Select the target to configure:		
menuconfig		
spm_menuconfig		
☑ Show Names □ Show Symbols □ Show All	Load Save As	Configure Cancel
Fig F 42, manuagufic		

#### 5- Choose menuconfig

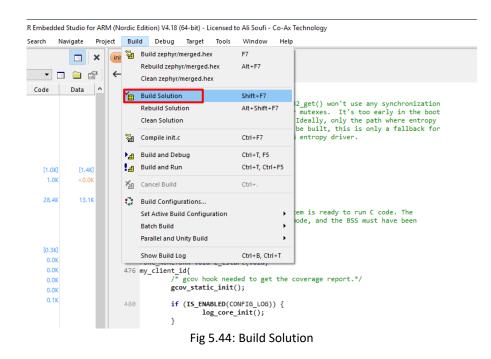
Fig 5.42: menuconfig

6- Change the broker hostname to the broker you need to connect. For testing issues, you can choose any public broker as mosquitto, eclipse or Hivemq, then choose **configure**.

SEGGER Embedded Studio				×
Configure nRF Connect SDK Project			Filter	
<ul> <li>MQTT simple sample</li> <li>MQTT publish topic <mqtt_pub_topic> my/publish/topic</mqtt_pub_topic></li> <li>MQTT subscribe topic <mqtt_sub_topic> my/subscribe/topic</mqtt_sub_topic></li> <li>MQTT Client ID <mqtt_client_id> my-client-id</mqtt_client_id></li> <li>MQTT broker hostname <mqtt_broker_hostname> mqtt.eclipse.org</mqtt_broker_hostname></li> <li>MQTT broker port <mqtt_broker_port> 1883</mqtt_broker_port></li> <li>MQTT message buffer size <mqtt_message_buffer_size> 128</mqtt_message_buffer_size></li> <li>MQTT payload buffer size <mqtt_payload_buffer_size> 128</mqtt_payload_buffer_size></li> <li>Zephyr Kernel</li> </ul>				
☑ Show Names □ Show Symbols □ Show All	Load	Save As	Configure	Cancel

Fig 5.43: menuconfig

7- Plug the nRF9160 DK to your computer and go to **Build > Build Solution**.



8- Go to **Target** > **Connect J-Link**, when its connected go back to **Target** and choose **Erase All** (Be sure to erase the board every time you change your code).

Build	Debug	Targ	get Too	ls Window	Help			
		*⊘	Connect	J-Link		Ctrl+T, C		
		X	Disconne	ect		Ctrl+T, D		
>		n P	Reconne	ct		Ctrl+T, E		
		()]	Attach D	ebugger		Ctrl+T, H		
		ţ,	Reset			Ctrl+T, S		
		↓∃	Downloa	d zephyr/zephyr	.elf	Ctrl+T, L		
		√≣	Verify zep	phyr/zephyr.elf		Ctrl+T, V		
			Erase All			Ctrl+T, K		
			Downloa	id File		•		
arm_co	recortex_		Verify Fil	e		•		
3 files 4 files		Z	Start Cyc	le Counter				
+ 11163		3	Pause Cy	cle Counter				
	m_core_c(	X	Zero Cycl	e Counter		Ctrl+T, Z		
.a'		P	Target Co	onnection Proper	ties			

9- Click on the green arrow to program.

mqtt_simple - SEGGE	R Embed	ded Stud	io for A	RM (No	ordic Edi	tion) V4.1	8 (64-bit) - I	Licensed t	to Ali Soufi	- Co-Ax	Technolog	U									-		×
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Fig 5.46: Start Programming

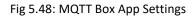
- 10- Run the program and use Tera Term for testing and monitoring.
- 11- In order to test publishing and subscribing with other client you can use any MQTT App, in this example we used **MQTT Box**.

This product is installe	ed.	Launch ····
	WQTTBox workswithweb • Developer tools > Utilities	Free Get
	Developers helper program to create, develop and test MQTT connectivity protocol. MQTTBox enables you to create MQTT clients to publish or subscribe to More	Add to cart  Wish list + Offers in-app purchases
	ESRE Digital Purchases	

## Fig 5.47: MQTT Box App

12- Pick a client name, change the protocol to mqtt/tcp and change the host broker to the broker you are using, then go to **save**.

MQTTBox Edit Help			- G >
MQTT Client Name Test3	MQTT Client Id 2806d780-0520-489b-a977-221337f0fa19	Append timestamp to MQTT client id?	Broker is MQTT v3.1.1 compliant? ⊛ Yes
Protocol mqtt / tcp	Host mqtt.ecilpse.org	Clean Session? ⊛ Yes	Auto connect on app launch?
Username Username	Password Password	Reschedule Pings?	Queue outgoing QoS zero messages?
Reconnect Period (milliseconds)			
1000	Connect Timeout (milliseconds) 30000	KeepAlive (seconds) 10	
			Will - Payload



13- Use your subscribe and publish topics to test publishing and subscribing.

Topic to publish	X Topic to subscribe	
my/subscribe/topic	my/publish/topic	
QoS	QoS	
0 - Almost Once	O - Almost Once	
Retain 🗆	Subscribe	
Payload Type		
Strings / JSON / XML / Characters	T	
e.g: {'hello':'world'}		
Payload		
Publish		

Fig 5.49: MQTT Client Settings

Be sure to use your publishing topic to publish your message on the other side(client) and your subscribing topic to receive a message from the other side(client). Figures 5.47 and 5.48 show the messages that both clients get in case of publishing or subscribing.

To Publish a message in this example you need to modify the example code by adding a publish function. We used this function to publish our test message

```
data_publish(&client, MQTT_QOS_1_AT_LEAST_ONCE, "test", strlen("test"));
```

```
void mqtt_evt_handler(struct mqtt_client *const c,
                      const struct mqtt_evt *evt)
{
        int err;
        switch (evt->type) {
        case MQTT_EVT_CONNACK:
                if (evt->result != 0) {
                        printk("MQTT connect failed %d\n", evt->result);
                        break;
                }
                connected = true;
                printk("[%s:%d] MQTT client connected!\n", __func__, __LINE__);
                subscribe();
{
                data_publish(&client, MQTT_QOS_1_AT_LEAST_ONCE, "test", strlen("test"));
        }
                break;
```

If you don't edit the code it will connect, and you will be able to receive messages but without publishing.

	🗙 my/publish/topic
my/subscribe/topic	
oS	test
0 - Almost Once	qos: 0, retain : false, cmd : publish, dup : false, topic : n
etain 🗐	ublish/topic, messageld : , length : 22, Raw payload : 11 1115116
ayload Type	
Strings / JSON / XML / Characters	
g: {'hello':'world'}	
ayload	
Test1	
	×
Publish	
ēst1	
opic:my/subscribe/topic, qos:0, retain:false	



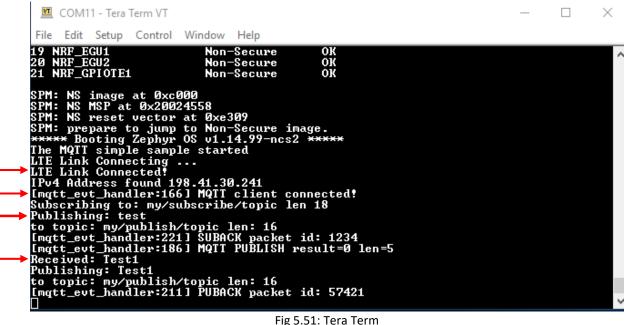


Fig 5.51: Tera Term

## AWS MQTT/TLS Sample:

The AWS MQTT/TLS sample connects an AWS MQTT broker securely. The code of this sample is attached with this document at the end of this section.

To connect your nRF9160 to an AWS broker you need to have an AWS account. If you don't have an AWS account already go to <u>AWS IoT Console</u> and create one, then follow the direction below to setup the account.

1- After creating an AWS account, the first thing you need to do is creating a policy, so select **Secure>>Policies>> Create a Policy.** 

aws Services -	Resource Groups 🗸 🐧 CTi Smart Systems 👻 Ohio 👻 Support	•
🕀 AWS IoT		Q ?
Monitor		$\bigcirc$
Onboard		
Manage		
Greengrass		
► Secure		
Certificates		
Policies		
CAs		
Role Aliases	You don't have any policies yet	
Authorizers	AWS IoT policies give things permission to access AWS IoT resources (like other things, MQTT topics, or thing shadows).	
Defend	אייש זטר אסוגנים קוויפ מוווקא אפרווואזטור גם מכבא אייש דטר רבאסורכיא נעגיב טערבו מוווקא, איקדר נעארא, טר מוווק אופטטיאא.	
Act	Learn more Create a policy	
Test		

Fig 5.52: Creating a policy

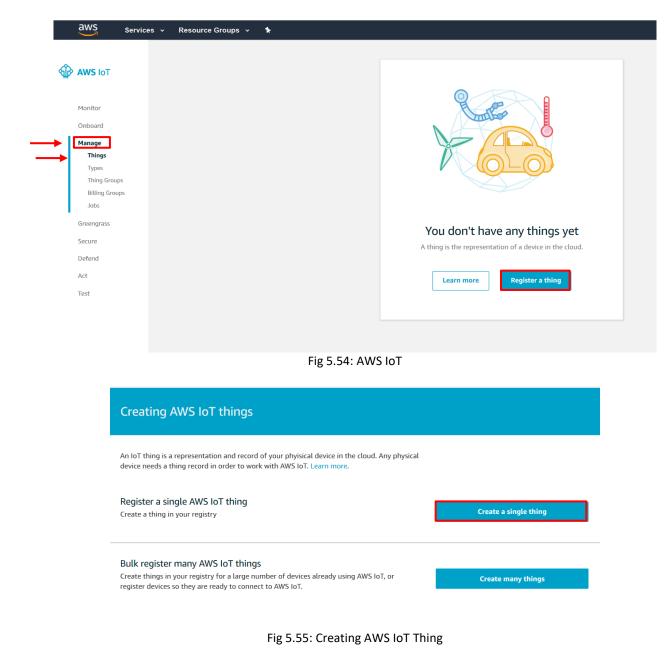
2- Add the policy statements you need, and if you are not sure what policies are needed for your device, you can use the one in the figure.

	Create a policy to define a set of authorized actions. You can authorize actions on one or more resources (things, topic more about IoT policies go to the AWS IoT Policies documentation page. Name	s, topic filters). To learn
-	Policy1	
	Add statements Policy statements define the types of actions that can be performed by a resource.	Advanced mo
	Action iot.*	
	Resource ARN	
	Effect	Remove
	Add statement	

Fig 5.53: create a policy

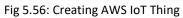
The \* in figure 5.53 means that you are using all available resources.

2- After creating a policy, you need to create a thing that matches your client id. Select
 Manage>>Things>>Register a thing, then choose Create a single thing.



3- Add your device to the thing registry by writing your client id as a thing name.

Add your device to the thing regis	stry	
This step creates an entry in the thing registry and a thin	ig shadow for your device.	
Name		
my-client-id		
Apply a type to this thing Using a thing type simplifies device management by prov common set of attributes, which describe the identity an	viding consistent registry data for things that share a type. Types pro	ovide things w
Thing Type		
No type selected	Create a type	
Add this thing to a group Adding your thing to a group allows you to manage devic	ices remotely using jobs.	
	ices remotely using jobs.	
Adding your thing to a group allows you to manage device		e group Cha
Adding your thing to a group allows you to manage device Thing Group	Creat	e group Cha
Adding your thing to a group allows you to manage devia Thing Group Groups / Set searchable thing attributes (optional) Enter a value for one or more of these attributes so that	Create you can search for your things in the registry.	
Adding your thing to a group allows you to manage devia Thing Group Groups / Set searchable thing attributes (optional) Enter a value for one or more of these attributes so that Attribute key Provide an attribute key, e.g. Manufacturer	You can search for your things in the registry.	
Adding your thing to a group allows you to manage devia Thing Group Groups / Set searchable thing attributes (optional) Enter a value for one or more of these attributes so that Attribute key	You can search for your things in the registry.	
Adding your thing to a group allows you to manage devia Thing Group Groups / Set searchable thing attributes (optional) Enter a value for one or more of these attributes so that Attribute key Provide an attribute key, e.g. Manufacturer	You can search for your things in the registry.	
Adding your thing to a group allows you to manage devia Thing Groups Groups / Set searchable thing attributes (optional) Enter a value for one or more of these attributes so that your set of the	You can search for your things in the registry.	e group Cha



# 4- You need to create a certificate for your thing.

CREATE A THING Add a certificate for your thing	STEP 2/3
A certificate is used to authenticate your device's connection to AWS IoT.	
One-click certificate creation (recommended) This will generate a certificate, public key, and private key using AWS IoT's certificate authority.	Create certificate
Create with CSR Upload your own certificate signing request (CSR) based on a private key you own.	2 Create with CSR
Use my certificate Register your CA certificate and use your own certificates for one or many devices.	Get started
Skip certificate and create thing You will need to add a certificate to your thing later before your device can connect to AWS IoT.	Create thing without certificate

# Fig 5.57: Adding a certificate

# 5- Download and Activate the certificate and the keys.

A certificate for this thing	51aedab585.cert.pem	Download	 _
A public key	51aedab585.public.key	Download	_
A private key	51aedab585.private.key	Download	_
ou also need to download root CA for AWS IoT Downl			

6- Before attaching policy, you need to download an **AWS root CA**, Click Download, and click on one of Amazon root certificates then copy the certificate and save it where you have the keys and the client certificate. We used **Amazon Root CA 1**.

Server Authentication
Server certificates allow your devices to verify that they're communicating with AWS IoT and not another server impersonating AWS IoT. Service certificates must be copied onto your device and referenced when devices connect to AWS IoT. For more information, see the AWS IoT Device SDKs.
AWS IoT server certificates are signed by one of the following CA certificates:
VeriSign Endpoints (legacy)
RSA 2048 bit key: VeriSign Class 3 Public Primary G5 root CA certificate
Amazon Trust Services Endpoints (preferred)
<ul> <li>RSA 2048 bit key: Amazon Root CA 1.</li> <li>RSA 4096 bit key: Amazon Root CA 2 - Reserved for future use.</li> <li>ECC 256 bit key: Amazon Root CA 3.</li> <li>ECC 384 bit key: Amazon Root CA 4 - Reserved for future use.</li> </ul>

### Fig 5.59: Amazon Root CA

## 7- You can go back and click Attach Policy.

Download these files and save them in a safe place. Certificates can be retrieved at any time, but the private and public keys cannot be retrieved after you close this page.

#### In order to connect a device, you need to download the following:

A certificate for this thing	51aedab585.cert.pem	Download
A public key	51aedab585.public.key	Download
A private key	51aedab585.private.key	Download

## You also need to download a root CA for AWS IoT:

A root CA for AWS IoT Download

Deactivate

Cancel

Done Attach a policy

Fig 5.60: Attach a Policy

# 8- Select your policy and click Register Thing

create a thing Add a policy for your thing	STEP 3/3
Select a policy to attach to this certificate:	
☑ Policy1	View
1 policy selected	Register Thing
Fig 5.61: Adding your policy	

9- You need to add the certificates you downloaded to your device configuration. Go to CC-MSIMPLE-TLS>>src>>cerificates.h

File Home Share View				
Pin to Quick access     Copy     Paste     Copy path       Paste shortcut     Paste shortcut	Move Copy to v to v	New folder New	Properties	Select all Select none
Clipboard	Organize	New	Open	Select
← → ∽ ↑ 🔒 > This PC > Desktop :	CCM-SIMPLE-TSL > CCM-SIMP	LE-TSL → src		5 ~
者 Quick access	Name	D	ate modified Type	Size
Quickaccess	certificates.h	8/	21/2019 2:00 PM H File	e 5 KB
o Creative Cloud Files	🍩 main.c	8/	22/2019 8:24 AM C File	12 KB
💱 Dropbox				
OneDrive				
This PC				
JLINK (F:)				
💣 Network				

Fig 5.62: Certificates.h directory

10- Copy the client certificate, private key and the Amazon root CA to certificates.h as strings then save. You don't need to use the public key here.

```
certificates.h - Notepad
File Edit Format View Help
 * Copyright (c) 2018 Nordic Semiconductor ASA
*
* SPDX-License-Identifier: BSD-5-Clause-Nordic
*/
#define CLIENT ID "nRF9160-DK"
#define CA CERTIFICATE \
"-----BEGIN CERTIFICATE-----\n" \
"MIIDQTCCAimgAuIBAgITBmyfzSm/jAo54v84ikPmlj2byjANBgkqhkiG9u08AQsF\n" \
"ADA5MOssic OVDVODGEs TVU2EPMABGA1UECHMGOb1head%UMRksFuVDVODDEsBBobF6\n"
"b24gUw9vdCBDQSAxMB4XDTE1MDUyN3AxMDAxMFoXDTM4MDExN2AxMDAxMFoxOTEL\n"
                                                                      1
"HAAGAIUEBHACVARGDIANBgRVBADTBKFtYXpvbjE2MBcGAIUEAxAQQAIhemPuIFJv\n" \
"b 30g08EgMTCCASIw0QY3KoZIhvcNAQE88QADggEPADCCAQoCggEBAL34gH9KeNXj\n" \
"ca9HgF80fW7Y14h2931o91ghYP10hAEvrAIthtOg03pOsqTQNroBvo3b5PgHFz2H\n" \
"906IIBc+6zf1tRn4SW1w3te5djgdY26k/oI2peVKVuRF4fn9tBb6dNqcmzU5L/qw\n"
                                                                      1
"IFAGbHrQgLKm+a/sRxmPUDgH3KKHOVj4utkip+UhrM3bu1Hheb4mjUcAuhmahRia6\n" \
"VOu ju/SHSSNz / Begul, XBt dHA114gk 957Ebbl67c4cX8 j 3GKL hD+rcdqsqB8p8kD111 \n" \
"93FcXmn/6pUKyz1Kr1A4b9v7LWIbwcceVOF34GFID5vHI9Y/OC8/IIDEgEw+OyOm\n" \
"jgSub3rIgg@CAuEAAaNOYEAuDuYDVR@TAQH/BAUuAuEB/zAOBgMAQBBAFBEBAVK\n"
"AVYWHQYDVRROBBYEFIQYzIU87LWHIJQuCFmcx7IQTgoIMABGCSqGSIb30QEBCWUA\n" \
"A4IBA0CY81da02Ch6sV2U5ggN1M0ruYou6r41K5Ip08/6/wk3Uu8yK6X9rbxenDI\n"
"USPMCCjjwCXP16T531HTfIUJrU6adTrCC2qJeHZERxh1bI18jjt/wsv0tadQ1wUs\n" \
"H+g0563pYaACbvXy8Mby7Vu33PgU00HeeE6V/Ug2V8v1T096LXFvK3U3bYK8U98vv\n"
"e/ufQ3VtHVT8QtPHRh8j=dkPSHCa2XV4cdFyQzR1b1d2wg3c3mApzyH2Fo61Q6XU\n" \
"Ms]+yMRQ+hDKX71oa1dXg5UkK642M4Uwt9VBob2x3NDd22hwLnoQdeXeGADbkpy\n" \
"rgXRfboQnoZsG4g5WTP4685QvvG5\n" \
"-----END CERTIFICATE-----\n" \
```

# #define CLIENT\_PUBLIC\_CERTIFICATE \ "-----BEGIN CERTIFICATE-----\n" \

```
B\n" \
t\n" \
2\n" \
2\n" \
2\n" \
2\n" \
2\n" \
Γ\n" \
i\n" \
```

Fig 5.63: Certificates.h file

TYPE1		Action
Details	Thing ARN	E
Security	A thing Amazon Resource Name uniquely identifies this thing.	
Thing Groups	arn:aws:iot:us-east-2:900793109101:thing/my-client-id	
Billing Groups Shadow Interact	Туре	
Activity	Q Type1	
Jobs		
Violations Defender metrics		
	Fig 5.64: Thing Details	
curity ing Groups	HTTPS	
ling Groups	Update your Thing Shadow using this Rest API Endpoint. Learn more	

11- Go back to your AWS account, click on the thing you created and select Interact. The thing shadow is the host broker that you will need to add to your configuration.

- Fig 5.65: Host Broker
- 12- Open your Segger embedded studio, select file, Open nRF connect SDK Project and choose our zip file.

13- Select Project>>Configure nRF Connect SDK Project>>menuconfig>>MQTT simple sample.

14- Use your new Host Broker, then choose publish and subscribe topics, and configure.

	Configure nRF Connect SDK Project			Filter	
	MQTT simple sample > MQTT Client ID				
	<ul> <li>MQTT simple sample</li> <li>Provision of certificate <provision_certificates></provision_certificates></li> <li>Certificates to use <certificates_file> certificates.h</certificates_file></li> <li>Security tag to use for the connection <sec_tag> 16842753</sec_tag></li> <li>MQTT publish topic <mqtt_pub_topic> myTopic/publish</mqtt_pub_topic></li> <li>MQTT subscribe topic <mqtt_sub_topic> myTopic/subscribe</mqtt_sub_topic></li> <li>MQTT Client ID <mqtt_client_id> my-client-id</mqtt_client_id></li> <li>MQTT broker hostname <mqtt_broker_hostname> a3lh9p3ie60pop-a</mqtt_broker_hostname></li> <li>MQTT broker port <mqtt_broker_port> 8883</mqtt_broker_port></li> <li>Zephyr Kernel</li> </ul>	ats			
-	☑ Show Names □ Show Symbols □ Show All	Load	Save As	Configure	Cancel

Fig 5.66: Configure nRF Connect SDK Project

- 15- Plug the nRF9160 DK to your computer and go to **Build > Build Solution**.
- 16- Go to **Target** > **Connect J-Link**, when its connected go back to **Target** and choose **Erase All** (Be sure to erase the board every time you need to reprogram it).
- 17- Program and run your program by clicking the green arrow.
- 18- To make sure that your nRF9160 is connected to your AWS account, open TeraTerm. It should look like figure 5.67.

🔟 COM11 - Tera Term VT	_	$\times$
File Edit Setup Control Window Help		
The MQTT simple sample started Deleting certs sec_tag: 16842753		
nrf_inbuilt_key_delete(16842753, 0) => result=0 Deleting certs sec_tag: 16842753		
nrf_inbuilt_key_delete(16842753, 1) => result=0		
Deleting certs sec_tag: 16842753 nrf_inbuilt_key_delete(16842753, 2) => result=0		
Deleting certs sec_tag: 16842753 nrf_inbuilt_key_delete<16842753, 3> => result=2		
Deleting certs sec_tag: 16842753 nrf_inbuilt_key_delete<16842753, 4> => result=2		
Write ca certs sec_tag: 16842753 Write private cert sec_tag: 16842753		
Write public cert sec_tag: 16842753		
LTE Link Connecting LTE Link Connected!		
IPv4 Address found 0x6441dd12		
[mqtt_evt_handler:146] MQTT client connected?		
Subscribing to: myTopic/subscribe len 17 Publish: Test		
to topic: myTopic/publish len: 15		
[mqtt_evt_handler:191] SUBACK packet id: 1234		
[mqtt_evt_handler:181] PUBACK packet id: 4151 □		

Fig 5.67: Tera Term

19- To test publishing and subscribing using AWS MQTT Client, go back to your **AWS account**, select **Activity>>MQTT Client**.

тніNG my-client-id					
NO TYPE					Actions -
Details	Activity		Pause	Edit Shadow	MQTT Client
Security	Listening for 51 minute(s)				
Thing Groups	•				
Billing Groups					
Shadow					
Interact					
Activity					
Jobs					
Violations					
Defender metrics					
		Fig 5.68: Activity			

20- Choose a publish and subscribe topics based on your publish and subscribe topics in the **menuconfig** (Segger Studio). Remember that you publish to a subscribe topic and you subscribe to a publish topic.

MQTT client ③	Connected as intronsole-1566493	817615-2
Subscriptions		
Subscribe to a topic Publish to a topic	Subscribe         Devices publish MQTT messages on topics. You can use this client to subscribe to a topic and receive these messages.         Subscribe topic         Specify a topic to subscribe to, e.g. my/tipic/1         Max message capture *         Do         Do         Outland of Service *         O         - 1- This client will acknowledge to the Device Gateway that messages are received         - 1- This client will acknowledge to the Device Gateway that messages are received         MOTT paylead display         O isplay payleads (improves readability)         O isplay raw payleads (in hexadecimat)	άε
	Publish Specify a topic and a message to publish with a QoS of 0. Specify a topic to publish to, e.g. myTopic/1 Publish to top * "essager": "wills from Ard. Soft controls"	sic

# Fig 5.69: Subscribe and publish topics

Subscriptions		
Subscribe to a topic Publish to a topic	Subscribe Devices publish MQTT messages on topics. You can use this client to subscribe to a topic and receive these messages. Subscription topic	
myTopic/publish	myTopic/publish	Subscribe to topic
	Max message capture       Image: Comparison of the comparison	

# Fig 5.70: Subscription Topic



Fig 5.71: Publish to Topic

21- To Publish a Test message press on Button 2 on your nRF9160 and you will see the message published in your AWS account.

myTopic/publish	Export Clear Pause
Publish Specify a topic and a message to publish with a QoS of 0. myTopic/subscribe	Publish to topic
1 ( 2 "message"; "Hello from AWS IoT console" 3 }	
myTopic/publish Aug 27, 2019 9:41:11 AM -0400	Export Hide
We cannot display the message as JSON, and are instead displaying it as UTF-8 String.	
Test	

Fig 5.72: Test message

Download the code here