Low Powered Network for the Internet of Things Use LoRa network with the SAP Hana Cloud

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Abstract

In this document, we guide you step by step toward the establishment of a Low Powered connectivity between a device, and the SAP HANA Cloud. You will do the following:

- Enable LoRa communication on an Arduino Uno
- Setup your own LoRa gateway on a RaspberryPi
- Setup your IoT platform account to push sensor data from your gateway

At the end of this session, you will have an Arduino device pushing data to the SAP Hana Cloud platform through the LoRa network.

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Introduction

In this lab session, we will establish the connection between an IoT device and the SAP IoT service hosted on the SAP Hana Cloud Platform. The overall architecture is depicted as follows:



Data generated by the Arduino device is sent over LoRa to a raspberryPi which serves as a LoRa gateway. LoRa is a communication protocol over ultra-narrow-band radio.

LoRaWAN™ is a Low Power Wide Area Network (LPWAN) specification intended for wireless battery operated Things in a regional, national or global network. LoRaWAN targets key requirements of Internet of Things such as secure bi-directional communication, mobility and localization services. The LoRaWAN specification provides seamless interoperability among smart Things without the need of complex local installations and gives back the freedom to the user, developer, businesses enabling the roll out of Internet of Things. [reference]

LoRa is part of the communication protocol for Low Power Network Wide Area. *Low-Power Wide-Area Network (LPWAN) or Low-Power Network (LPN) is a type of wireless telecommunication network designed to allow long range communications at a low bit rate among things (connected objects), such as sensors operated on a battery.*[*reference*]

Our LoRa gateway then forwards the data packet to the SAP IoT service on SAP HCP. SAP HANA Cloud Platform is an open platform-as-a-service that provides unique in-memory database and application services. [reference]

Setup

In this section, we will guide through

- the setup of your own IoT Service on HCP,
- the setup of your Arduino device with the LoRa module
- the setup of your LoRa gateway on raspberryPI

Setup the Internet of Things Services on your our own HCP trial account Activate the Internet of Things Services

1. Go to https://account.hanatrial.ondemand.com/ and log on. If you don't have an account yet you may have to register using your @sap.com email address.



2. Go to Services and enable the Internet of Things Services.

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3. In the *Internet of Things Services* open *Configure Internet of Things Services* and assign the *IoT-User* role to your user.

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4. Go back to the Internet of Things Services Overview and open *Go to Service*.



Deploy the Message Management Service

 In the Internet of Things Services Cockpit select *Deploy Message Management Service* enter your username and password and press *Deploy*. (In our case the Message Management Service (MMS) is responsible for receiving messages from IoT devices.)



6. Go back to your HCP-trial-Cockpit Overview and go to *Applications > Java Applications*.

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 Select the Application *iotmms* and go to *Security > Roles* and assign the *IoT-MMS-User* role to your user.

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Go back to the *iotmms Overview* and click on the URL below *Application URLs* (e.g. <u>https://iotmmsd0xxxxtrial.hanatrial.ondemand.com/com.sap.iotservices.mms</u>). This takes you to the MMS-Cockpit (let this page remain open in a separate tab).

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Configure devices in the Internet of Things Services

9. Go to *View registered devices and device types* which takes you back to the IoT Services Cockpit.



10. Go to *Message Types* and create a new message type called *LoRaMessage*.

The first field of the message type is deviceid

The second field of the message type is **data**.



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11. Open a text editor and paste the now appearing *message type ID* in a new text file.

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12. Go to *Device Types* and create a new device type called *Arduino* and add the message type *LoRaMessage* with the direction *from device*.





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13. Go back to Internet of Things Services Cockpit and then go to Devices.

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14. Create a new device called *ArduinooverLoRa* and choose *Arduino* as device type.

15. Paste the now appearing *token* in your already opened text file.

✓ OAuth Access Token
New OAuth access token for device "ArduinooverLoRa" created. Token: d46
Fermer

16. Also paste the *device ID* appearing after closing the token window in your text file.

Test the MMS via HTTP API

17. Go to the Message Management Service Cockpit (separate tab) and now go to Send and receive messages via HTTP.



18. Below *Send message* change the last part of the URL associated to *HTTP endpoint* [usually: d000-e000-v000-i000-c000-e001] to your devices' ID (last pasted string in text file).

Send Message	
Data Endpoint:	https://iotmmsp423485trial.hanatrial.ondemand.com/com.sap.iotservices.mms/v1/api/http/data/ede
Message:	{"mode":"sync","messageType":"53
	Send Send

- 19. Now replace the value from messageType in the message [usually: m0t0y0p0e1] to your message type ID (first pasted string in text file) and replace [{"sensor":"sensor1", "value":"20", "timestamp":1413191650}]} by [{"deviceid":"sensor1", "data":"20"}]
- 20. Press *Send* and the *Reply from server* console should now show a message like this: 200 {"msg":"1 message(s) received from device [<your Device ID>]"}.

Repl	y from	Server
		<u>~</u>
		UII Clear Table
	Code	Message
	000	
	200	{"msg":"1 message(s) received from device [edb111dd-ecu8-4b18-9ba9-bb162bb24978]"}

Congratulations! Now your IoT Services are set up properly and you can see your messages by going back to the *Message Management Service Cockpit* and going to *Display stored messages*. Your messages are usually stored in the first appearing table which is named T_IOT_<your message type ID>.



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ed	·	Sat Dec 10 2016 22:47:09 GMT+0100 (Romance Standard Time)	sensor1	20	
ed	34	Sat Dec 10 2016 22:47:01 GMT+0100 (Romance Standard Time)	sensor1	20	

Arduino

Install the Arduino IDE

- 1. Get the Arduino IDE installation form <u>here</u>.
- 2. Start the installation

🥺 Arduino Setup: Installation (Options	_		×
Check the components yo you don't want to install.	ou want to install a Click Next to conti	nd uncheck the nue.	compone	nts
Select components to install:	 ✓ Install Ardu ✓ Install USB ✓ Create Star ✓ Create Des ✓ Associate .i 	ino software driver It Menu shortcu ktop shortcut no files	t	
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Cancel	Nullsort Install System V3.0	< <u>B</u> ack	Install	
🥺 Arduino Setu	p: Installing	_		×
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Image: Show details	p: Installing older: C:\Program Files (x86)\Ardu	ino\hardware\	arduino \avr \fi	× rmw;

Windows Security ×
 Would you like to install this device software?
 Name: Arduino USB Driver
 Publisher: Arduino LLC
 Always trust software from "Arduino LLC". Install Don't Install
 You should only install driver software from publishers you trust. How can I decide which device software is safe to install?

Install the LoRa libraries

- 1. Copy the LoRa library into the <*ArduinoInstallationFolder*>/libraries and extract it 📔 🛃 📒 💌 🛛 libraries o × File Home Share ~ 0 * 🗎 🗋 🐰 Cut
 Image: Second M Copy path Pin to Quick Copy Paste access Paste shortcut to • to • Delete Rename folder Clipboard ← → → ↑ 🖡 > NCEN34057649A > OSDisk (C:) > Program Files (x86) > Arduino > libraries ✓ ひ Search libraries Q Name Date modified Туре Size A Quick access 📕 WiFi 14/11/2016 15:31 File folder Documents TFT 14/11/2016 15:31 File folder Downloads * Temboo 14/11/2016 15:31 File folde Pictures SX1272_library_arduino_v1.4 06/12/2016 19:02 File folder DataProtection 14/11/2016 15:31 Stepper File folde Desktop SpacebrewYun 14/11/2016 15:31 File folder PublicConnectedSpaces@Antibes Servo 14/11/2016 15:31 File folder Strategy SD 14/11/2016 15:31 File folde RobotlRremote 14/11/2016 15:31 File folder la OneDrive Robot Motor 14/11/2016 15:31 File folder SNCEN34057649A Robot_Control 14/11/2016 15:31 File folde Mouse 14/11/2016 15:31 File folder a Desktop LiquidCrystal 14/11/2016 15:31 File folder Documents 14/11/2016 15:31 Keyboard File folde Downloads GSM 14/11/2016 15:31 File folder Music Firmata 14/11/2016 15:31 File folder Nictures Ethernet 14/11/2016 15:31 File folde 🗃 Videos Esplora 14/11/2016 15:31 File folder USDisk (C:) 14/11/2016 15:31 Bridge File folder ✓ I023506 (\\FRPARH101.par.global.corp.sap) (I:) Metwork 19 items 81 K
- 2. Unzip the two ZIP *arduino-api_v1_4.zip* and *arduinoLoRa_v_1_4.zip* in <*ArduinoInstallationFolder>/libraries*

Image: SX1272_library_arduino_v1 File Home Share View	4				- 0	× ^ ?
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Check the LoRa module

- 1. Start the Arduino IDE
- 2. Check for LoRa libraries examples



3. Open SX_00_Config_LoRa

SX_00_CONFIG_LoRa Arduino 1.6.12	– a ×
ile Edit Sketch Iools Help	
	<u>م</u>
SX_00_CONFIG_LoRa	
<pre>Serial.println(e, DEC);</pre>	,
<pre>// Set CRC e = sxl272.setCRC_ON(); Serial.print(F("SetTing CRC ON: state ")); Serial.println(e, DBC); // Select output power (Max, High or Low) e = sxl272.setPower('H'); Serial.print(F("SetTing Power: state ")); Serial.print(f("SetTing Power: state ")); Serial.print(f("setTing node address: state ")); Serial.print(f("setTi</pre>	
<pre>// Fint a success message if (e = 0) Serial.println(F("SX1272 successfully configured")); else Serial.println(F("SX1272 initialization failed"));</pre>	
roid loop(void)	
	Arduino Nano, ATmega328 on COM7

4. Connect the LoRa Arduino module to the Arduino Uno





5. Configure the board as Arduino Uno

SX_00_CONFIG_	LoRa Arduino 1.6.12				- 0	\times
Eile Edit Sketch To	ols Help					
	Auto Format	Ctrl+T				
	Archive Sketch					
SX_00_CON	Fix Encoding & Reload					
/*	Serial Monitor	Ctrl+Shift+M				^
* LoRa 868	Serial Plotter	Ctrl+Shift+L				
* * Copyrigh	WiFi101 Firmware Updater					
* http://w	Board: "Arduino/Genuino Uno"	>	Boards Manager			
*	Port: "COM27 (Arduino/Genuino Uno)" >	Arduino AVR Boards			
* This pro	Get Board Info		Arduino Yún			
* it under	Programmer "AV/PICP mkll"		Arduino/Genuino Uno			
* (at your	Purp Rootloader	Í	Arduino Duemilanove or Diecimila			
*	burn bootioader		Arduino Nano			
 * This program 	am is distributed in the hope	that it will	Arduino/Genuino Mega or Mega 2560			
* but WITHOU	F ANY WARRANTY; without even t	the implied wa	Arduino Mega ADK			
* MERCHANTAB	LLITY OF FITNESS FOR A PARTICUL Public License for more deta	JLAR PURPOSE.	Arduino Leonardo			
*			Arduino/Genuino Micro			
* You should	have received a copy of the G	GNU General Pu	Arduino Esplora			
* along with	this program. If not, see ht	tp://www.gnu.	Arduino Mini			
÷			Arduino Ethernet			~
An error ecourted y	while uploading the elector		Arduino Fio		Conv error me	scanes
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Invalid library	found in C:\Program Files (x	86)\Arduino\l	Arduino Pro or Pro Mini	.4: C:\Program Files (x86)\Arduino\libraries\SX1272 library arduino v1.4		
Invalid library	found in C:\Program Files (x	86)\Arduino\1	Arduino NG or older	.4: C:\Program Files (x86)\Arduino\libraries\SX1272_library_arduino_v1.4		
Invalid library	found in C:\Program Files (x	86)\Arduino\1	Arduino Robot Control	.4: C:\Program Files (x86)\Arduino\libraries\SX1272_library_arduino_v1.4		
Invalid library	found in C:\Program Files (x	86)\Arduino\l	Arduino Robot Motor	.4: C:\Program Files (x86)\Arduino\libraries\SX1272_library_arduino_v1.4		
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Invalid library	found in C:\Program Files (x	86)\Arduino\li	braries\SX1272 library arduino vi	.4: C:\Program Files (x86)\Arduino\libraries\SX1272 library arduino v1.4		
Invalid library	found in C:\Program Files (x	86)\Arduino\li	braries\SX1272 library arduino v	.4: C:\Program Files (x86)\Arduino\libraries\SX1272 library arduino v1.4		~
				Arduino/	Genuino Uno on CC	DM27

6. Configure the Port

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	Auto Format	Ctrl+T								Ø
SX 00 CON	Archive Sketch									
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	Serial Monitor	Ctrl+Shift+M								~
// Set CRC	Serial Plotter	Ctrl+Shift+L								
e = sx127 Serial.pri	WiFi101 Firmware Update	r								
Serial.pri	Board: "Arduino Nano"	>								
	Processor: "ATmega328"	>								
// Select	Port	> Se	erial ports							
Serial.pri	Get Board Info	CC	CM3							
Serial pri	Programmer "A\/PICD mkl		OM27 (Arduin	o/Genuino Ur	10)					
	Programmer: AVRISP mki									
// Set the .	built bootlouder									
e = sx1272.	<pre>setNodeAddress(3);</pre>	orge state ")).								
Serial.print	<pre>(r("Seccing node addr ln(e, DEC);</pre>	ess: state "));								
// Print a s	uccess message									
if (e == 0)										- 1
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erse Serial pri	ntln/F/"SV1272 initia	lization failed"))								
}	interior (Directo Interio	indición futica //	<i>,</i>							
void loop(void)									
{										
}										~
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Search			- L J			<u> </u>			09/12/	/2016

7. Modify *arduinoLoRa.ccp* as follows:



8. Load SX_00_CONFIG_LoRa

SX_00_CON	IFIG_LoRa Arduind	0 1.6.12			-	٥	\times
File Edit Sketc	h Iools <u>H</u> elp						
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Close	Ctrl+W	08.Strings	>				
Save	Ctrl+S	09.USB	, das S.L.				
Save As	Ctrl+Shift+S	10.StarterKit_BasicKit	>				
Page Setu	p Ctrl+Shift+P	11.ArduinoISP	>pute it and/or modify				
Print	Ctrl+P	Examples for any board	cense as published by				
Preference	es Ctrl+Comma	arduinoLoRa	> SX_00_CONFIG_LoRa				
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THITS PI	Ogram 15 urser	Ethernet	> SX_01b_RX_LoRa				
* but WIT	THOUT ANY WARRS	Firmata	> SX_02a_TX_LoRa_ACK				
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* Version		Stenner	>				
* Design:		Temboo	>				
* Impleme	entation: Co	TFT	,pria, Ruben Martin				
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		Examples for Arduino Nano					~
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		SPI	>				Ê
		Wire	>				
		v					
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				Arduino Na	ano, ATmega	a328 on CO	M7

9. Compile it

The ball state roots help			
🗸 🕒 🗈 🖸 Verity			
SX_00_CONFIG_LoRa			
* toRa 868 / 915MHz SX1272 LoRa module			
<pre>* Copyright (2) Libelium Comunicaciones Distribuidas S.L. * http://wox.libelium.com * This program is free software: you can redistribute it and/or modify it under the terms of the GRU General Public License as published by the free Software Foundation, elther version 3 of the License, or (at your option) any later version. * This program is distributed in the hope that it will be useful, but WITHOUT ANY MAREMATY's Without even the implied warranty of * MERCHAMPARTLITY or FITHERS FOR A PARTICULAR PURPOSE. See the GRU General Public License for more details. * You should have received a copy of the GRU General Public License along with this program. If not, see http://kow.gnu.org/licenses/. * Version: 1.2 * Version: 1.2 * Design: David Gascon ** Thismelementation: Covadonga Albifana, Victor Boria, Ruben Martin */ Finclude <wite.h> * * ********************************</wite.h></pre>			
Findinge (wile n/			
Done compling.			
Done compiling. Sketch uses 6,998 bytes (22%) of program storage space. Maximum is 30,720 bytes.			
Done compiling. Sketch uses 6,990 bytes (22%) of program storage space. Maximum is 30,720 bytes. Slobal variables use 1,203 bytes (50%) of dynamic memory, leaving 045 bytes for local variables. Maximum is 2,040 bytes.			
Done compling. Sketch uses 6,998 bytes (22%) of program storage space. Maximum is 30,720 bytes. Slobal variables use 1,203 bytes (58%) of dynamic memory, leaving 845 bytes for local variables. Maximum is 2,048 bytes.	Arduino Nano, ATm	ega328 on	сом
Done compling. Sketch uses 6,998 bytes (22%) of program storage space. Maximum is 30,720 bytes. Slobal variables use 1,203 bytes (58%) of dynamic memory, leaving 845 bytes for local variables. Maximum is 2,048 bytes. 10. Load it on the board	Arduino Nano, ATm	ega328 on	COM
Done compling. Sketch uses 6,998 bytes (22%) of program storage space. Maximum is 30,720 bytes. Slobal variables use 1,203 bytes (58%) of dynamic memory, leaving 845 bytes for local variables. Maximum is 2,048 bytes. 10. Load it on the board SX_00_CONFIG_LORA Arduino 1.6.12 Hie Edit Sketh Tools Help	Arduino Nano, ATm 	ega328 on	сом
Cone compiling Sketch uses 6,998 bytes (22%) of program storage space. Maximum is 30,720 bytes. Slobal variables use 1,203 bytes (58%) of dynamic memory, leaving 845 bytes for local variables. Maximum is 2,048 bytes. 10. Load it on the board SX.00_CONFIG_LoRa Arduino 1.6.12 He did Sketch Tools Help V N IN X	Arduino Nano, ATm 	ega328 on	сом)
Cone compiling Skotch uses 6,998 bytes (22%) of program storage space. Maximum is 30,720 bytes. Slobal Variables use 1,203 bytes (58%) of dynamic memory, leaving 845 bytes for local variables. Maximum is 2,048 bytes. 10. Load it on the board SX_00_CONFIG_Lofa Arduino 16.12 File Edit Sketch Tools Help V O V V C O FIG_Lora	Arduino Nano, ATm	ega328 on	сом) ;
Cone compiling Sketch uses 6,998 bytes (22%) of program storage space. Maximum is 30,720 bytes. Slobal variables use 1,203 bytes (58%) of dynamic memory, leaving 845 bytes for local variables. Maximum is 2,048 bytes. 10. Load it on the board Sx,00_CONFIG_LoRa * This program is free software: you can redistribute it and/or modify * the free software foundation, either version 3 of the License, or * (a typur option) any later version.	Arduino Nano, ATm 	ega328 on	COM J

1.2 David Gascón Covadonga Albifiana, Victor Boria, Ruben Martin

#include <Wire.h>

ketch uses 6,998 bytes (21%) of program storage space. Maximum is 32,256 bytes. lobal variables use 1,203 bytes (58%) of dynamic memory, leaving 845 bytes for local variables. Maximum is 2,048 bytes. nvalid library found in C:\Program Files (x86)\Arduino\libraries\SX1272_library_arduino_v1.4: C:\Program Files (x86)\Arduino\libraries\SX1272_library_arduino_v1.4 nvalid library found in C:\Program Files (x86)\Arduino\libraries\SX1272_library_arduino_v1.4: C:\Program Files (x86)\Arduino\libraries\SX1272_library_arduino_v1.4

11. Check the output in the Serial Monitor Start the serial monitor with *CTRL+SHIFT+M*

💿 COM8 (Arduino/Genuino Uno)	—		×
			Send
SX1272 module configuration in Arduino			
Setting power ON: state 0			
Setting Mode: state 0			
Setting Header ON: state 0			
Setting Channel: state 0			
Setting CRC ON: state 0			
Setting Power: state 0			
Setting node address: state 0			
SX1272 successfully configured			
Autoscroll No line e	ending	√ 9600 bau	ıd ~

LoRa gateway

1. Plug the LoRa module on the rapsberrypi





- 2. Log to the raspberry pi
- 3. Install the library on the raspberrypi.

The following instructions can be found here.

The SX1272 library for Raspberry Pi requires the ArduPi library and both libraries should be in the same path.

Download the SX1272 Libraries for Raspberry Pi.

```
wget http://www.cooking-
hacks.com/media/cooking/images/documentation/tutorial_SX1272/arduPi-
api_LoRa_v1_4.zip && unzip -u arduPi-api_LoRa_v1_4.zip && cd
cooking/examples/LoRa && chmod +x cook.sh && cd ../../..
```

4. Install ArduPi library

ArduPi For Raspberry Pi:

```
wget http://www.cooking-
hacks.com/media/cooking/images/documentation/raspberry\_arduino\_shield
/raspberrypi.zip && unzip raspberrypi.zip && cd cooking/arduPi &&
chmod +x install arduPi && ./install arduPi && rm install arduPi &&
cd ../..
```

ArduPi For Raspberry Pi 2:

```
wget http://www.cooking-
hacks.com/media/cooking/images/documentation/raspberry arduino shield
```

Dr. Laurent Gomez, OSCP laurent.gomez@sap.com

```
/raspberrypi2.zip && unzip raspberrypi2.zip && cd cooking/arduPi &&
chmod +x install_arduPi && ./install_arduPi && rm install_arduPi &&
cd ../..
```

5. Go to examples folder:

cd cooking/examples/LoRa/
6. Compile SX_00_CONFIG_LoRa.cpp:

./cook.sh SX_00_CONFIG_LoRa.cpp

7. Start SX_00_CONFIG_LoRa.cpp.exe

```
sudo ./SX 00 CONFIG LoRa.cpp
pi@raspberrypi:~/lora/cooking/examples/LoRa $ sudo ./SX_00_CONFIG_LoRa.cpp_exe
SX1272 module configuration in Raspberry Pi
Setting power ON: state 0
Setting Mode: state 0
Setting Header ON: state 0
Setting CRC ON: state 0
Setting Power: state 0
Setting Power: state 0
Setting Node address: state 0
SX1272 successfully configured
```

Send messages from Arduino to HCP

Push data from Arduino

- 1. Create a new sketch in the Arduino IDE
- 2. Copy paste the following program

/*	
* LoRa 868 / 915MHz SX1272 LoRa module	
*	
* Copyright (C) Libelium Comunicaciones Distribuidas S.L.	
* http://www.libelium.com	
*	
* This program is free software: you can redistribute it and/or modify	
* it under the terms of the GNU General Public License as published by	
* the Free Software Foundation, either version 3 of the License, or	
* (at your option) any later version.	
*	
* This program is distributed in the hope that it will be useful,	
* but WITHOUT ANY WARRANTY; without even the implied warranty of	
* MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the	
* GNU General Public License for more details.	
*	
* You should have received a copy of the GNU General Public License	
* along with this program. If not, see http://www.gnu.org/licenses/.	
*	
* Version: 1.2	
* Design: David Gascón	
* Implementation: Covadonga Albiñana, Victor Boria, Ruben Martin	
*/	
#include <wire.h></wire.h>	
// Cooking API libraries	
#include <arduinoutils.h></arduinoutils.h>	
// Include the SX1272 and SPI library:	
#include "arduinoLoRa.h"	
#INCIUAE <spi.h></spi.h>	
int e	
n. c,	
void setup()	
// Open serial communications and wait for port to open:	
Serial.begin(9600);	
// Print a start message	
Serial.println(F("SX1272 module and Arduino: send packets without ACK"));	
// Power ON the module	
e = sx1272.ON():	

Serial.print(F("Setting power ON: state ")); Serial.println(e, DEC);

// Set transmission mode and print the result
e |= sx1272.setMode(4);
Serial.print(F("Setting Mode: state "));
Serial.println(e, DEC);

// Set header
e |= sx1272.setHeaderON();
Serial.print(F("Setting Header ON: state "));
Serial.println(e, DEC);

// Select frequency channel
e |= sx1272.setChannel(CH_10_868);
Serial.print(F("Setting Channel: state "));
Serial.println(e, DEC);

// Set CRC
e |= sx1272.setCRC_ON();
Serial.print(F("Setting CRC ON: state "));
Serial.println(e, DEC);

// Select output power (Max, High or Low)
e |= sx1272.setPower('H');
Serial.print(F("Setting Power: state "));
Serial.println(e, DEC);

// Set the node address and print the result
e |= sx1272.setNodeAddress(3);
Serial.print(F("Setting node address: state "));
Serial.println(e, DEC);

```
// Print a success message
if (e == 0)
Serial.println(F("SX1272 successfully configured"));
else
Serial.println(F("SX1272 initialization failed"));
```

void loop(void)

}

// Send the message to the lora module
e = sx1272.sendPacketTimeout(8, message);
// Debug output
Serial.print(F("Packet sent, state "));
Serial.println(e, DEC);

// Wait 4 seconds delay(4000);

3. Change the *deviceid*

4. Compile and load the program

💿 COM8 (Arduino/Genuino Uno)	_		Х
			Send
SX1272 module and Arduino: send packets without ACK			^
Setting power ON: state 0			
Setting Mode: state 0			
Setting Header ON: state 0			
Setting Channel: state 0			
Setting CRC ON: state 0			
Setting Power: state 0			
Setting node address: state 0			
SX1272 successfully configured			
DEADBEEF#10			
Packet sent, state 0			
DEADBEEF#10			
Packet sent, state 0			
DEADBEEF#10			
Packet sent, state 0			
DEADBEEF#10			
Packet sent, state 0			~
Autoscroll	No line ending	∨ 9600 bau	ıd ~

Receive data on the gateway

1. Create the following cpp code under <cooking/examples/LoRa>

/* LoRa 868 / 915MHz SX1272 LoRa module * * Copyright (C) Libelium Comunicaciones Distribuidas S.L. * http://www.libelium.com * * This program is free software: you can redistribute it and/or modify * it under the terms of the GNU General Public License as published by * the Free Software Foundation, either version 3 of the License, or * (at your option) any later version. * * This program is distributed in the hope that it will be useful, * but WITHOUT ANY WARRANTY; without even the implied warranty of * MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the * GNU General Public License for more details. *

* You should have received a copy of the GNU General Public License * along with this program. If not, see http://www.gnu.org/licenses/. * Version: 1.2 * Design: David Gascón * Implementation: Covadonga Albiñana, Victor Boria, Ruben Martin */ // Include the SX1272 and SPI library: #include "arduPiLoRa.h" *#include <cstdlib> #include <iostream>* int e; char my_packet[100]; void setup() { // Print a start message printf("SX1272 module and Raspberry Pi: receive packets without ACK\n"); // Power ON the module e = sx1272.ON();printf("Setting power ON: state %d\n", e); // Set transmission mode *e |* = *sx*1272.*setMode*(4); printf("Setting Mode: state %d\n", e); // Set header e |= sx1272.setHeaderON(); printf("Setting Header ON: state %d\n", e); // Select frequency channel e |= sx1272.setChannel(CH_10_868); printf("Setting Channel: state %d\n", e); // Set CRC e |= sx1272.setCRC_ON(); printf("Setting CRC ON: state %d\n", e); // Select output power (Max, High or Low) *e* |*= sx*1272.*setPower*('*H*'); printf("Setting Power: state %d\n", e); // Set the node address e |= sx1272.setNodeAddress(8); printf("Setting Node address: state %d\n", e);

// Print a success message

```
if (e == 0)
  printf("SX1272 successfully configured\n");
 else
  printf("SX1272 initialization failed\n");
 delay(1000);
}
void loop(void)
{
// Receive message
 e = sx1272.receivePacketTimeout(10000);
 // if there is no error
 if ( e == 0 )
 {
  for (unsigned int i = 0; i < sx1272.packet_received.length; i++)</pre>
  {
   my_packet[i] = (char)sx1272.packet_received.data[i];
  }
  // Change the path to your send2HCP python script
  char cmd[100];
  strcpy(cmd,"python /home/pi/cooking/examples/LoRa/send2HCP.py ");
  // Discard message containing anything but [0-9][a-z][A-Z][#]
  int validCharacters = strspn(my_packet,"0123456789abcdefunABCDEFUN#");
  if (validCharacters == strlen(my packet)){
   // contains only listed chars
   strcat(cmd,my_packet);
   printf("C %s\n",cmd);
   printf("Message sent: %s\n", my_packet);
   system(cmd);
  } else {
   // contains other chars
   printf("Message NOT sent: %s\n", my_packet);
  }
 }
 else {
  printf("Receive packet, state %d\n",e);
 }
}
int main (){
setup();
 while(1){
  loop();
 }
 return (0);
```

2. Create send2HCP.py under <cooking/examples/LoRa>

```
import requests
import sys
import time
def main():
       # Handle and split the arguments provided with the commandline
       print sys.argv[1]
       messageArr = sys.argv[1]
       messageContent = messageArr.split("#")
       print messageContent
       # Store Message Pieces separately
       messagePayload = messageContent[0]
       deviceID = messageContent[1]
       # send the message only if it matches your deviceid
       sendMessage(deviceID, messagePayload)
def sendMessage(deviceID, messagePayload):
       // TODO: SET ACCORDING TO YOUR CONFIGURATION
       url = "https://xxxxx.hana.ondemand.com/com.sap.iotservices.mms/v1/api/http/data/messag
id"
       // TODO: SET ACCORDING TO YOUR CONFIGURATION
       payload =
"{\"mode\":\"sync\",\"messageType\":\"MESSAGETYPE\",\"messages\":[{\"deviceid\":\"" +
str(deviceID) + "\",\"value\":\"" + str(messagePayload) + "\"}]}"
       // TODO: SET ACCORDING TO YOUR CONFIGURATION
              headers = {
         'authorization': "Bearer OAUTHTOKEN",
         'content-type': "application/json",
         'cache-control': "no-cache"
         }
       response = requests.request("POST", url, data=payload, headers=headers)
       print(payload)
       print(response.text)
if__name__ == "__main__":
       try:
              main()
       except (KeyboardInterrupt, SystemExit):
              raise
       except:
              print("Error detected. Check the layout of the message.")
```

- 3. Modify it according to your HCP IoT message and device type.
- 4. Modify it to discard any message not coming from your Arduino.

Send message to HCP

1. Start the gateway and plug your Arduino device



2. Check the sent messages in HCP

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4	③ ▲ https://iotmmsp423485trial.hanatrial.or	ndemand.com/com.sap.iotservices.mms/#/appda	ta/NEO_4E9QOB9XFI C Rechercher		☆	Ê	ŧ	Â	◙	≡
<		Appli	cation Data							
S	RAFRAÎCHIR Last updated on 10/12/2016 à 23	:18:02								^
	Table NEO_4E9QOB9XFLKH53DOW6 (24 row(s) out of 24 loaded. Newest on top.)	RFV0QPW.T_IOT_530F3D0FEC2B8583	BBBA			Ć	2 OE)ata Al	21	
	G_DEVICE	G_CREATED	C_DEVICEID	C_DATA						
	ed6f1fdd-ec08-4b18-9ba9-5b162bb24978	Sat Dec 10 2016 23:17:54 GMT+0100 (Romance Standard Time)	DEADBEEF	10						
	ed6f1fdd-ec08-4b18-9ba9-5b162bb24978	Sat Dec 10 2016 23:17:44 GMT+0100 (Romance Standard Time)	DEADBEEF	10						
	ed6f1fdd-ec08-4b18-9ba9-5b162bb24978	Sat Dec 10 2016 23:17:35 GMT+0100 (Romance Standard Time)	DEADBEEF	10						
	ed6f1fdd-ec08-4b18-9ba9-5b162bb24978	Sat Dec 10 2016 23:17:25 GMT+0100 (Romance Standard Time)	DEADBEEF	10						
	ed6f1fdd-ec08-4b18-9ba9-5b162bb24978	Sat Dec 10 2016 23:17:16 GMT+0100 (Romance Standard Time)	DEADBEEF	10						
	ed6f1fdd-ec08-4b18-9ba9-5b162bb24978	Sat Dec 10 2016 23:17:07 GMT+0100 (Romance Standard Time)	DEADBEEF	10						