

How to build an end to end IoT application with ST IoT DK, IBM Watson IoT and Node-RED

Ernesto Manuel CANTONE

AME IoT Promotion and Enablement

ernesto.cantone@st.com



**ST Developers
Conference**

September 5, 2018
Santa Clara Convention Center - Mission City Ballroom
Santa Clara, CA



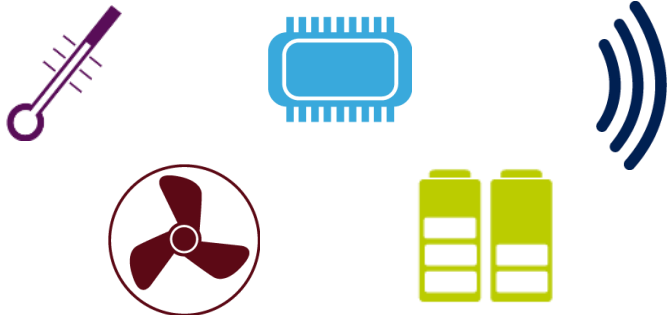
ST Has all the Building Blocks for the IoT

2



“Thing” you know how to build.

Plus what “Smart”?



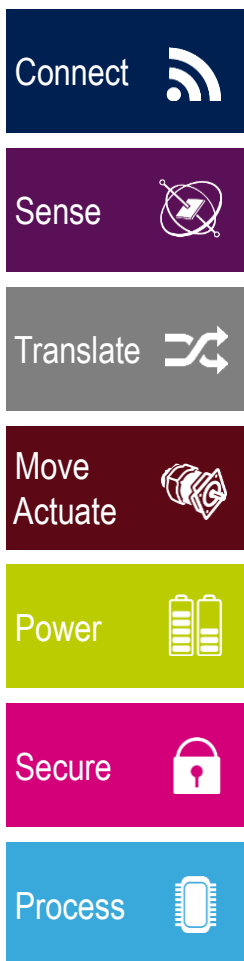
Pieces from different sources and
and no building instructions...

...or



Supporting the IoT Movement

3




SensorTile


BlueCoin


SmarTAG


Discovery Kit IoT Node


STM32 Nucleo Development
& Expansion boards

Pre-integrated SW for vertical applications



Development Ecosystem





STM32L475 Discovery Kit IoT Node

B-L475E-IOT01A

4

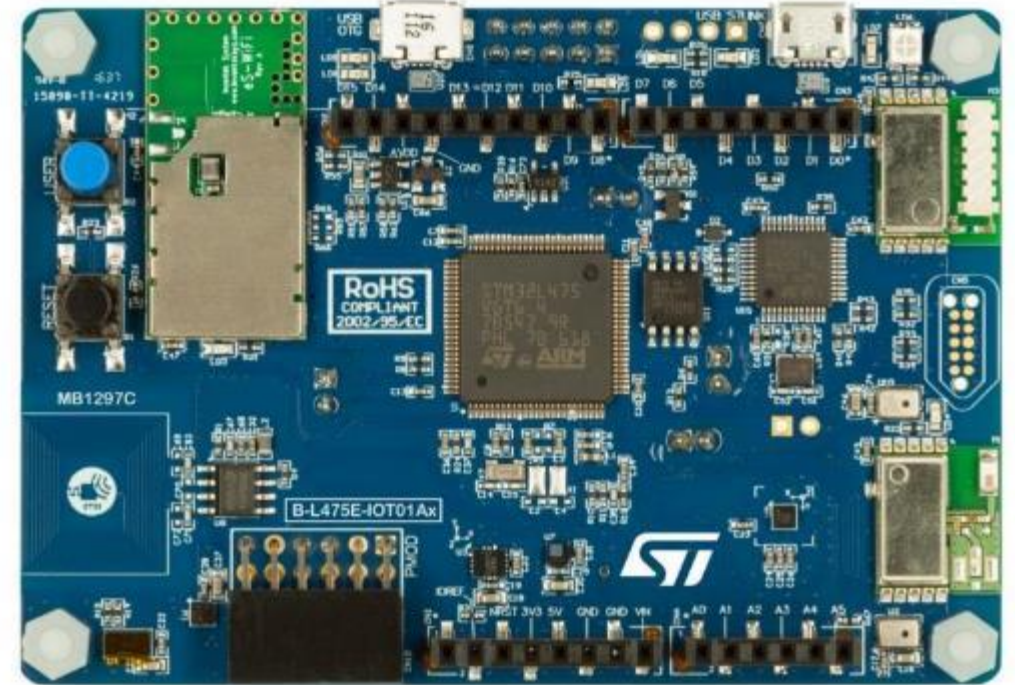
SW Libraries for STM32L4 MCU & Sensors

Low-power long-range communication (SubGHz)

Direct Wi-Fi connection to cloud servers

Environmental awareness: humidity, pressure, temp

Detection hub: motion, proximity, audio

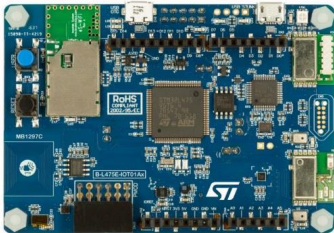


- For the workshop ST will provide



USB Key Content

```
.\\Windows SW\\en.stsw-link004.zip  
.\\Windows SW\\en.stsw-link009.zip  
.\\Windows SW\\teraterm-4.99.exe  
.\\X-CUBE-WATSON\\en.fp-cld-watson1.zip  
.\\X-CUBE-WATSON\\WATSON_1.0.1.patch  
.\\X-CUBE-WATSON\\WATSON_1.0.2.patch  
.\\B-L475E-IOT01_Watson_IoT_Cloud_1.0.2.bin
```



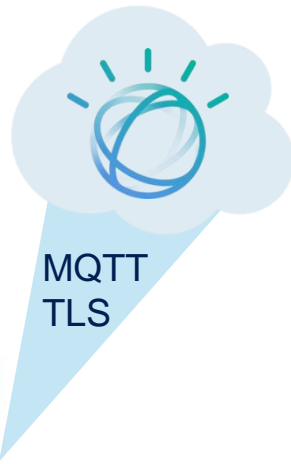
Discovery Kit IoT node



USB 2.0 A-Male to Micro B Cable

Lab Setup

6



MQTT
TLS

Serial Terminal

```
COM105 - Tera Term VT
File Edit Setup Control Window KanjiCode Help

*****
*** STM32 IoT Discovery kit for STM32L475/STM32F413/STM32F769 MCU ***
*** X-CUBE-WATSON-X Cloud Connectivity Demonstration ***
*** FW version 1.0.1 - Jul 26 2018, 11:10:45 ***
*****

*** Board personalization ***

*** WIFI connection ***

Push the User button (Blue) within the next 5 seconds if you want to update the
WiFi network configuration.

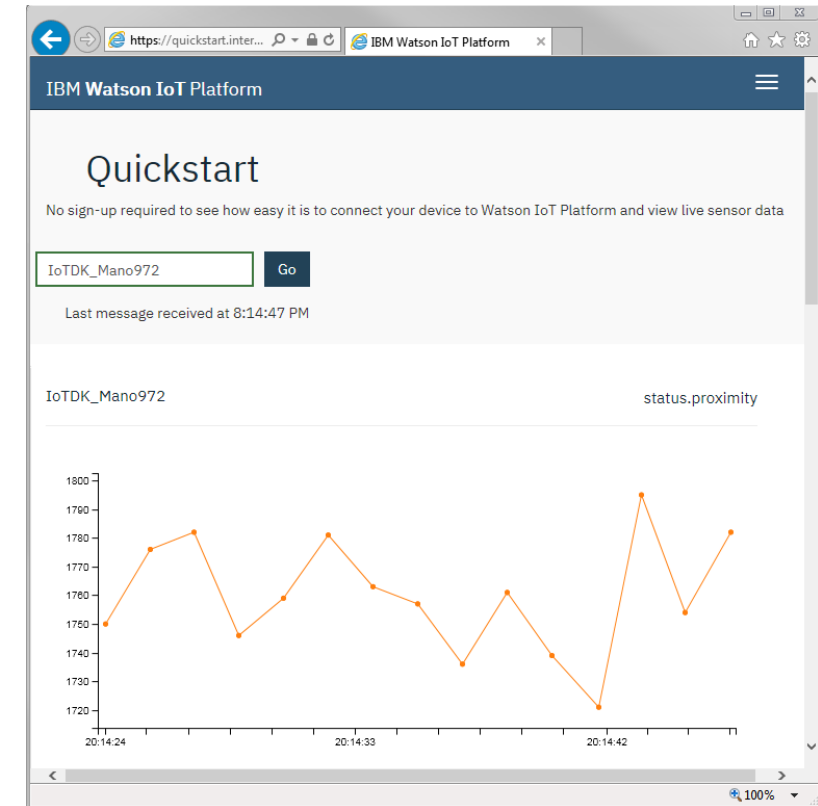
Your WiFi parameters need to be entered to proceed.

Enter SSID: stm32iot
You have entered stm32iot as the ssid.

Enter Security Mode (0 - Open, 1 - WEP, 2 - WPA, 3 - WPA2):3
You have entered 3 as the security mode.

Enter password: stm32iot
```

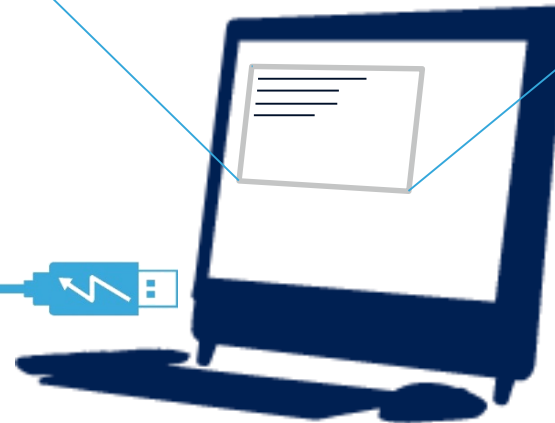
Web Browser



IoT DK

STLINK
USB Port

USB 2.0 A-Male
to Micro B Cable





Software and Others Pre-requisites

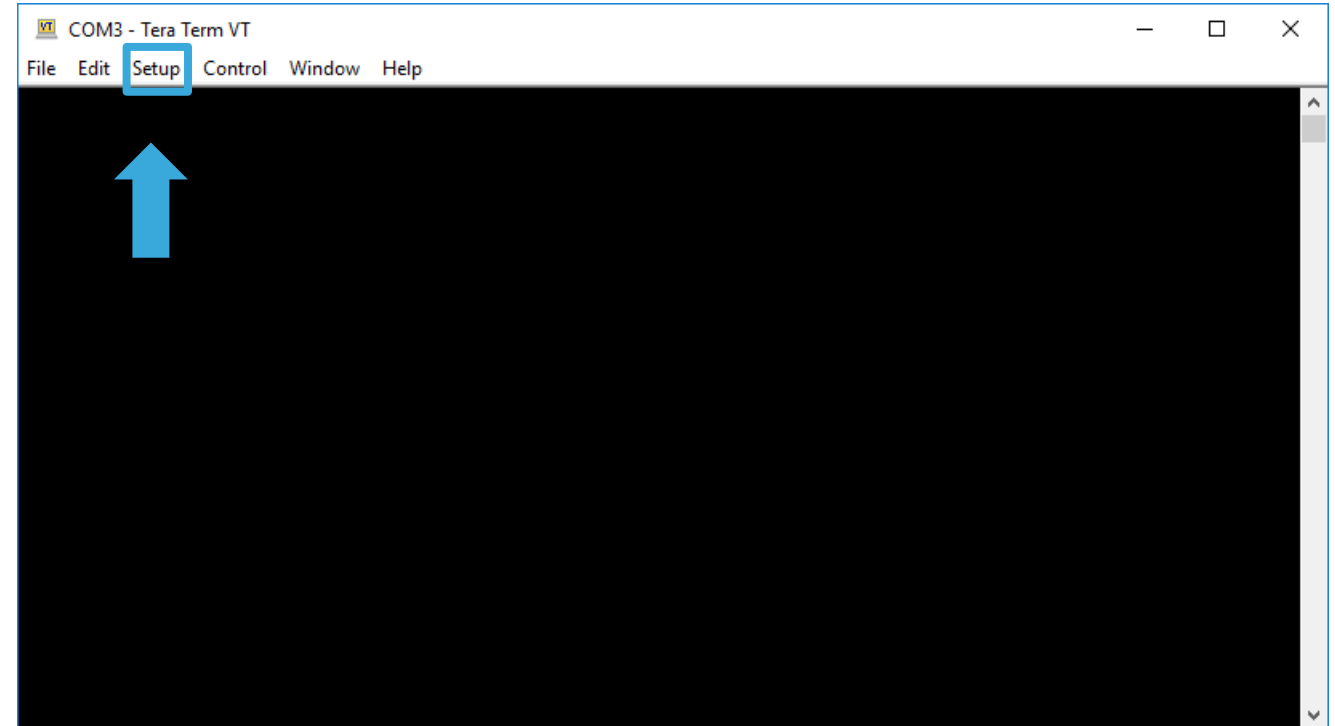
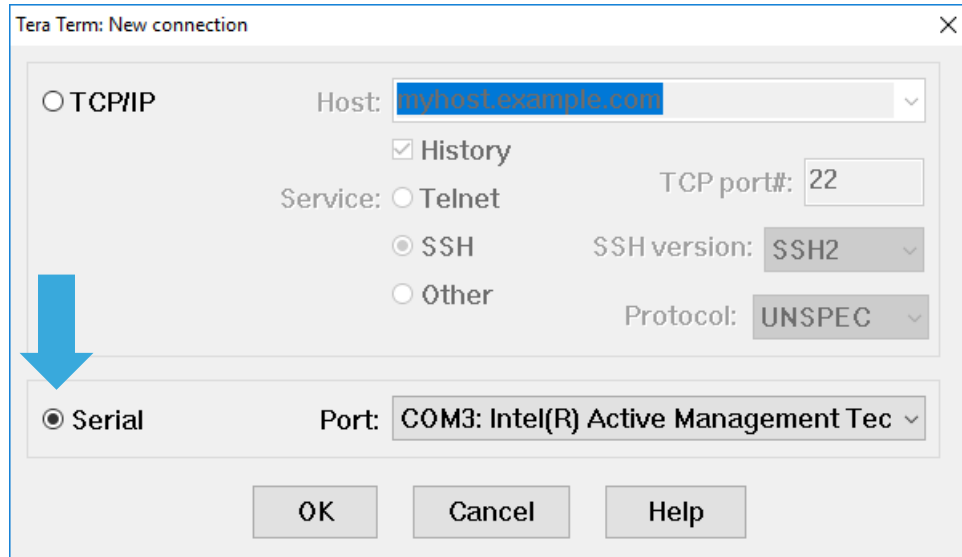
Windows (Win7, Win8, Win10)

7

- **STM32 ST-Link Utility**: STSW-LINK004 (requires registration to my.st.com)
 - NOTE: Required for Window 7
- **ST-LINK, ST-LINK/V2, ST-LINK/V2-1 USB driver signed for Windows7, 8, 10:** STSW-LINK009 (requires registration to my.st.com)
 - NOTE: Required for Window 7
- **Serial line monitor**: Tera Term (<https://ttssh2.osdn.jp/>)
 - Install from USB .\Windows SW\teraterm-4.99.exe

Tera Term Setup

8



Tera Term Setup

9

Tera Term: Serial port setup

Port: COM3

Speed: 115200

Data: 8 bit

Parity: none

Stop bits: 1 bit

Flow control: none

Transmit delay: 0 msec/char 0 msec/line

OK Cancel Help

Tera Term: Terminal setup

Terminal size: 80 x 25

☒ Term size = win size

☐ Auto window resize

New-line: Receive: LF Transmit: CR+LF

Terminal ID: VT100

☒ Local echo

☐ Auto switch (VT<->TEK)

Answerback:

Coding (receive): UTF-8

Coding (transmit): UTF-8

locale: american

CodePage: 65001

OK Cancel Help



Software and Others Pre-requisites

Mac OS: PicoCom

10

Serial line monitor: PicoCom or Screen

- Launch Spotlight by pressing Cmd + Space. Type terminal and select the Terminal app.
- In the Terminal window, enter the commands
 - `$ brew install picocom`
 - `$ ls -l /dev/tty*usbmodem*`
 - Example: `/dev/tty.usbmodem413`
 - `$ picocom --imap lfcrLf -b 115200 -p 1 -d 8 -c <usb device file>`
 - Example: `$ picocom --imap lfcrLf -b 115200 -p 1 -d 8 -c /dev/tty.usbmodem413`



Software and Others Pre-requisites

Mac OS: Screen (native app)

11

Serial line monitor: PicoCom or Screen

- Launch Spotlight by pressing Cmd + Space. Type terminal and select the Terminal app.
- In the Terminal window, enter the command: `ls /dev/cu.usb*`
- In the list of devices, look for a device that contains `cu.usbserial` or `cu.usbmodem`; in the example below IoT DK is mapped to `/dev/cu.usbmodem1413`
- Launch the from the terminal the screen utility by entering the command:

```
screen -L /dev/cu.usbmodem1413 115200 -L
```

```
[cesmosrv03:hack marco$ ls /dev/cu.usb*
```

```
/dev/cu.usbmodem1413
```

usb device name

```
cesmosrv03:hack marco$ screen -L /dev/cu.usbmodem1413 115200 -L
```

Serial terminal baudrate

- The screen command will open a serial terminal connected to the device.
Reset the board to see log messages from the device



Software and Others Pre-requisites

Linux (Ubuntu)

12

Serial line monitor: Putty or Picocom

- Putty
 - `sudo apt-get update` (This command updates the Ubuntu package list with latest one)
 - `sudo apt-get install -y putty`
- Picocom
 - `$ sudo apt-get install picocom`
 - `$ ls -l /dev/tty*usbmodem*`
 - Example: `/dev/tty.usbmodem413`
 - `$ picocom --imap lfcrLf -b 115200 -p 1 -d 8 -c <usb device file>`
 - Example: `$ picocom --imap lfcrLf -b 115200 -p 1 -d 8 -c /dev/tty.usbmodem413`

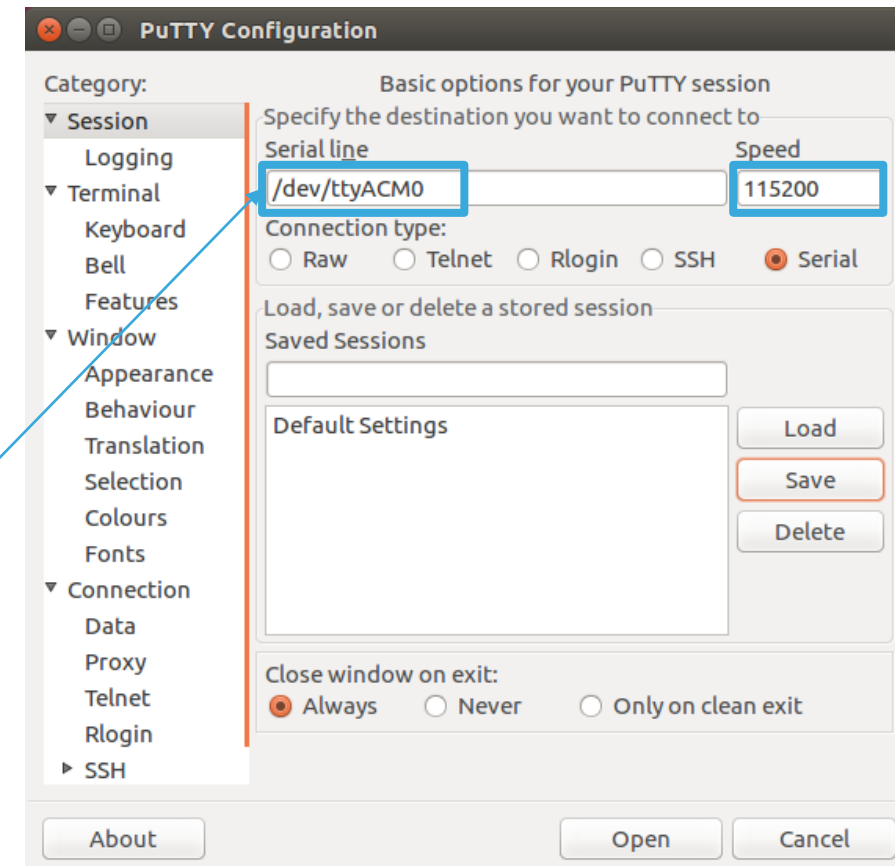


Open and Configure Serial Terminal (Putty)

- Open a Linux terminal and enter command: `dmesg`
- Open Putty

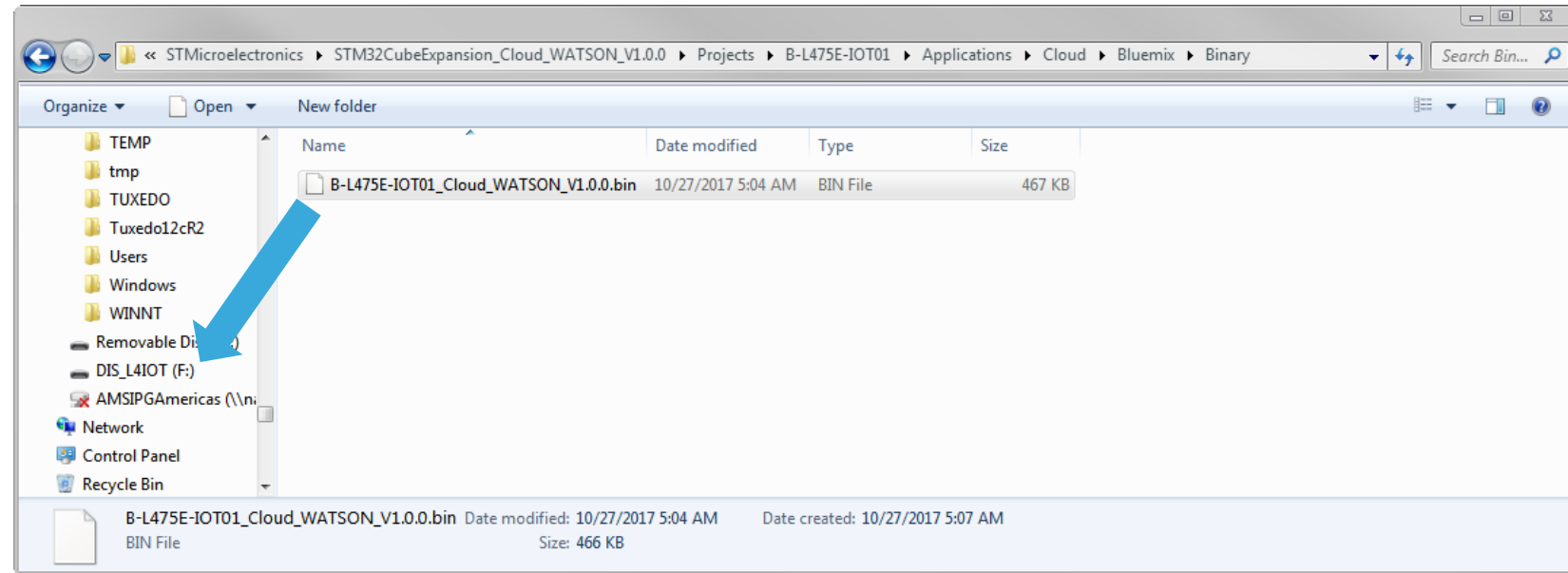
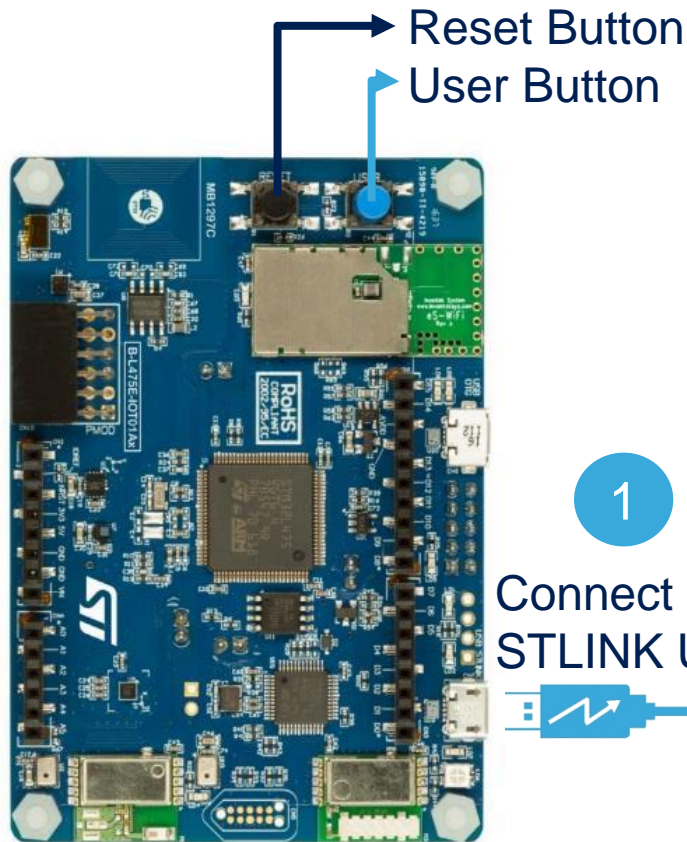
```
mano@Mano-HP8460p: ~  
[ 1277.173596] sd 6:0:0:0: [sdb] Attached SCSI removable disk  
[ 1295.516620] usb 2-1.2: USB disconnect, device number 7  
[ 1295.553583] blk_partition_remap: fail for partition 1  
[ 1297.017230] usb 2-1.2: new full-speed USB device number 8 using ehci-pci  
[ 1297.128516] usb 2-1.2: New USB device found, idVendor=0483, idProduct=374b  
[ 1297.128524] usb 2-1.2: New USB device strings: Mfr=1, Product=2, SerialNumber  
=3  
[ 1297.128529] usb 2-1.2: Product: STM32 STLink  
[ 1297.128533] usb 2-1.2: Manufacturer: STMicroelectronics  
[ 1297.128538] usb 2-1.2: SerialNumber: 066FFF484851877267045729  
[ 1297.388141] usb-storage 2-1.2:1.1: USB Mass Storage device detected  
[ 1297.388461] scsi host6: usb-storage 2-1.2:1.1  
[ 1297.389062] cdc_acm 2-1.2:1.2: ttyACM0: USB ACM device  
[ 1298.406662] scsi 6:0:0:0: Direct-Access  MBLD  Microcontroller  1.0  PQ  
: 0 ANSI: 2  
[ 1298.407553] sd 6:0:0:0: Attached scsi generic sg2 type 0  
[ 1298.408136] sd 6:0:0:0: [sdb] 2120 512-byte logical blocks: (1.09 MB/1.04 MiB  
)  
[ 1298.408851] sd 6:0:0:0: [sdb] Write Protect is off  
[ 1298.408857] sd 6:0:0:0: [sdb] Mode Sense: 03 00 00 00  
[ 1298.409738] sd 6:0:0:0: [sdb] No Caching mode page found  
[ 1298.409749] sd 6:0:0:0: [sdb] Assuming drive cache: write through  
[ 1298.433859] sd 6:0:0:0: [sdb] Attached SCSI removable disk  
mano@Mano-HP8460p:~$
```

Note down device
name for Discovery Kit



How to Flash the IoT DK

14



- 2 Drag'n'Drop
B-L475E-IOT01_Watson_IoT_Cloud_1.0.2.bin
into
DIS_L4IOT (F: in the example)
This action will flash the board with the
new FW
- 3 Press the Reset Button
to restart program

```
COM105 - Tera Term VT
File Edit Setup Control Window KanjiCode Help
*****
*** STM32 IoT Discovery kit For STM32L475/STM32F413/STM32F769 MCU ***
*** X-CUBE-WATSON-X Cloud Connectivity Demonstration ***
*** FW version 1.0.1 - Jul 26 2018, 11:10:45 ***
*****

*** Board personalization ***

*** WIFI connection ***

Push the User button (Blue) within the next 5 seconds if you want to update the
WiFi network configuration.

Your WiFi parameters need to be entered to proceed.

Enter SSID: stm32iot
You have entered stm32iot as the ssid.

Enter Security Mode (0 - Open, 1 - WEP, 2 - WPA, 3 - WPA2):3
You have entered 3 as the security mode.

Enter password: stm32iot

Initializing the WiFi module
Module initialized successfully: Inventek eS-WiFi ISM43362-M3G-L44-SPI C3.5.2.5.
STM
Retrieving the WiFi module MAC address: c4:7f:51:03:7c:8e

Connecting to AP: stm32iot Attempt 1/3 ...
Connected to AP stm32iot
Mac address: c4:7f:51:03:7c:8e
Retrieving the IP address.
IP address: 192.168.1.69
Do you want to update your way to register, or the device credentials? (y/n)
y
Enter Registration Mode (1 - Quickstart, 2 - Simple):1
You have selected the Quickstart registration mode.

Enter the Bluemix connection string of your device: (template: DeviceType=xxx;De
viceId=xxx)
DeviceType=IoTDK;DeviceId=IoTDK972
connection string: --->
QuickStart;DeviceType=IoTDK;DeviceId=IoTDK972
<---
Setting the RTC from the network time.
```

IoT DK Setup

15

- Enter SSID: **stm32iot_ibm**
- Enter Security Mode (3 - WPA2): **3**
- Enter Password: **stm32iot_ibm**
- Enter Registration Mode (1 - Quickstart): **1**
- Enter the Bluemix connection string of your device:
DeviceType=IoTDK;DeviceId=IoTDK972



Homework

System Workbench for STM32

(requires registration to openstm32.org)

17



<http://www.openstm32.org/Downloading+the+System+Workbench+for+STM32+installer>

- install_sw4stm32_win_64bits-v2.5.exe



- install_sw4stm32_macos_64bits-v2.5.run

- Warning: To run System Workbench for STM32 on MAC OSX systems, XCode may be required. To download it, please refer to the Apple developer website (registration as Apple Developer is required)
- The downloaded installer is an executable binary file. Your web browser might have removed the execution right of the file. Please set the execution right to the installer file (chmod 755 install_sw4stm32.run then ./install_sw4stm32.run) OR Launch it with /bin/bash (/bin/bash install_sw4stm32.run)
- If an error message saying the installer “is damaged and can’t be opened. You should move it to the Trash.”, please modify the installation access right in the Gatekeeper. On latest version of MAC OSX, go in the terminal:

```
#To disable
sudo spctl --master-disable
#To set the Gatekeeper access right back
sudo spctl --master-enable
```

- On older version of MAC OSX:
- Go in the “System Preferences” > “Security & Privacy”, then select “Allow downloaded app from :” “Anywhere”. When the installation is done, restore the setting value back at “Mac App Store and identified developers”



- install_sw4stm32_linux_64bits-latest.run

- The installer in GUI-mode requires gksudo. On Ubuntu, gksudo is in package gksu, that you can install by sudo apt-get install gksu. If gksudo is not installed, the installer can still be launched in command-line.
- The downloaded installer is an executable binary file. Your web browser might have removed the execution right of the file. Please set the execution right to the installer file (chmod 755 install_sw4stm32.run then ./install_sw4stm32.run) OR launch it with /bin/bash (/bin/bash install_sw4stm32.run)



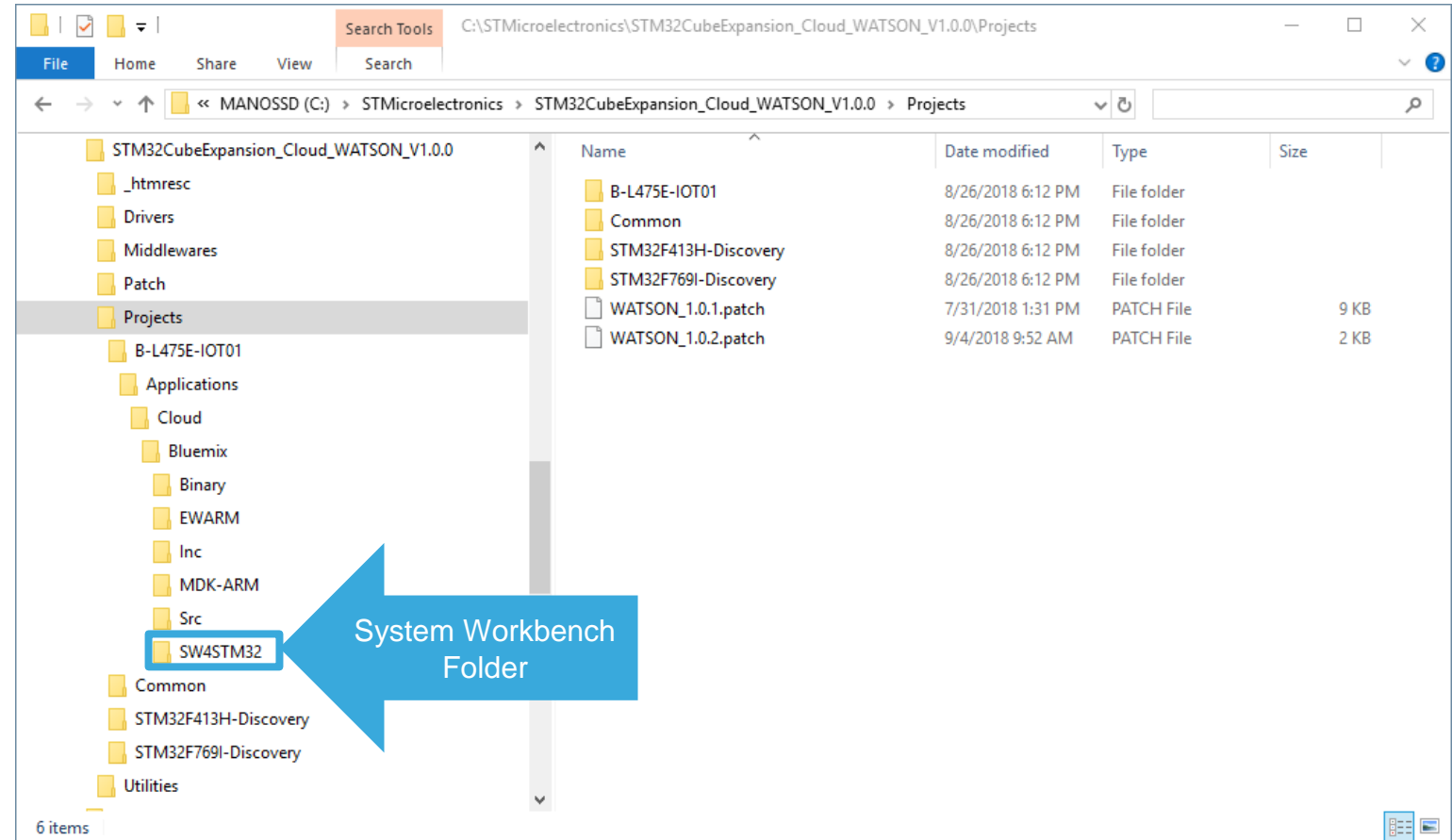
X-CUBE-WATSON V1.0.0

18

WATSON_1.0.2.patch is a cumulative patch which must be applied on top of WATSON_1.0.1.patch

To apply a patch from the Project directory of the WATSON.1.0.0 release:

- `patch -p1 < WATSON_1.0.1.patch`
- `patch -p1 < WATSON_1.0.2.patch`



- Atollic TrueSTUDIO for STM32 is a commercially enhanced C/C++ IDE based on open source components with powerful professional extensions, features and utilities.
- **Now available free for STM32 developers!**
 - Free to download and use for STM32 development
 - Single installer for all components
 - Out of the box support for STM32 boards and devices
 - Full-featured IDE with advanced debugging and code analysis
 - Project wizards and importers
 - Getting started tutorials plus tips and techniques
 - User forum
- Atollic provides a single installer for all TrueSTUDIO editions, one for each operating system.
 - <https://atollic.com/resources/download/>



How to Open the Project in TrueSTUDIO

20

- Launch Atollic TrueSTUDIO for STM32
- File → Open Project from File System... → Import Source: [Directory]
 - Point to ..\STM32CubeExpansion_Cloud_WATSON_V1.0.0\Projects\B-L475E-IOT01\Applications\Cloud\Bluemix\SW4STM32
- Press Finish, two projects will be created
- Right Click on SW4STM32 and Delete
- Run → Debug Configurations...
 - Click Embedded C/C++ Application
 - Sub Menu Debugger, Select ST-LINK
- Before Building the project (Linux Only):
 - Change ..\STM32CubeExpansion_Cloud_WATSON_V1.0.0\Projects\Common\Bluemix\Inc from lower to UPPER case

