**What are the units used for the sensor values?**
**Hint: refer to the manual and the BSP source code for the Microcontroller and the sensors. (if not explicit showing units, please show the information about resolution (8-bit/16-bit etc and the range about the measurement)**

| Device | Unit | Other information |
|---|---|---|
| 60 hPa to 1260 hPa absolute digital output barometer (LPS22HB) | hPa | 24-bit pressure data output |
| relative humidity and temperature (HTS221) | rH for humidity, °C for temperature | 16-bit |
| High-performance 3-axis magnetometer (LIS3MDL) | guass | |
| 3D accelerometer and 3D gyroscope (LSM6DSL) | G / dps | |

**What is I2C read address and I2C write address allocated for the LSM6DSL 3D accelerometer and 3D gyroscope sensors in the IoT node (B-L475E-IOT01A or B-L4S5I-IOT01A)? (Hint: refer to the manual and the BSP source code for the Microcontroller and the sensors.)**

| Command | SAD[6:1] | SAD[0] = SA0 | R/W | SAD+R/W |
|---|---|---|---|---|
| Read | 110101 | 0 | 1 | 11010101 (D5h) |
| Write | 110101 | 0 | 0 | 11010100 (D4h) |
| Read | 110101 | 1 | 1 | 11010111 (D7h) |
| Write | 110101 | 1 | 0 | 11010110 (D6h) |

**What are the main differences I2C between SMbus (System Management Bus)?**

The following answers refer to the website:

- SMBus是一種2線式匯流排，類似於飛利浦公司於1980年代開發的I2C 匯流排。兩個主要訊號是時脈(SMBCLK)和數據(SMBDAT)。I2CPrimer和SMBus相互相容，但存在明顯差異，例如：
- SMBus邏輯位準閾值是固定的，與元件的電源電壓不成比例。因此，具有不同電源電壓的元件可以在同一Primer上運行。例如，一個SMBus可能具有多個由1.8 V、3.3 V和5 V電源供電的元件。
- 它們都以最高100 kHz的相同速度運行，但I2C Primer有400 kHz和2 MHz兩個版本。
- SMBus規定了最低時脈速度，並限制了時脈在一個事務中可以延展的量。違反超時限制會導致所有SMBus元件重定其I／O邏輯以允許匯流排重啟。這種設計增強了匯流排的穩固性。

- 二者的超時也不同。I2C Primer沒有超時，而SMBus有超時——對於10 kHz最低時脈速度，可以考慮35 ms的超時。
- 分組差錯校驗(PEC)最初是為SMBus定義的。在每個事務的尾端增加一個分組錯誤碼位元組。
- 其餘的一些差異涉及傳輸類型、警報線、暫停線、關斷或上電。

### What is the I2C address of ADXL 345, if ALT ADDRESS is connected to HIGH? (hint: check the lecture note and the manual of ASXL 345 that can be found at Internet)

- With the ALT ADDRESS pin high, the 7-bit I2C address for the device is 0x1D, followed by the R/W bit

### How to connect two open-drain signal lines to achieve the wired-AND logic?

- Connect them together and then add a pull-up resistor.

### What is the main difference between the bus master and the bus slave?

- The master is defined as the one who is normally operating on the external bus, performing instruction fetches and data read/writes from/to the external memory. The slave is defined to normally execute out of internal resources, such as its internal ROM or RAM. (Reference)

### Personal report:

The lecture was mainly about communication protocols such as SPI, I2C and UART. I got to learn the basic differences between these three protocols, as well as the applications scenario. Through this experiment, I learn how STM32 module connects the Internet and communicates with servers via http protocol. I also learn how to gather the data acquired by on-board sensors on the module. This experiment is very useful for an IoT project.

### Codes:

https://github.com/stanthemaker/EmbeddedSystem/tree/main/hw2