# Toxic-Detection-PCB – Product Brief

## Revision

| Revision | Date | Author | Comment |
|---|---|---|---|
| v4.0 | Oct 16 | Paul Capgras | First draft |

## 1. Motivation

This project aims to design a new PCB to interface with **2 sets of 4 chemical sensors** used to detect toxic gases in the air.

The previous electronic interface, **TELLUS Network Sensor Solutions (rev. 3.2)**, is now limited because it provides only one interface for the sensor AFE, thus supporting only four sensors instead of eight. The current workaround uses **two TELLUS boards** connected in a controller/target architecture.

In parallel, the first AI models have been developed and deployed on an **STM32** to perform real-time toxic gas detection. These algorithms were tested on an STM32 development board but **cannot be embedded** in the current TELLUS board, as the onboard **ESP32** MCU is not powerful enough to run this new software.

A new revision of the TELLUS board is therefore required, with two main goals:

- Support **2 sets of 4 chemical sensors** by providing two AFE interfaces.
- Integrate a **computing chip powerful enough** to handle the new software requirements.

## 2. Functional Description

The device will interface with **two sets of four chemical sensors** and **one temperature sensor**.

- Every **10 seconds**, a measurement of the eight sensors is performed.
- Every **minute**, a Wi-Fi communication occurs to push data to:
    - **Mode 1:** the cloud database, or
    - **Mode 2:** a local computer connected via Wi-Fi.

Data processing can also be enabled and performed on the onboard MCU before transmission via Wi-Fi.

The device will be **powered through a USB-C connector**. The external power source (transformer or battery) is **out of scope** for this project.

The device will include a **computing chip powerful enough to run small AI models**, such as the **STM32H755**. It will be **reprogrammable** as many times as the user desires.

Additional features:

- Provide **power for a ventilator**.
- Optionally support a **LoRa connection**.

## 3. Electrical Specifications

- **Input power:** 5 V via USB-C connector
- **Maximum power consumption:** TBD

## 4. Mechanical and Form Factor

- **Board dimensions:** Must fit within the predefined box (TBD).
- **Mounting holes:** Yes (4 total, size TBD).
- **Connector placement constraints:** None.
- **Other mechanical constraints:** None.

## 5. Interface & Connectivity

- 2 interfaces for 4-sensor AFEs
- 1 interface to power a ventilator
- 1 LoRa interface (optional)
- 1 USB-C connector for power
- Programming/debug interfaces

## 6. System Block Diagram

TBD

## 7. Design Constraints

- **PCB layers:** Up to 4
- **EMI/EMC requirements:** None
- **Safety certifications:** None
- **Standard certifications:** None
- **ESD protection:** Yes, where required

## 8. Power Architecture

No specific requirements at this stage.

## 9. Firmware / Software Considerations

- Existing projects were developed using **ESP32-WROOM** and **STM32H755**.
- The Wi-Fi stack uses **MQTT** protocol.

## 10. Testing & Validation

- All signals should be accessible for probing.
- All power lines should be easily accessible.
- The debug bus should be clearly exposed for observation.

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## 11. Deliverables

- Component selection
- Schematic
- Schematic design notes
- PCB layout
- Layout design notes
- Bill of Materials (BOM)
- Gerber files

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## 12. Manufacturing & Assembly

- **Manufacturing:** External
- **Assembly:** TBD (to decide whether in-lab or outsourced)

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## 13. Questions

The **TELLUS Network Sensor Solutions board** includes more features than required for this project (see Motivation). Unless stated otherwise, these will **not be retained**.

| Feature | Keep? |
|---|---|
| Microphone | No |
| Temperature & humidity sensor | No |
| PM sensor connector (MOLEX-53261-0871) | No |
| User button | No |
| Thermal probe | No |
| eSIM interface | No |
| GNSS antenna | No |
| Main antenna | No |
| BG77 module | No |
| GPS module | No |
| GPS antenna | No |

Additional open points:

- Should we include a **microSD card connector**?

- Will the PCB be **assembled in the lab** or externally?

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# Appendix

## Why a measurement every 10 seconds?

Because real-time operation is required for many applications, and the evolution of air composition is slow enough to justify a sampling frequency of **0.1 Hz**.

## Why can’t we process the data in the cloud?

Because the project targets applications that may **not have cloud connectivity** and might require **immediate, local alerts** (e.g., alarms, warning lights).