

# Toxic-Detection-PCB – Product Brief

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## Revision

Revision	Date	Author	Comment
v4.0	2025, Oct 16	Paul Capgras	First draft
v4.1	2025, Nov 10	Paul Capgras	Take into account review from Tharnath, Raven and PE.
v4.2	2026, Feb 12	Paul Capgras	Update architecture diagrams

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## 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.
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## 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.

Measurement includes the device position using GNSS.

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**.
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### 3. Electrical Specifications

- **Input power:** 5 V via USB-C connector
  - **Maximum power consumption:** TBD
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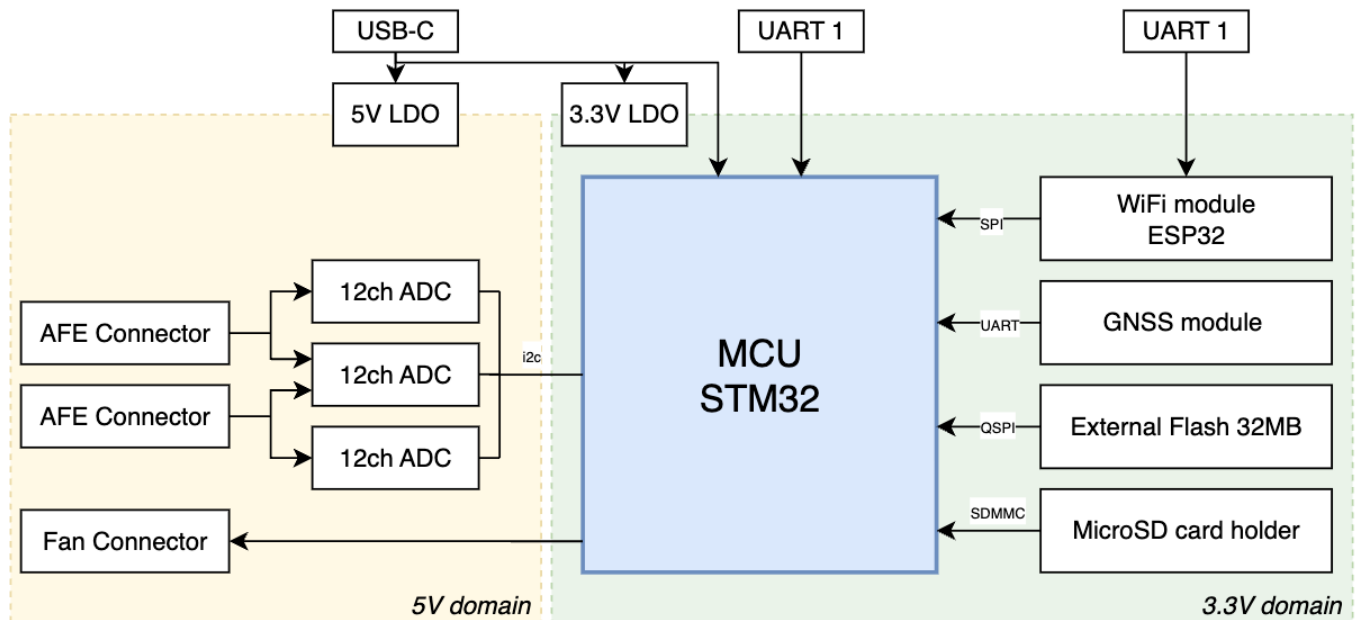
### 4. Mechanical and Form Factor

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

- 2 interfaces for 4-sensor AFEs
  - 1 interface to power a ventilator
  - 1 GNSS device
  - 1 SD card device
  - 1 EEPROM / flash
  - 1 LoRa interface (optional)
  - 1 USB-C connector for power
  - Programming/debug interfaces
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### 6. System Block Diagram



## 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.

## 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

**A GNSS module should be kept.**

## 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).

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

Yes.

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

In house for prototyping, external for production.

What is the confidentiality level of the project? Once finished, can it be open-source?