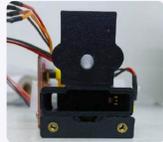# TLD Rack Automation System

The TLD Rack Automation System is an intelligent, RFID-enabled rack solution designed for automated tracking, monitoring, and management of TLD badges. The system ensures correct badge placement, real-time identification, and alerts for missing or incorrectly returned badges through visual, audio, and SMS notifications.

This also enables centralized control and slot assignment through a server-based architecture, ensuring operational accuracy and traceability. The system is ideal for radiation monitoring facilities, laboratories, hospitals, and other controlled environments requiring secure and reliable personnel dosimetry handling ensuring operational accuracy, traceability, and audit readiness.

Automated Badge Tracking	Modular Rack Design	Real-Time Monitoring	PoE-Powered System	SMS Alert System

System Overview

System Type	Automated TLD Badge Storage Rack
Identification Method	NFC / RFID (13.56 MHz)
Rack Configuration	3 × 3 Matrix (9 Racks)
Total Racks	9
Slots per Rack	16
Total Badge Capacity	144 TLD Badges
Slot Assignment	Server-managed
Communication	Ethernet, LTE
Power Delivery	Power over Ethernet (PoE)

Identification & Slot Interface

RFID Reader Model	PN532 or equivalent
RFID Communication Interface	UART
Slot Detection Method	Mechanical Limit Switch
Visual Indication	Slot-wise LED
Audio Feedback	Integrated Buzzer
Wrong Slot Detection	LED Blink Indication

Communication & Alerts

Wireless Modem	Cavli C16QS
Cellular Network	LTE Cat-1 bis
Alert Mechanism	SMS Alert for Non-Returned Badge
Networking Interface	Ethernet with PoE
PoE Switch	16-Port TP-Link

Control & Processing

Main Controller	ESP32 Olimex PoE
Controller Architecture	Dual-core Xtensa 32-bit
Server Processor	Raspberry Pi 4
Server Functionality	MQTT Broker & Rack Server

Mechanical & Application Details

RFID Reader Offset	5 mm
NFC Tag Offset	6 mm
Slot Construction	Acrylic + SS Cover