

**TECHNOLOGY MANAGEMENT**

**SpecificATION**

**Integrated Locomotive Tracking Unit**

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Table of Contents

[1. Scope 3](#_Toc201931484)

[1.1. Identification 3](#_Toc201931485)

[1.2. System Overview 3](#_Toc201931486)

[1.3. Abbreviations 3](#_Toc201931487)

[1.4. Applicable documentation 3](#_Toc201931488)

[2. Functional Requirements 3](#_Toc201931489)

[3. Performance requirements 4](#_Toc201931490)

[4. Operational and maintenance requirements 5](#_Toc201931491)

[5. Security Requirements 5](#_Toc201931492)

[6. General System implementation requirements 5](#_Toc201931493)

[7. Quality Assurance 5](#_Toc201931494)

# Scope

## Identification

## System Overview

{Context Diagram}

Real time locomotive position communicated promptly.

## Abbreviations

## Applicable documentation

# Functional Requirements

* 1. The LTU shall determine its position using a Global navigation satellite system (GNSS).
  2. The LTU shall log and send position data at a configurable interval (e.g., 10s, 30s, 60s).
  3. Each recorded position shall be time-stamped using Transnet network time as the reference clock.
  4. The LTU shall measure position continuously while powered.
  5. The LTU shall transmit position data to a central server using satellite communications.
  6. In case of communication failure, the LTU shall retry transmission until successful.
  7. Critical communication (e.g., real-time position data, train number assignments) shall always be prioritized.
  8. Communication protocols shall be divided by priority:
     1. Critical messages (real-time positions, train number assignments/deactivations) shall use satellite communications.
     2. Non-critical messages (e.g., software updates, self-checks, data backups) shall use GSM or an equivalent cellular network when available.
  9. Use of a supplier or third-party server as an intermediary is permitted, provided that API integration options are available for communication with a TRIM server.
  10. Each LTU shall have a unique device ID.
  11. Each LTU shall be configurable with a locomotive number.
  12. Both the unique ID and configured locomotive number shall be included in all outbound position messages.
  13. The LTU shall be capable of receiving and processing train number assignment and deactivation messages.
  14. The LTU shall support this train number assignment workflow:
      1. Step 1: LTU receives a train number assignment message from the server.
      2. Step 2: LTU prompts the user for confirmation via the onboard interface.
      3. Step 3: Upon user confirmation, the LTU stores the train number in local memory.
      4. Step 4: When a "train clear and complete" message is received from the server, the user is prompted to confirm this state.
      5. Step 5: Upon user confirmation, the LTU clears the train number from memory.
  15. The LTU shall have a simple onboard display and input interface.
  16. The display shall provide the following information:
      1. Configured Locomotive Number
      2. Currently Assigned Train Number
  17. The input interface shall consist of:
      1. One "Up" and one "Down" button to scroll through display information
      2. One "OK" button to confirm actions (e.g., train number assignment confirmation)
  18. The LTU shall support over-the-air (OTA) software updates.
  19. The LTU shall perform periodic self-checks and system diagnostics.
  20. The LTU shall maintain a rolling log of the last {X} hours/days of position reports, regardless of communication success.
  21. Logs shall be downloadable via local USB or Bluetooth interface (if available) for forensic or compliance purposes.
  22. The LTU shall be powered by the locomotive’s auxiliary power system. (Refer to Power Specification Document). The Locomotive System shall be powered from the locomotive’s 50 - 110V DC battery supply. BBF0944 Version 7

# Performance requirements

* 1. The positional accuracy shall be within {X meters or degrees}.
  2. Position data must be transmitted and received by the central server within {10 seconds} under normal operating conditions.
  3. If the LTU loses power, it shall resume position tracking within {X} minutes of being powered on again.
  4. The LTU shall achieve a system availability of >99% during any 30 -day period, excluding times of locomotive inactivity (and resulting power loss).
  5. In the event of communication failure, the LTU shall retain up to **{7 days}** of data in local storage.
  6. The LTU shall have onboard non-volatile memory of **{XX GB}** for local data storage.
  7. Stored data must persist across power cycles and device restarts.
  8. The LTU shall implement a graceful shutdown mechanism to protect onboard computing systems in case of power loss and ensure critical data is not lost.
  9. The LTU’s screen and buttons shall respond to input within {1 second}.
  10. The interface shall display clear prompts for train assignment, confirmation, and errors.
  11. The central server and communication protocol must support at least 5 000 concurrent LTUs without degradation in response time.

# Operational and maintenance requirements

* 1. The LTU shall be appropriately environmentally hardened as per CSE-1154-001-CAT E48 Version 2 Class F.
  2. The unit shall comply with applicable electromagnetic compatibility standards for railway equipment.
  3. Power supply shall be immunised against higher surges than would normally be expected. In this respect the requirements that are stipulated in IEC 60571 should be used as a minimum.
  4. The equipment must be able to withstand vibration and shock according to IEC 61373.
  5. The system shall support remote firmware updates with rollback capability if an update fails.
  6. The LTU shall support diagnostic mode accessible via secure local interface (e.g., USB or mobile app).
  7. Hardware and software components shall be designed in a modular fashion for ease of repair or upgrade.

# Security Requirements

* 1. All remote server communications must be authenticated using tokens, keys, or signed messages.
  2. Local configuration must require secure PIN or password entry to prevent unauthorized access.
  3. Each LTU must securely process only the messages intended for its unique ID and shall not receive messages intended for another unit.
  4. All API-integrated transmissions shall support secure endpoints (authentication, encryption as per standard).

# General System implementation requirements

# Quality Assurance