Railway Case Study

by LoRa Alliance® and GS1 in Europe

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Within the framework of the MoU signed in 2020 between the LoRa Alliance and GS1 in Europe, to present the collaboration between two organisations developing open standards; LoRaWAN for the Internet of Things by LoRa Alliance and identification, data capture and data sharing by GS1 in Europe.

This document describes the value of collaboration between both organisations for the railway sector.

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Business needs in the railway industry

Context

▸Why?

- Railway asset tracking to improve punctuality, security, maintenance, operations in general

▸ Is there a community supporting these business need?

- Both the LoRa Alliance and GS1 members already have LoRaWAN projects ongoing in the railway industry

Issues we solve

▸ Pain points

- Inventory and condition monitoring of railway industry assets
- Heterogeneous IDs of railway assets
- Unstructured typology for information sharing
- Significant cost of collecting IDs and sensor data

▸ Expectations

- Cost effective visibility on railway assets
- Reducing the TCO (HW cost, OPEX/connectivity, long battery life) to collect IDs and sensor data (eg geolocation)

Description

▸Current processes or tools used regarding the business needs

- Manual reading is evolving towards RFID manual/automatic reading by fixed or mobile readers, but is still lacking a Long Range option.

▸Project scope

- Share GS1 identifiers (GIAI, SGTIN, SSCC, GLN,…) + additional sensor data (geolocation, temperature, vibration, shocks,…) over LoRaWAN
- Harmonize the compatibility between LoRaWAN and relevant standards such as the EPCIS data model to increase visibility between supply chain stakeholders

Objectives

General

▸Cost effective infrastructure to collect identification, geolocation and maintenance data from sensors and provide value to the railway industry:

- Improve safety
- Reduce operational costs
- Provide new customer services for end to end supply chain

▸Deliverables

- #1 Collection of requirements
- #2 First project proving use case
- #3 Communication and promotion at joint events
- #4 White paper explaining the value for industry players across the supply chain
- #5 Joint contribution to standards

Possible scenarios

▸Coverage

- Maintenance applications with private network on railway player sites
- Tracks or carriage applications with public network along the tracks

▸Geolocation

- For migration / retrofit market, using LoRaWAN with existing GPS/Wi-Fi
- For new installation market, using an advanced partner to bring recent LoRa Edge (benefit from integrated LoRaWAN with geographical location service)

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GS1 in Europe

Combining LoRaWAN and RFID for railway

Description

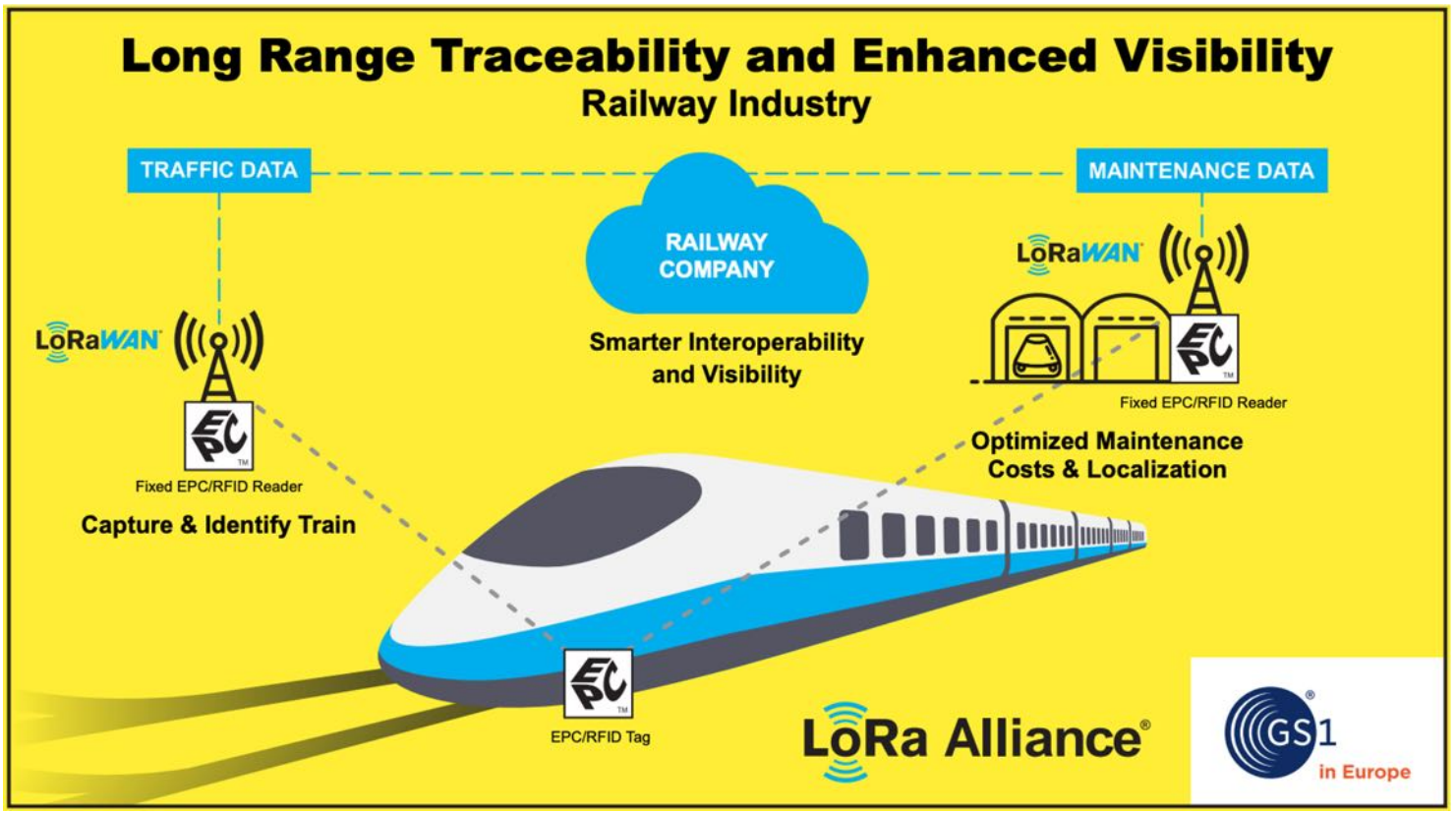
Interfacing fixed EPC/RFID readers with LoRaWAN Gateways and Network

2-way communication for
- EPC/RFID reader management
- Collecting data from EPC/RFID readers

Integration with
- Existing EPC/RFID infrastructure
- Existing LoRaWAN network

Benefits

- Reducing cost by removing cable between RFID reader and IT network
- Location of readers is flexible
- LoRaWAN coverage is available and covers entire train track
- Seamless integration with existing/legacy infrastructure
- Capturing, aggregating, merging data from different carriers
- Data is transmitted nearly in real-time and does not need to be stored locally
- Data sharing with more than one application a day
- RFID readers do not longer depend on access to CPU or internet



Project in France

Business value

- Cost effective visibility on railway industry assets allows inventory and condition monitoring to improve security, maintenance and operations in general
- Identify rolling stock for maintenance automated benches, washing stations, site or station entrance and exit
- Locate rolling stock in particular areas such as service tracks and tunnels

Solution

- RFID tags on rolling stock
- RFID readers at certain locations
- Transmitting GS1 EPC identifiers over LoRaWAN using private or public networks

Possible future improvements

- Implement standard adaptation layer to carry IP-based protocols over LoRaWAN based on Static Context Header Compression, SCHC
- Easier connection with mobile readers

Benoît Besson, Rail Open Lab Project manager from SNCF Réseau, said *« This collaboration should help us to be better in tracking and maintenance through the entire lifecycle of our assets (…)The expected results is to obtain standardized information by integrating GS1 identifiers in the LoRaWAN protocol.»*

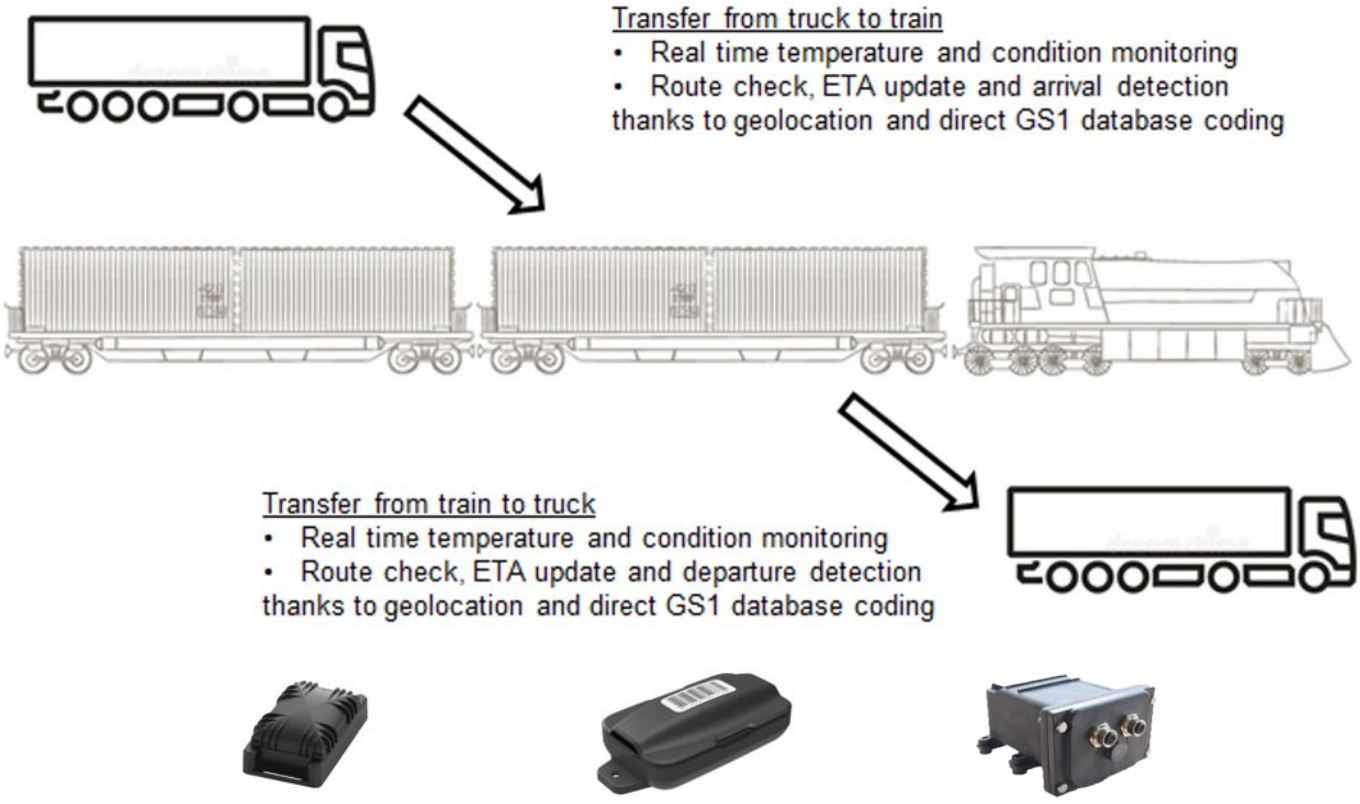
Partners

SNCF

GS1 France

LoRa Alliance®

Railway container tracking



LoRaWAN devices carrying GS1 identifiers with additional sensor data and geolocation

OVERVIEW

- GS1 EPC is data carrier agnostic
- EPC binary format can be encoded in any kind of electronic device
  - EPC/RFID tags
  - NFC tags
  - LoRaWAN devices
- Applications based on unique identification of assets can choose between the different data carriers
  - Long range
  - High-speed inventory
  - Smartphone readers
- Compatibility with GS1 Datamatrix 2D barcodes and EPCIS

DESCRIPTION

- Make use of LoRaWAN devices as an alternative to carry GS1 EPC identifiers such as GIAI, SGTIN, GLN, SSCC

BENEFITS (for end user)

- Benefit from the full set of GS1 standards and numbering system no matter the data carrier
- Leverage wireless LoRaWAN network and devices for any kind of IoT use-cases
- Avoid multiple markings on the same asset
- Reduce the TCO (HW cost, OPEX/connectivity, long battery life) to collect IDs and additional sensor data with geolocation

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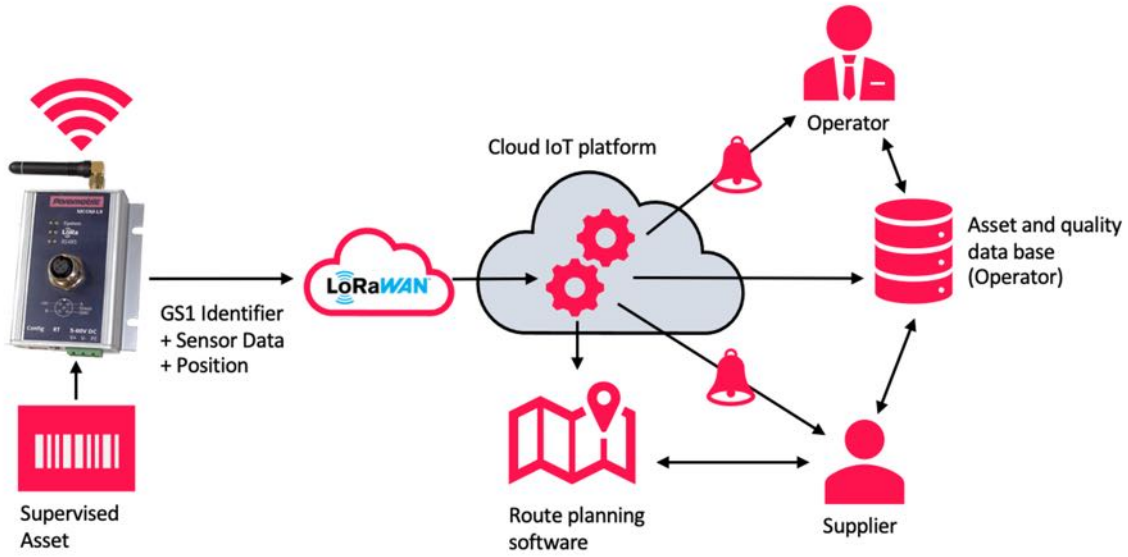
GS1 in Europe

Predictive Maintenance Planning, Product Lifecycle Tracing and Quality Assurance

Thanks to GS1 identified items and geolocation services, planning of replacements and materials sourcing can be done directly by the parts supplier or the railway operator. This greatly simplifies the maintenance process; 100% traceability of material replacements without additional administration, and increased quality and materials sourcing in advance saves a lot of time.

Useful for assets such as:

- Batteries (voltage, internal resistance, health)
- HVAC modules (air quality, heating/temperature, humidity)
- Fan operation (tachometer data)
- Bearings/wheels (vibration, shock)
- Traction converters / Control systems (status, energy consumption)
- Water closets (water level, lighting)



Process without live data/GS1+LoRaWAN:

1. Operator detects an issue
2. Operator checks hardware
3. Operator replaces hardware
4. Operator finds GS1 identifier and notifies supplier of issue
5. Operator generates new serial number
6. Operator orders new material
7. Supplier delivers new material
8. Inbound check of shipment
9. Operator changes entries in asset management database
10. Operator updates quality documents for supplier

Process with live data/GS1+LoRaWAN:

1. Issue detected based on sensor data
2. Supplier sends or replaces module
3. Inbound check of shipment
4. Asset management and quality database is automatically updated

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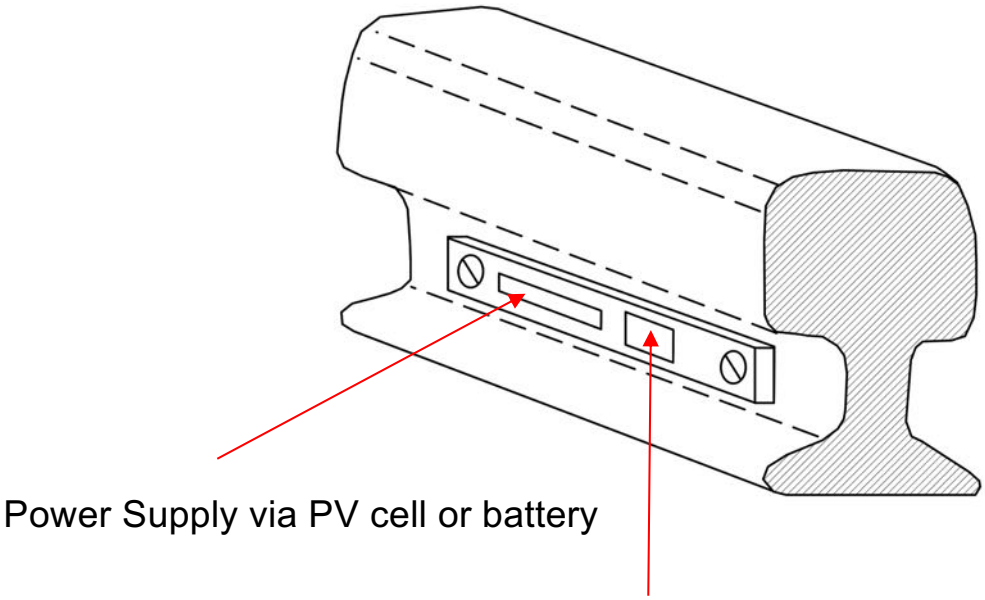
Parametric

GS1 in Europe

Intelligent Railway Track

Monitoring of railway track elements (and railway track bed) health and mechanical deformation of tracks in heat. Quality assurance by operator and supplier thanks to unique GS1 identifier. Train passage counting is also possible.



Power Supply via PV cell or battery

LoRaWAN Sensor with integrated strain gauge

Sensor measurements:

- Track temperature (Metal)
- Material Expansion
- Deflection

Data:

- Railway track quality and condition
- Train passages and timestamps
- Approximate train weight and number of axles
- Unique Identifier of railway track segment for quality control

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Appendix:
Key enabling technologies

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GS1 in Europe

GS1 system of standards

- SGTIN Serialized Global Trade Item Number
- SSCC Serial Shipping Container Code
- GRAI Global Returnable Asset Identifier
- GIAI Global Individual Asset Identifier
- GSRN Global Service Relation Number
- GDTI Global Document Type Identifier
- CPID Component Part Identifier + serial
- SGCN Serialized Global Coupon Number
- GINC Global Identification Number for Consignment
- GSIN Global Shipment Identification Number
- BIC BIC Container Code
- ADI Aerospace & Defense Identifier

https://www.gs1.org/standards/gs1-architecture

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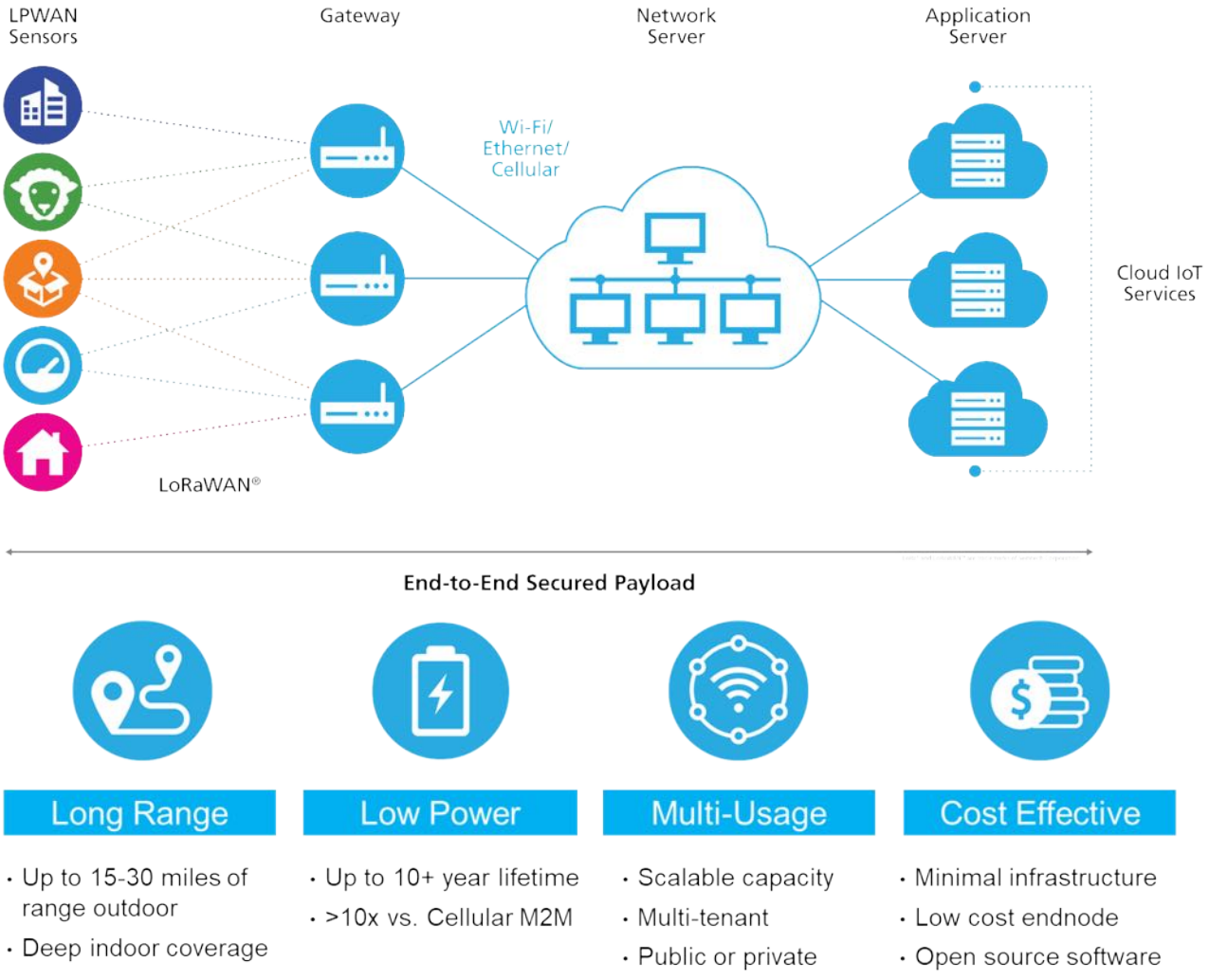
LoRaWAN architecture



Geolocation with LoRaWAN

LoRa Edge is an all-in-one chipset for tracking applications which combines LoRaWAN connectivity and cloud-based service for geolocation. It provides location accuracy indoor/outdoor and low power consumption, optimizing system cost, and complexity by eliminating the need for extra GNSS and Wi-Fi components. The resulting geo-coordinates can be either directly mapped in GLN or included in EPCIS message.

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