

HealthHub™

Smart asset monitoring for optimised life-cycle cost

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**ALSTOM**  
*Designing fluidity*

# Agenda

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- 1. Introduction**
2. HealthHub™ overview
3. Rolling Stock Data Capture and Processing
4. Infrastructure Data Capture and Processing
5. Condition Monitoring Tools for Data Analysis
6. Various application cases

# Introduction

## Alstom in maintenance activity

- Services is the entity in charge of Maintenance activity
  - Represents about 25% of Alstom turnover
  - It includes maintenance, modernisation, overhaul, renovation, parts
- Maintenance activities covers :
  - Rolling stock: Alstom and non-Alstom
  - Infrastructure: 5,000 Km of track maintained
  - Signalling: services focus on availability improvements and allowing continuous safe operation



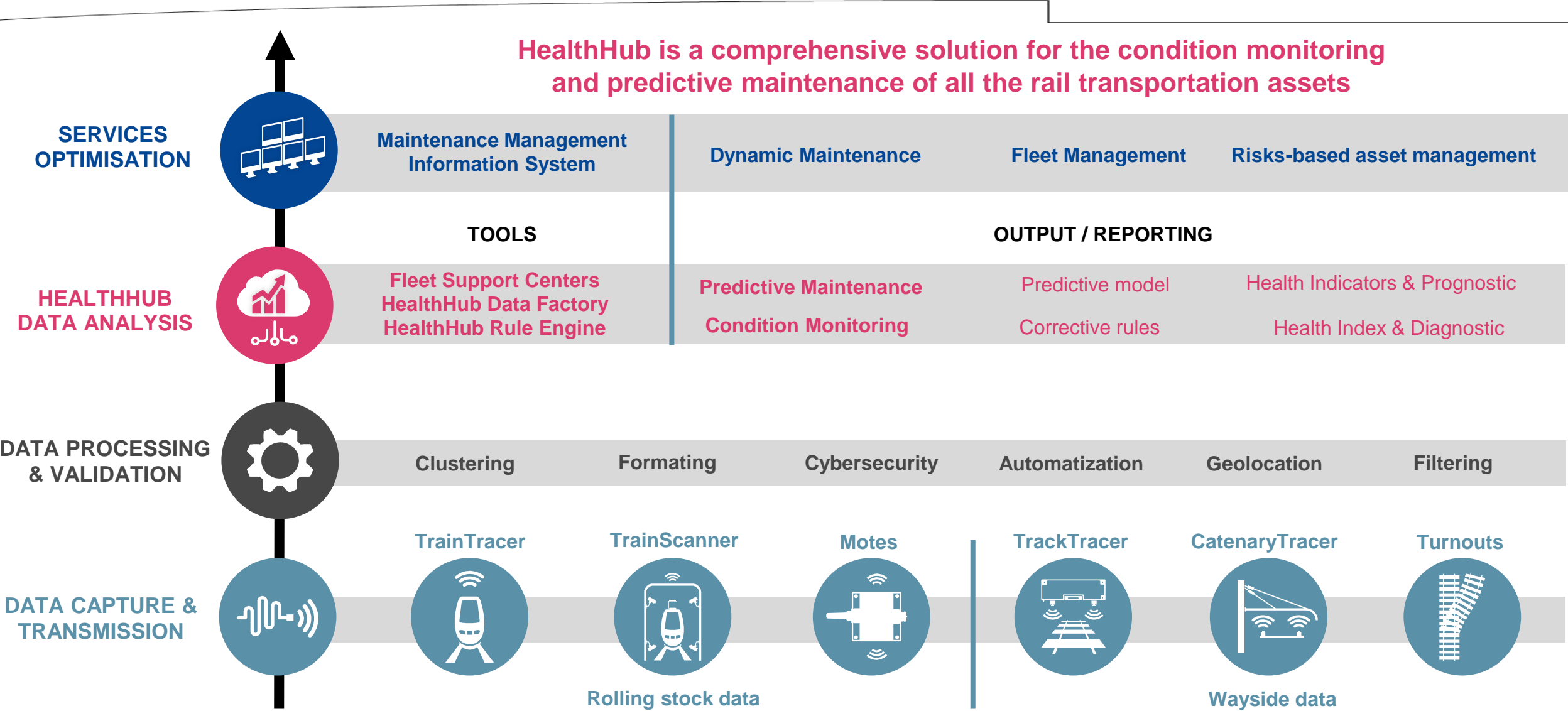
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2. **HealthHub™ overview**
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# What is HealthHub ?



# HealthHub™ objectives

## MAINTENANCE OPERATIONS

## HEALTHHUB OBJECTIVES

## BENEFITS

### CONDITION MONITORING

PATROLING, MEASURING, INSPECTING

HEALTH DIAGNOSTIC

TROUBLE SHOOTING

AUTOMATIZATION  
HIGHER FREQUENCY

REMOTE AND REAL TIME  
ACCURATE GEOLOCALIZATION

FALSE ALERTS REDUCTION  
FAILING ASSET IDENTIFICATION

TIME  
SAVINGS

KPI

### PREDICTIVE MAINTENANCE

HEALTH PROGNOSTIC

HEALTH MANAGEMENT

REMAINING USEFUL LIFE RULES  
ASSET LIFETIME INCREASE

DYNAMIC MAINTENANCE PLANNING  
SAF REDUCTION

LCC  
SAVINGS

KPI

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# Data capture and processing solution for rolling stock

## Train Tracer

- Collect on-board TCMS data
- Equipment status and events
- Position of alerts and events
- Data transmission to ground
- Data compilation per fleet



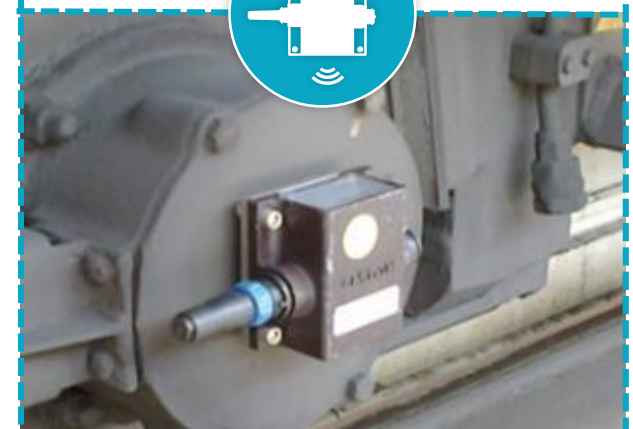
## Train Scanner

- Automatic train inspection for wheels, brake pads and pantograph carbon strip
- Automatic train integrity check



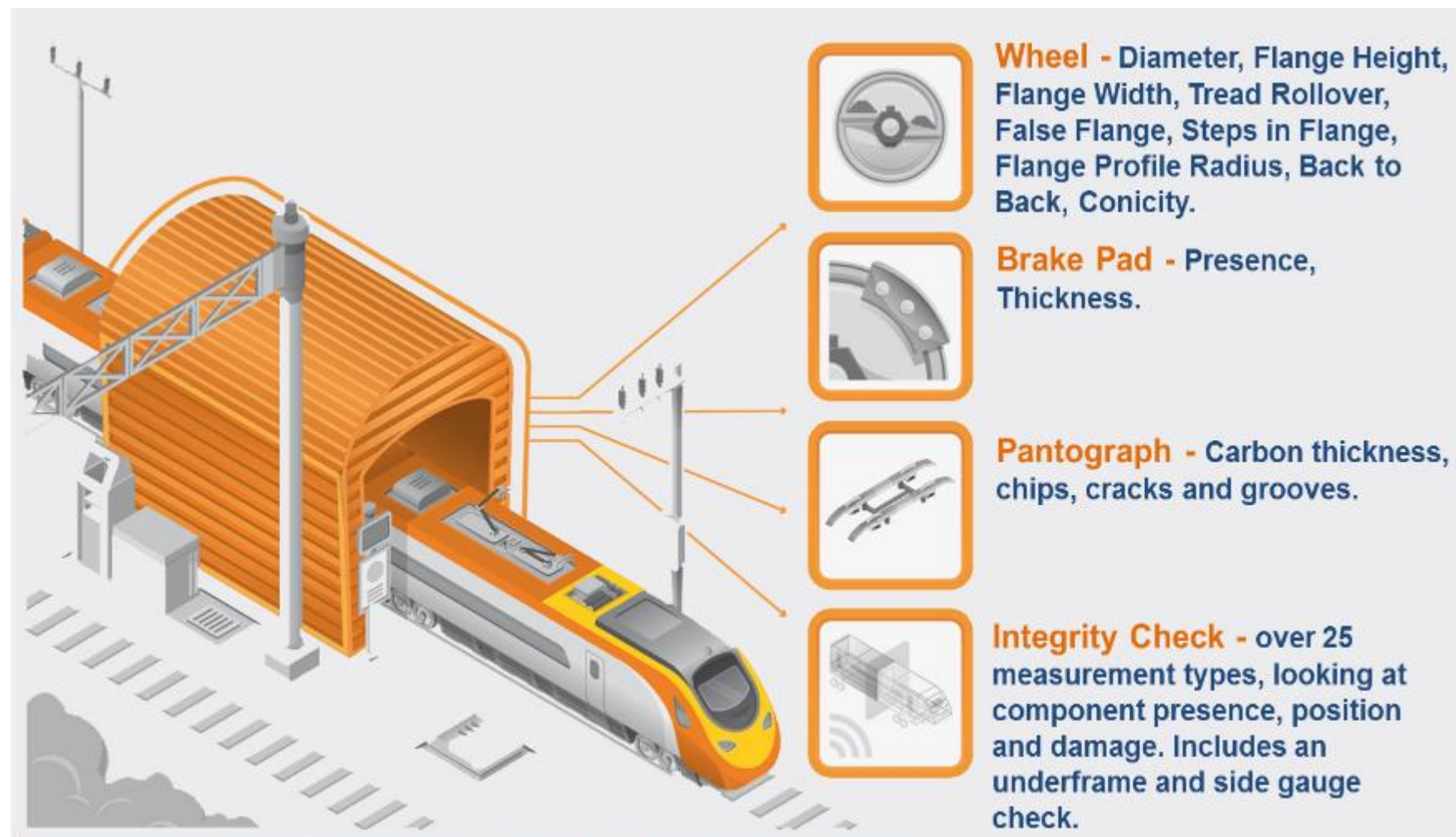
## Motes / IOT

- Monitor vibration
- Monitor temperature
- Monitor pressure
- Wireless data (LORA/Wi-Fi)





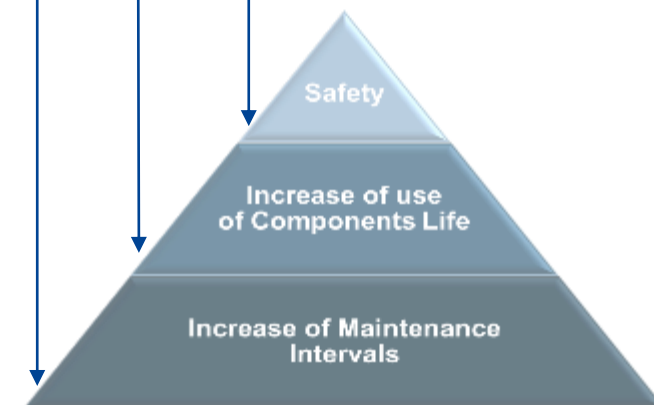
# TrainScanner: data capture for train wayside parameters



- Amtrak:  
7,500 → 15,000 km
- WCML:  
20,000 → 56,000 miles

- Wheels
- Brake pads
- Carbon strips

- Integrity Check
- Missing parts
- Avoidance of SAF

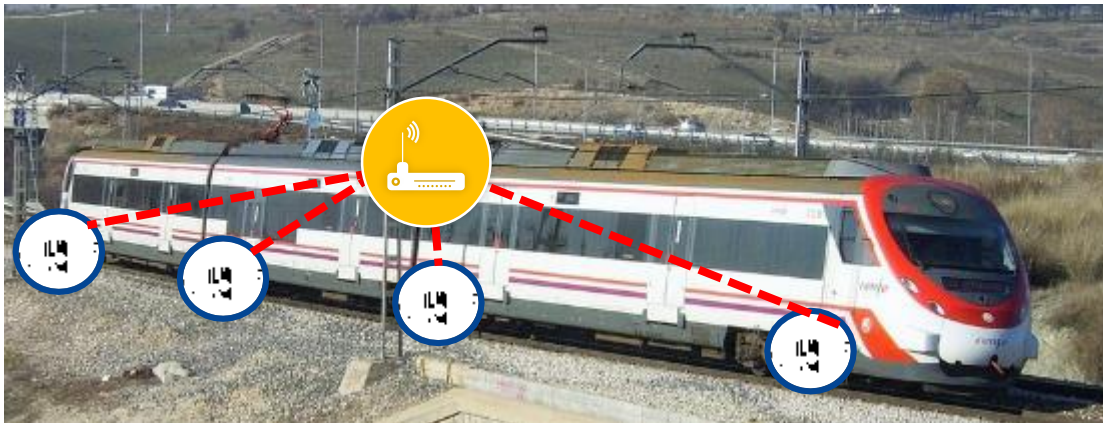


Measurements Include: Parameters, 3D Profiles, 2D Profiles and HD images.

# The Motes

## Mobile Data Capturing System:

- Full train length Coverage
- Enhanced Autonomy (>3 years)
- Enhanced Acceleration Sensor ( $\pm 50g$ , 5KHz)



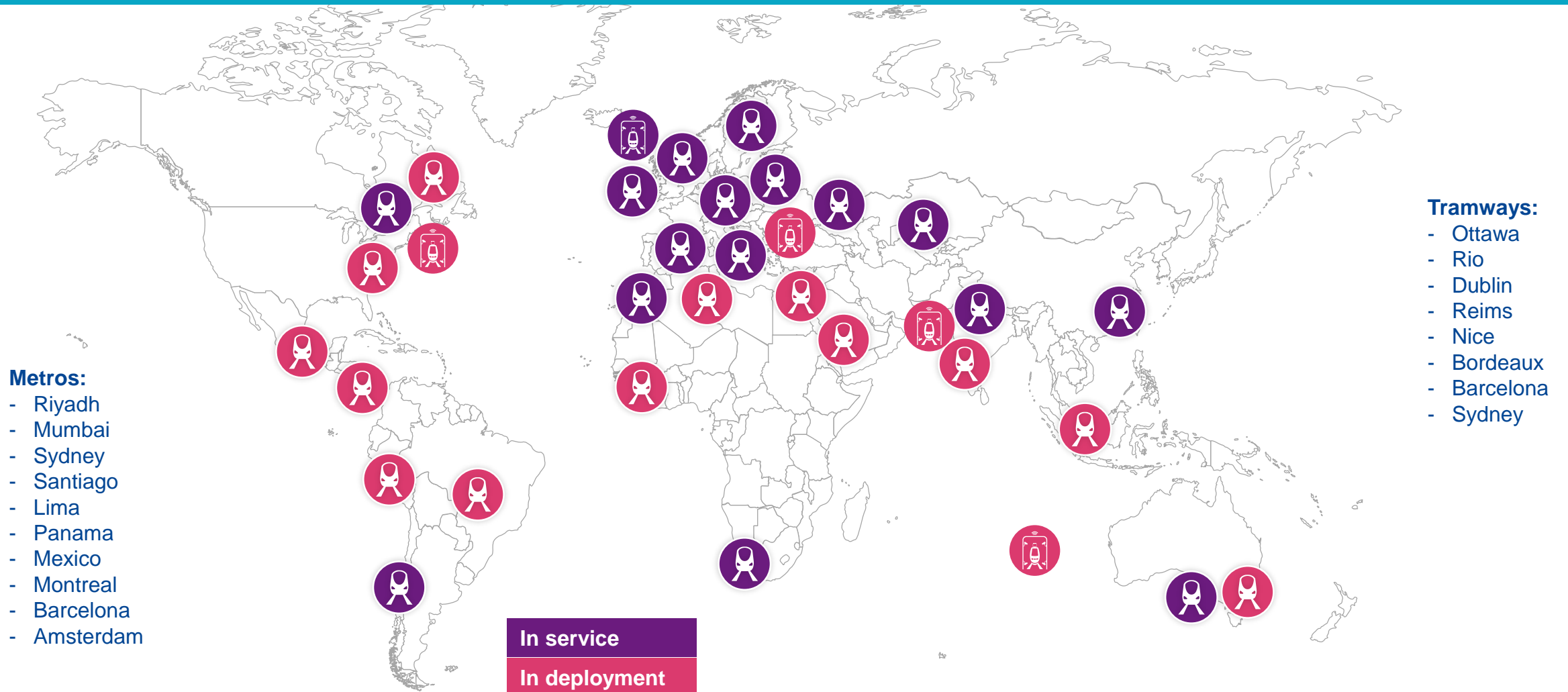
- LoRa wireless connectivity
- Ultra Low Power
- Short Range Communications
- Industrial Wired Bus



- Monitors vibration, temperature, pressure
- Easy installation
- Sensible data security is always enabled via encryption
- Immediate analysis feedback

# Rolling Stock references

More than 30 fleets with 2000 trains monitored since 2006



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# Data acquisition and condition monitoring for Infrastructure

## Track & Catenary Tracer

- Measure track geometry
- Measure rail corrugation
- Measure rail profile & wear
- Measure catenary geometry
- Measure contact wire wear



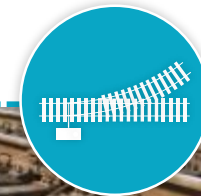
## APS & 3<sup>rd</sup> Rail Tracer

- Measure APS rail shocks
- APS rail video inspection
- Measure 3<sup>rd</sup> rail position
- Measure 3<sup>rd</sup> rail profile & wear



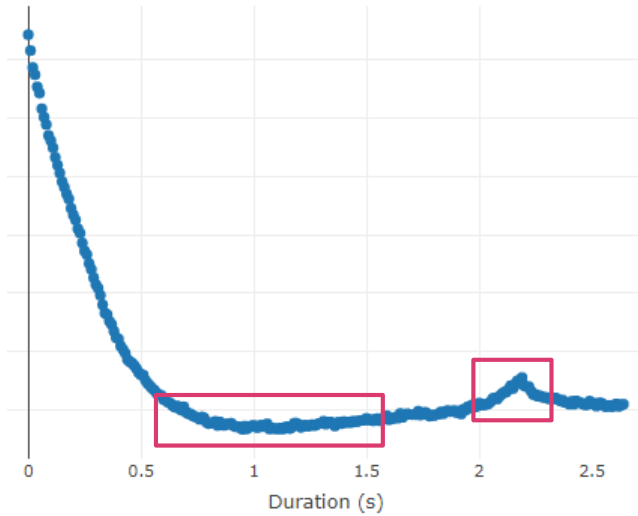
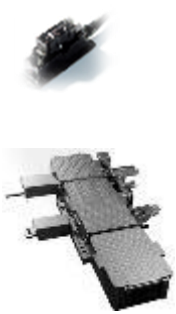
## Wayside Signaling

- Point machine health monitoring
- Track circuit health monitoring





# Point machine data capture and processing



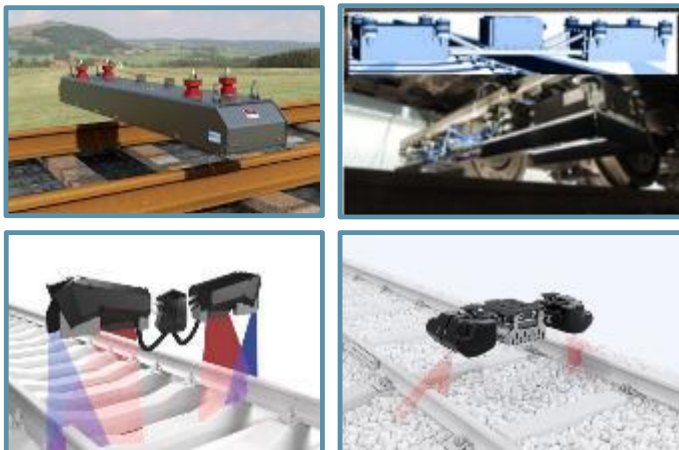
## A basic approach to detecting degradations

1. Storage of a « reference curve »
2. Setup of a set of thresholds around the reference curve with test benching
3. Creation of an alert when the signal acquired exceeds the threshold

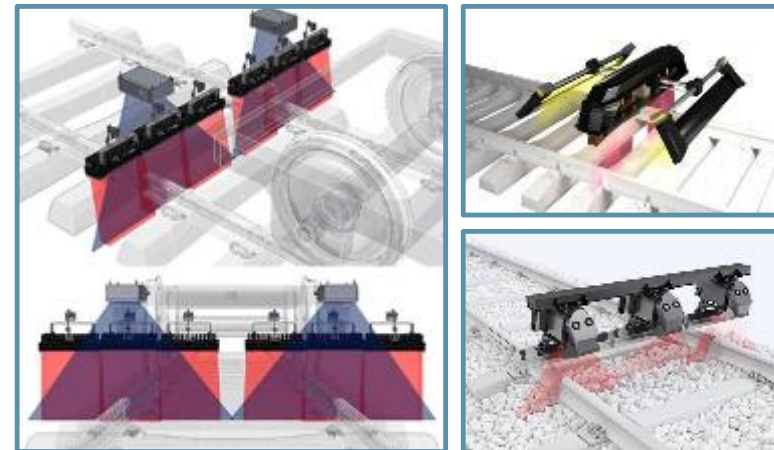


# Track data capture : measurement and inspection systems

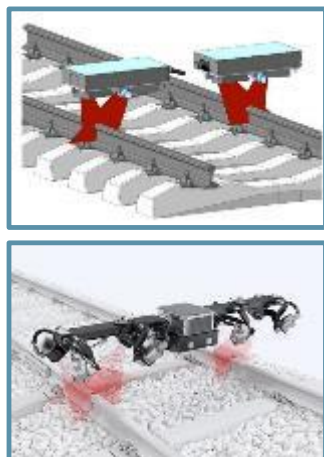
## Track Geometry Measurement systems



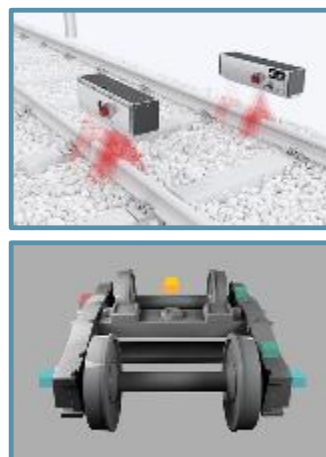
## Track Video Inspection systems



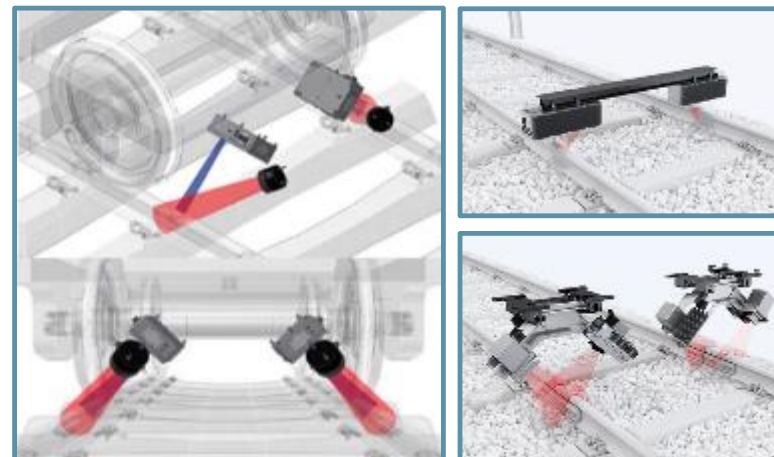
## Rail Profile / Wear



## Rail Corrugation



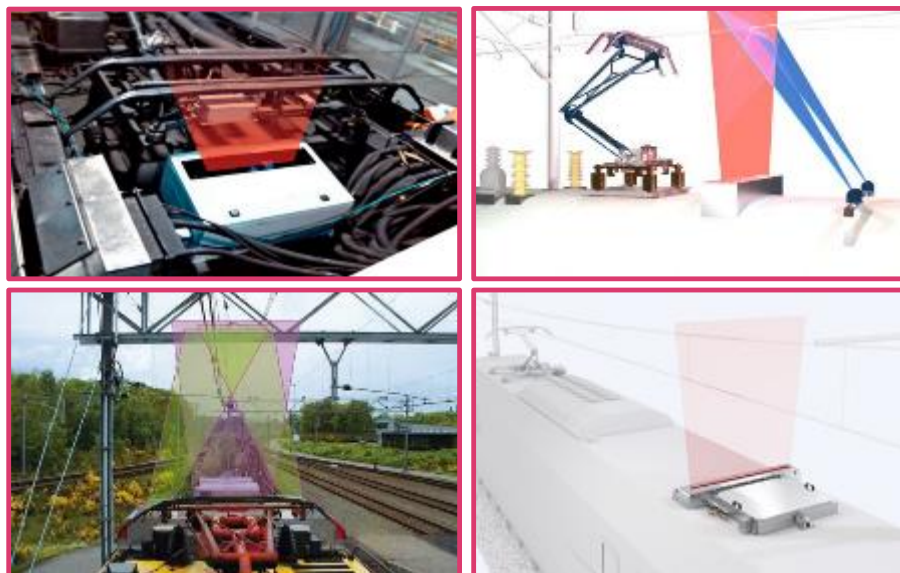
## Rail (Broken) Video Inspection systems



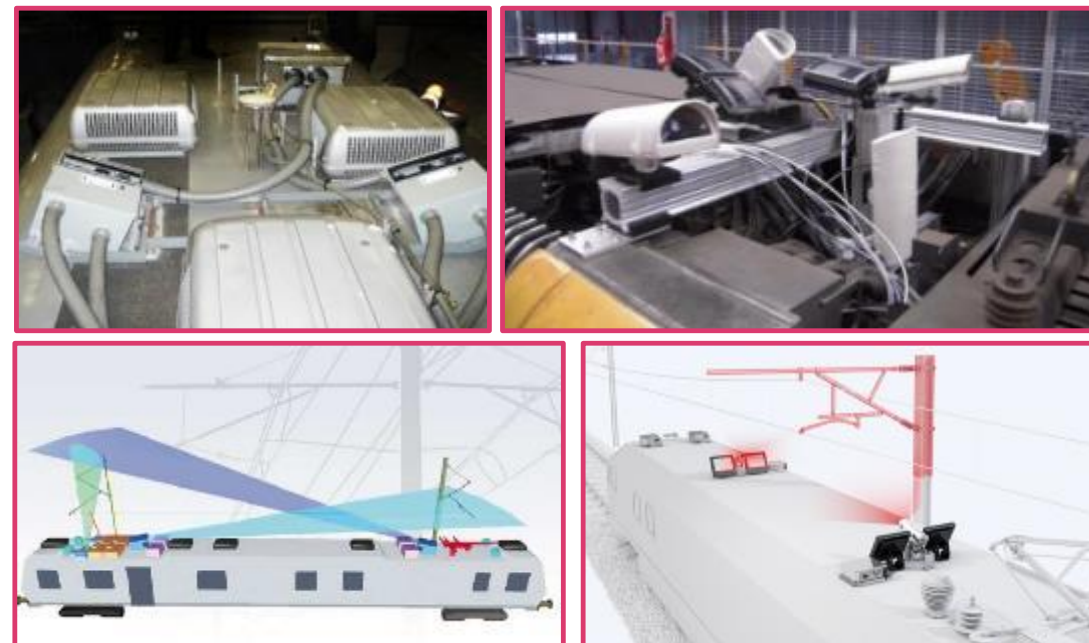


# Catenary/ 3<sup>rd</sup> rail / APS data capture : measurement and inspection systems

## Catenary Geometry & Wear Measurement systems



## Catenary Video Inspection systems



## 3<sup>rd</sup> Rail Position Measurement systems



## APS rail position inspection system



# TrackTracer and CatenaryTracer: 2 types of installation

## Installation on train



Preferred for mainlines and long urban networks

## Installation on dedicated vehicle



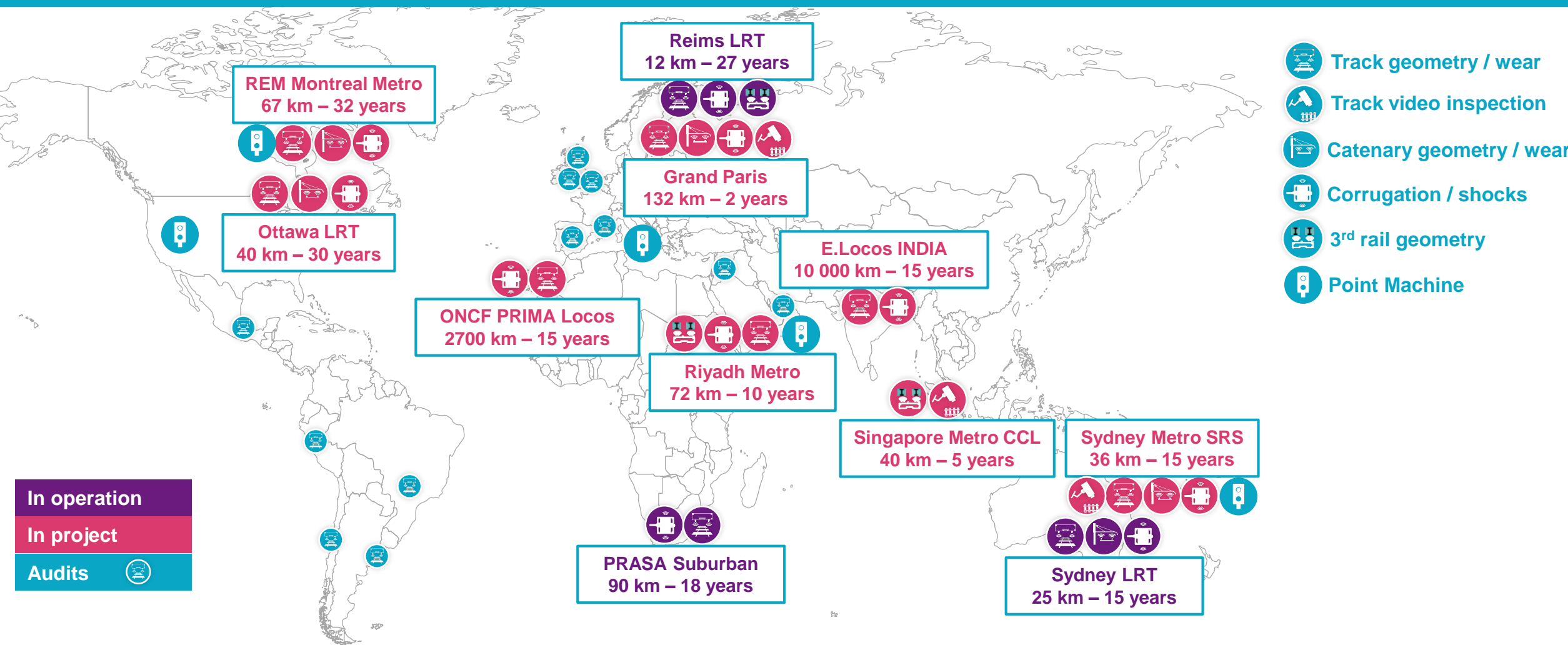
Preferred for tramways and short urban networks

Data are geo-localized with GPS and odometer combination



# Infrastructure references

5000 km of lines monitored since 2015





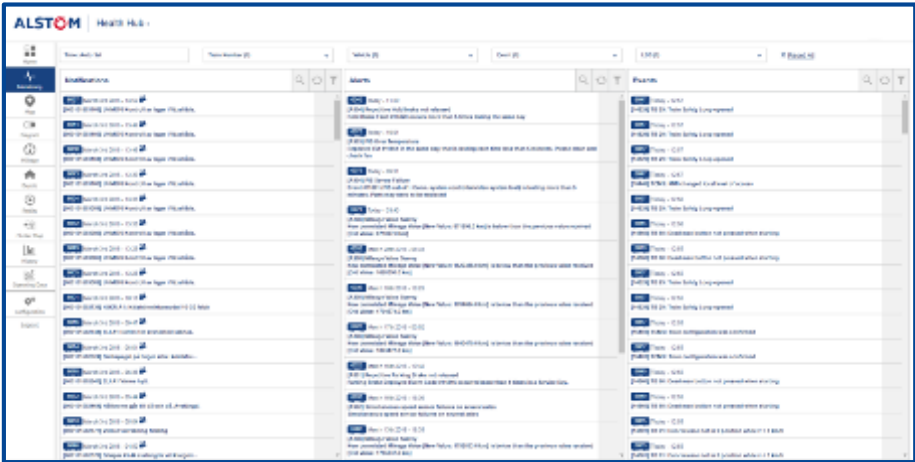
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# Rolling stock alerts and events management

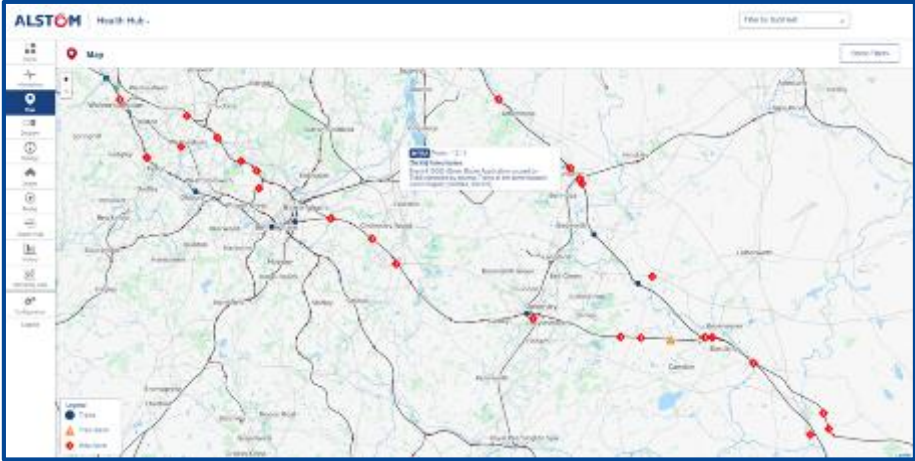
Monitoring and Service orders



Visualization of alerts for the whole fleet



Visualization of alerts on a map

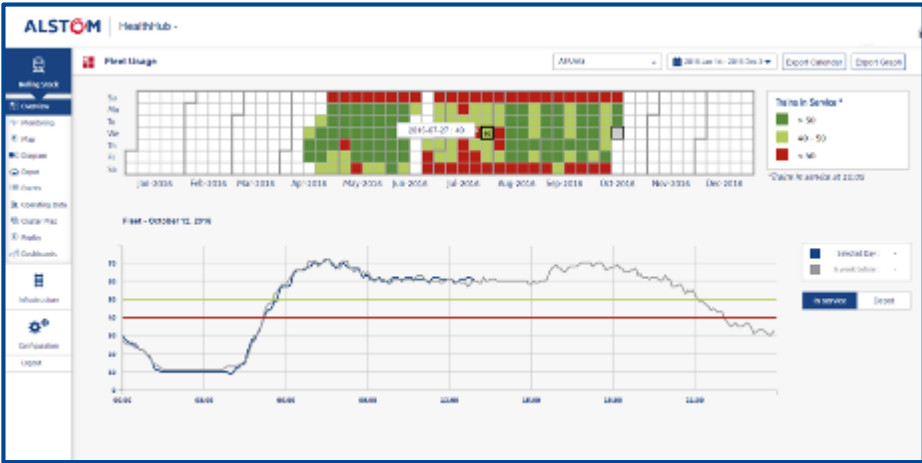


Variables and preventive counter

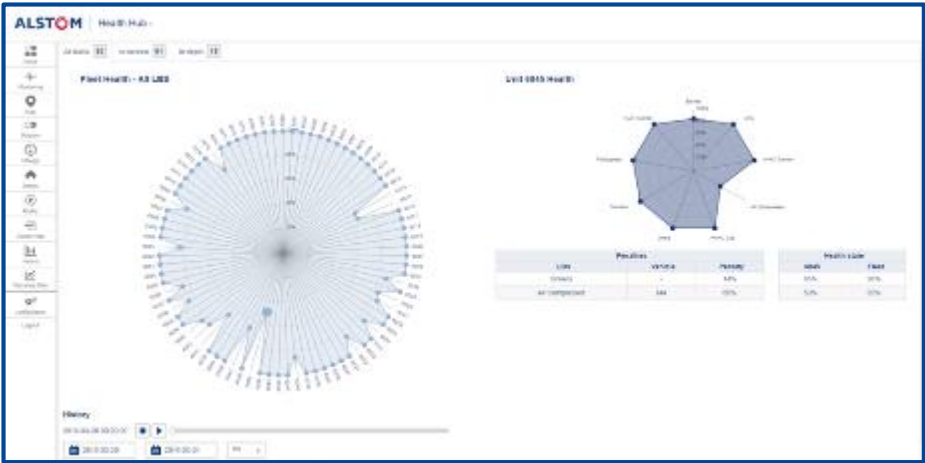


# Fleet management

Fleet usage



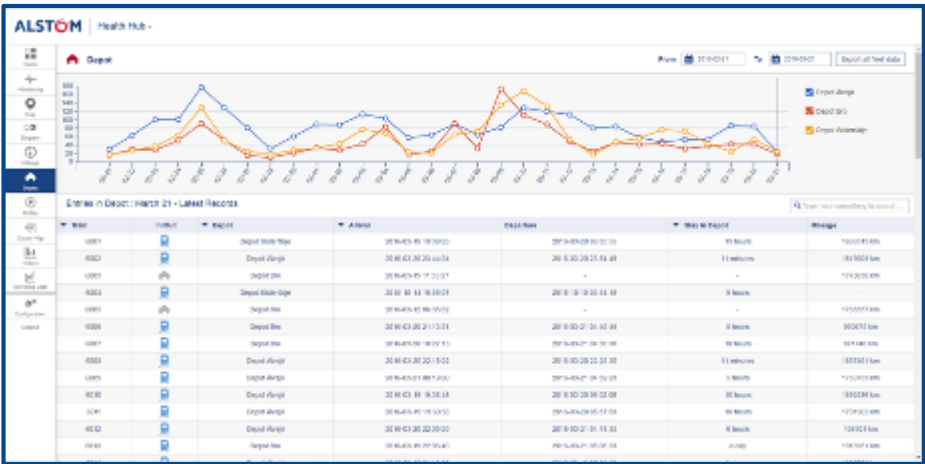
Availability and autonomy



Service diagram

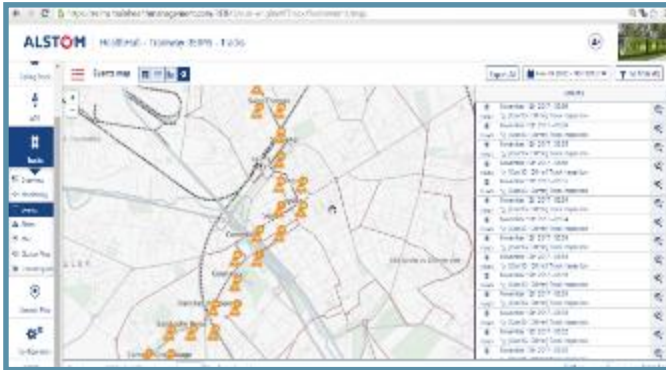


Depot usage



# Infrastructure alerts, diagnostic and health index

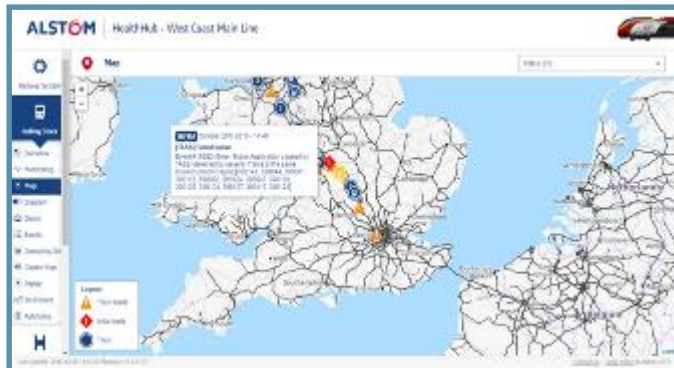
## Alerts



## Diagnostic



## Health Index





# Examples of reports

Alerts report



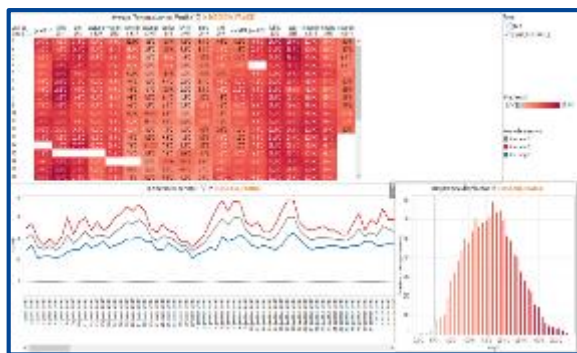
MMIS report



Compressor report



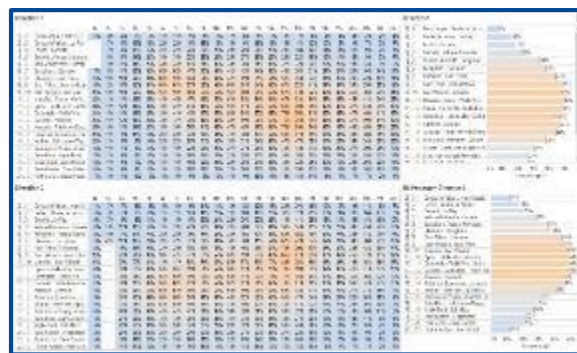
Weather report



Availability report



Passenger counting report



185 reports generated per day



# Some figures

- Applied on 2900 trains
- 1787 Alerts, 344 health index
- 60 000+ alerts generated last month
- 54 000+ alerts SMS sent in 2018
- 436 different users
- 44 TB of data
- Total 482 month of history (i.e. 40 years cumulated)

Significative data, projects and users

# Some references with key figures



Projects	X60	Regiolis	NTV	AVE-S100	WCML	ETR600	Reims	Nice	PRASA
Trains	45	116	25	24	56	12	18	28	18
Since	2014	2014	2016	2016	2017	2017	2017	2017	2017
Rules	38	62	40	70	240	644	38	65	20
Reports	15	16	12	11	7	9	5	6	8

Generalization & Capitalization

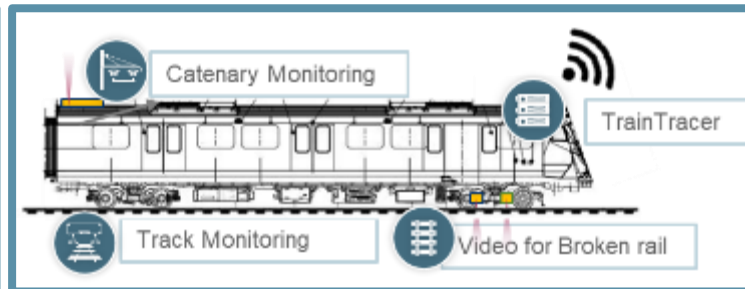
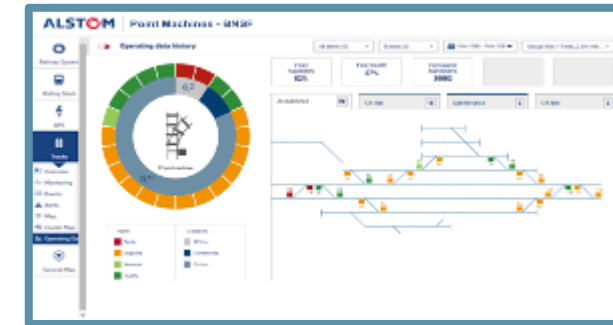
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# HealthHub turnkey application

## SYDNEY METRO NORTH WEST RAIL LINK TURNKEY MONITORING

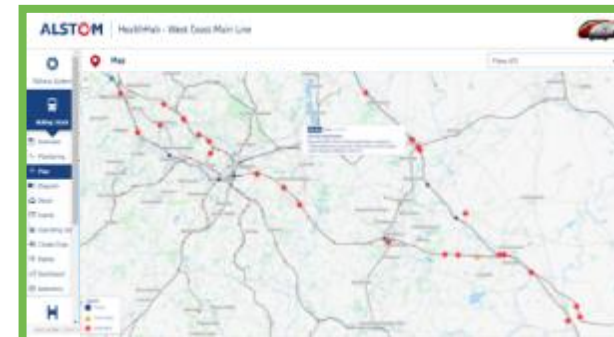
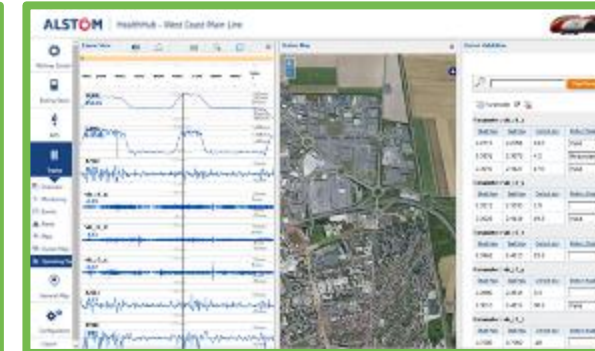


- > Monitoring of 13 point machines in real time
- > Monitoring of 22 metro trains in real time
- > Monitoring of 36 km of track and catenary with real time alerts
- > Integrated HealthHub Web platform with OCC alert viewer



# HealthHub application on infrastructure

## TRACK GEOMETRY MONITORED ON WEST COAST MAIN LINE UK



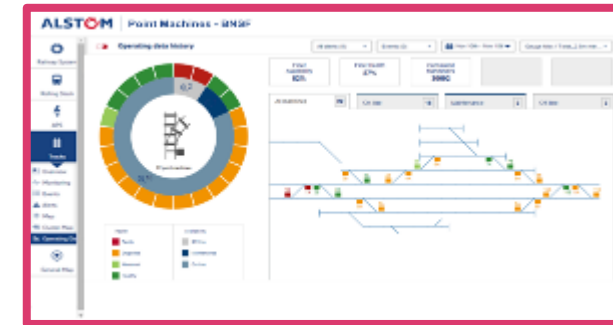
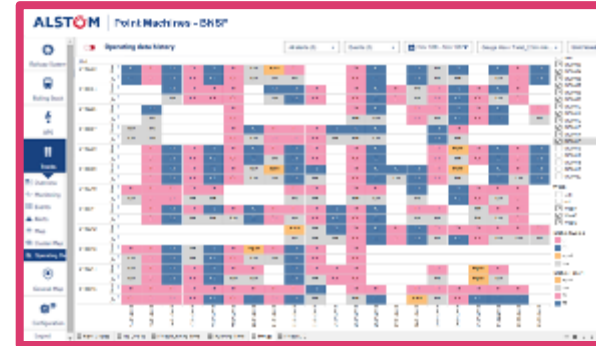
- > Data geolocation validation compared to NR Yellow trains
- > Daily reports against monthly reports
- > Data processing automation saving 10 data analysts
- > Statistical analysis allowing track prognostic

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# HealthHub application on point machines

## POINT MACHINES MONITORING FOR BNSF ACROSS USA



- > Diagnostic of obstacles, lack of lubricant, rail deformation
- > Detection of exceptional weather conditions impacts
- > Saving of patrolling technicians on root cause analysis
- > Prognostic of Service Affecting Failure





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