‡ Incremental

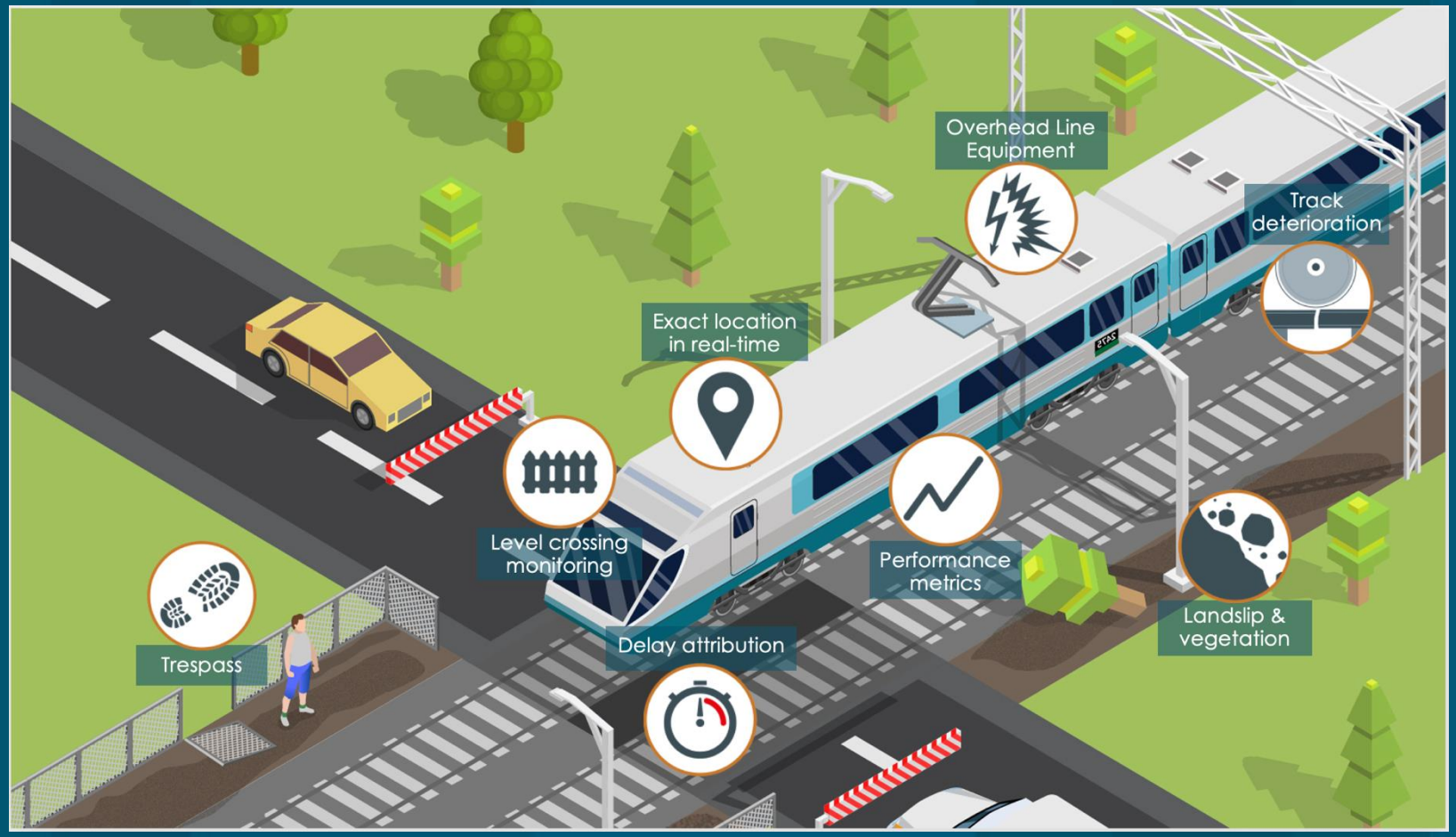
Overhead Line Monitoring and Incident Management

Tim Flower

‡ Incremental

Why Incremental?

We have the components, capability and credibility



Award winning Innovation

THE KING'S AWARDS FOR ENTERPRISE 2024 INNOVATION

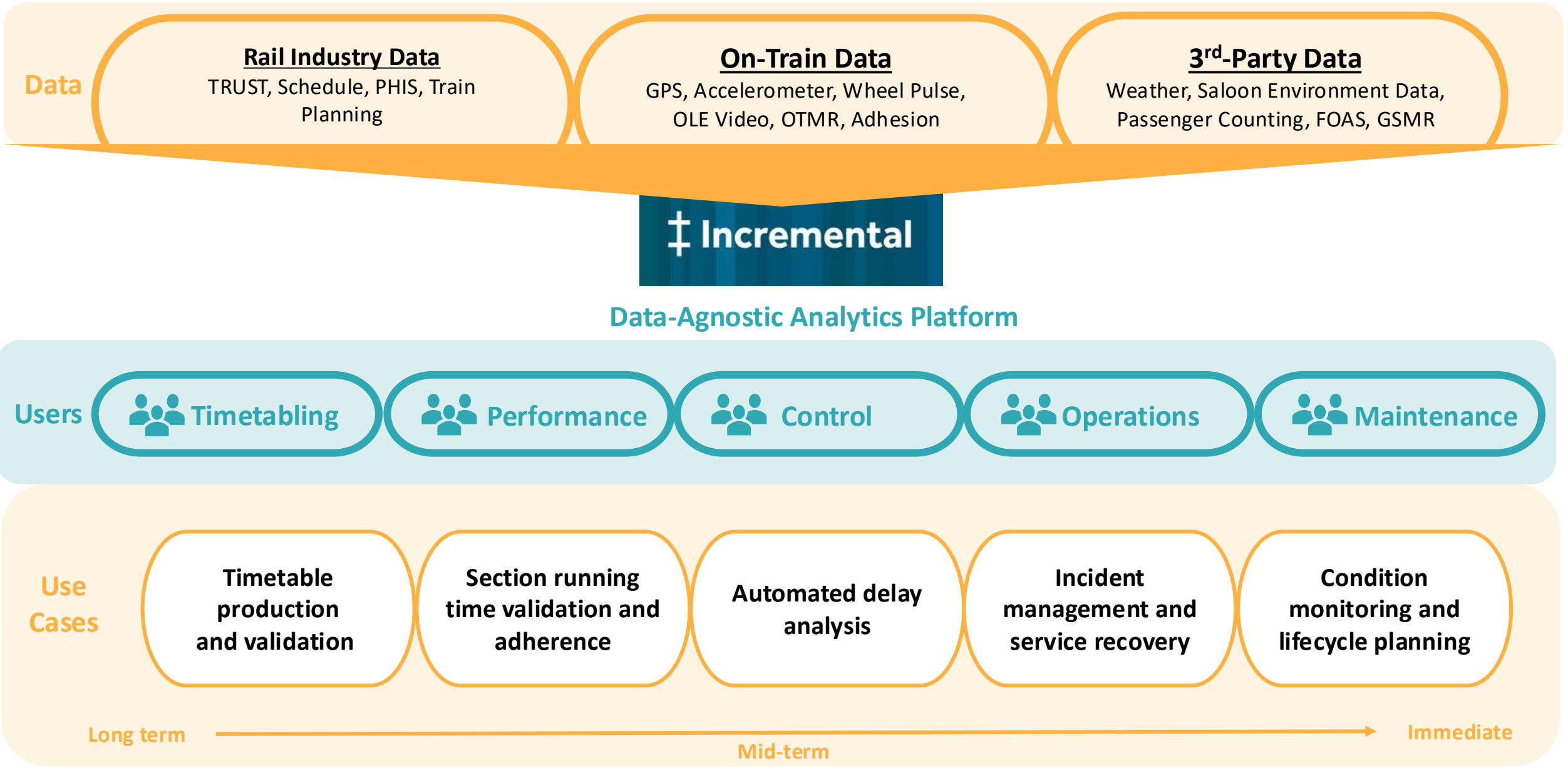
Certifications

British Assessment Bureau
ISO 27001 Certified
Information Security Management

ISO 27001

INSTITUTE FOR COLLABORATIVE WORKING ICW

ISO 44003


Data
Rail Industry Data
TRUST, Schedule, PHIS, Train Planning
On-Train Data
GPS, Accelerometer, Wheel Pulse, OLE Video, OTMR, Adhesion
3rd-Party Data
Weather, Saloon Environment Data, Passenger Counting, FOAS, GSMR
‡ Incremental
Data-Agnostic Analytics Platform
Users
Timetabling
Performance
Control
Operations
Maintenance
Use Cases
Timetable production and validation
Section running time validation and adherence
Automated delay analysis
Incident management and service recovery
Condition monitoring and lifecycle planning
Long term
Mid-term
Immediate


OLErt

Common problems

Arcing

Our algorithm recognizes arcing between overhead cables and contact area.

Contact Force / Impact

Measure force of contact wire with pantograph – and any unexpected changes or high shocks.

Low Incoming Wire

Compare heights of consequent contact wires to ensure smooth transition

Stagger

Measure anomalies in expected tolerances throughout every journey.

Pan Height

Senses irregularities and variances of pan height throughout track sections.

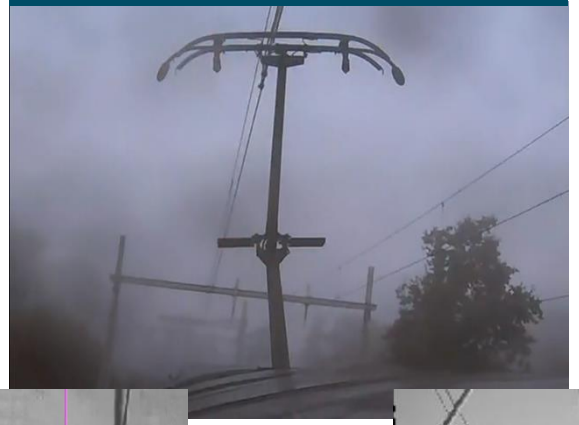
How OLErt works

- At OLErt's core is a machine vision algorithm developed in partnership with University of Oxford academics.
- This algorithm is key to turning the captured images into meaningful insights in conjunction with the accelerometer data.
- The algorithm & accelerometers identify and calculate height, stagger & contact force through image recognition & impact analysis.
- Any variances to these measurements, outside of the pre-determined tolerances are recorded and alerts are generated to prevent future failures.
- These alerts alongside the video and image capture, provides evidence for maintenance teams to take preventative action.
- OLErt clustering highlight's locations with a high number of individual alerts, based on track position, enabling a more targeted approach to engineering maintenance.

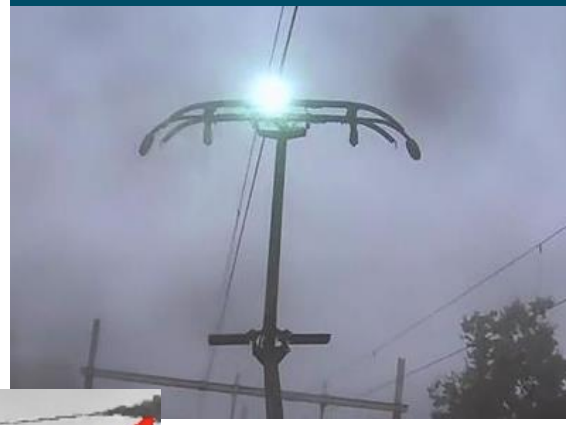
Example Alert Types

Pan Too Low

Pan Too High



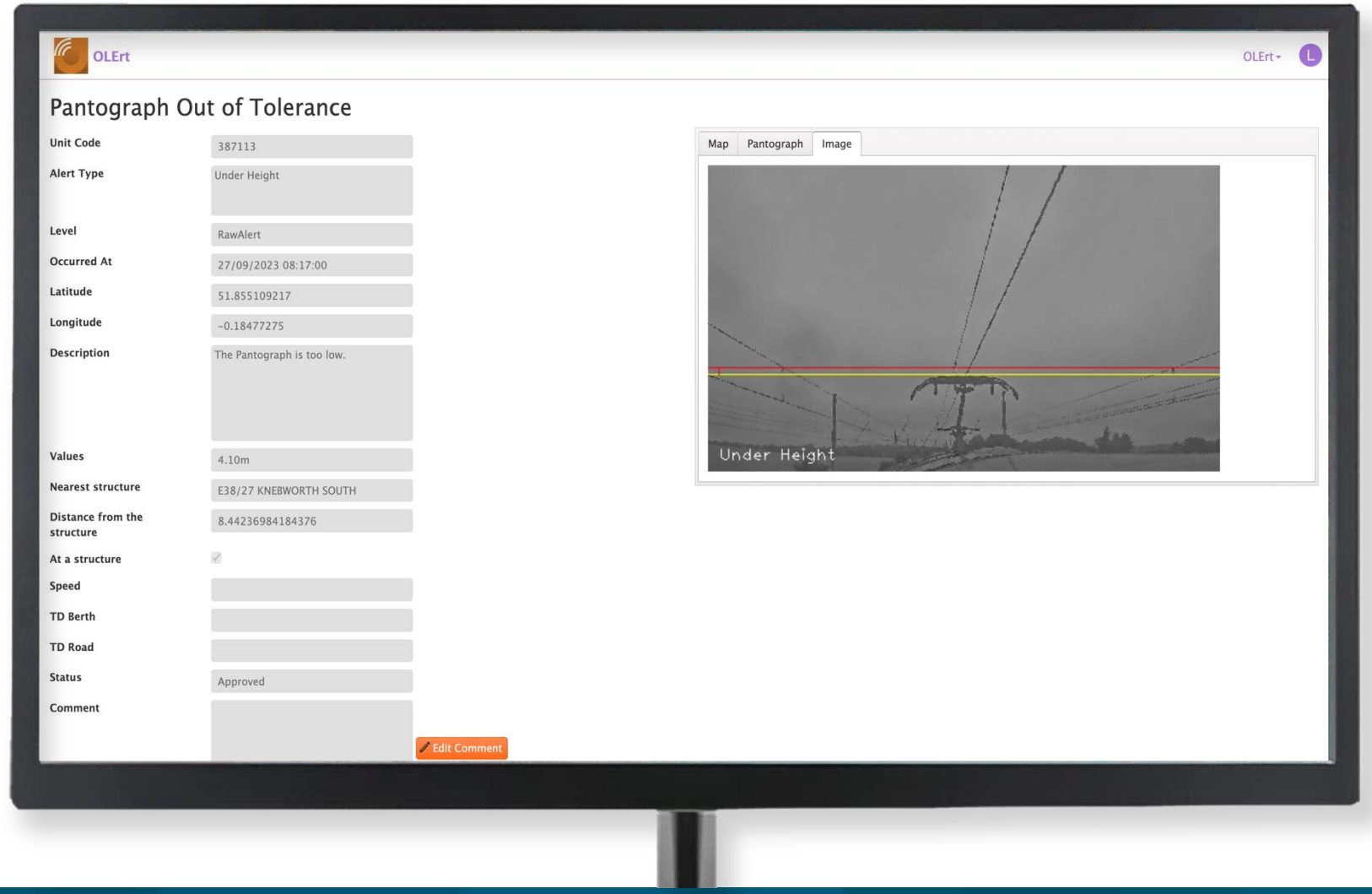
Arcing



Wire Contact

Low Incoming Wire

Alert Detail

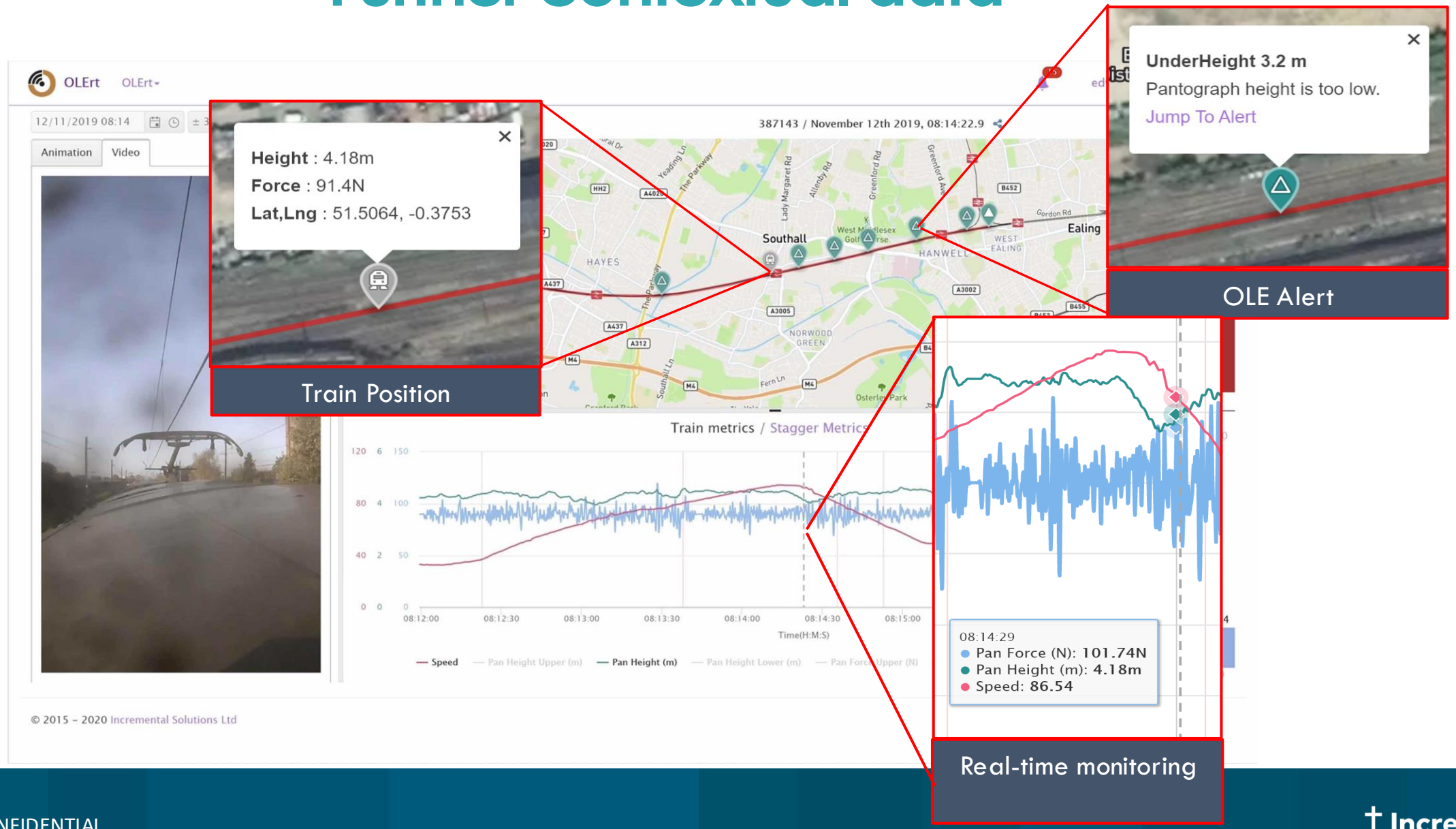


Alert detail can show captured video footage or a graphic representation.

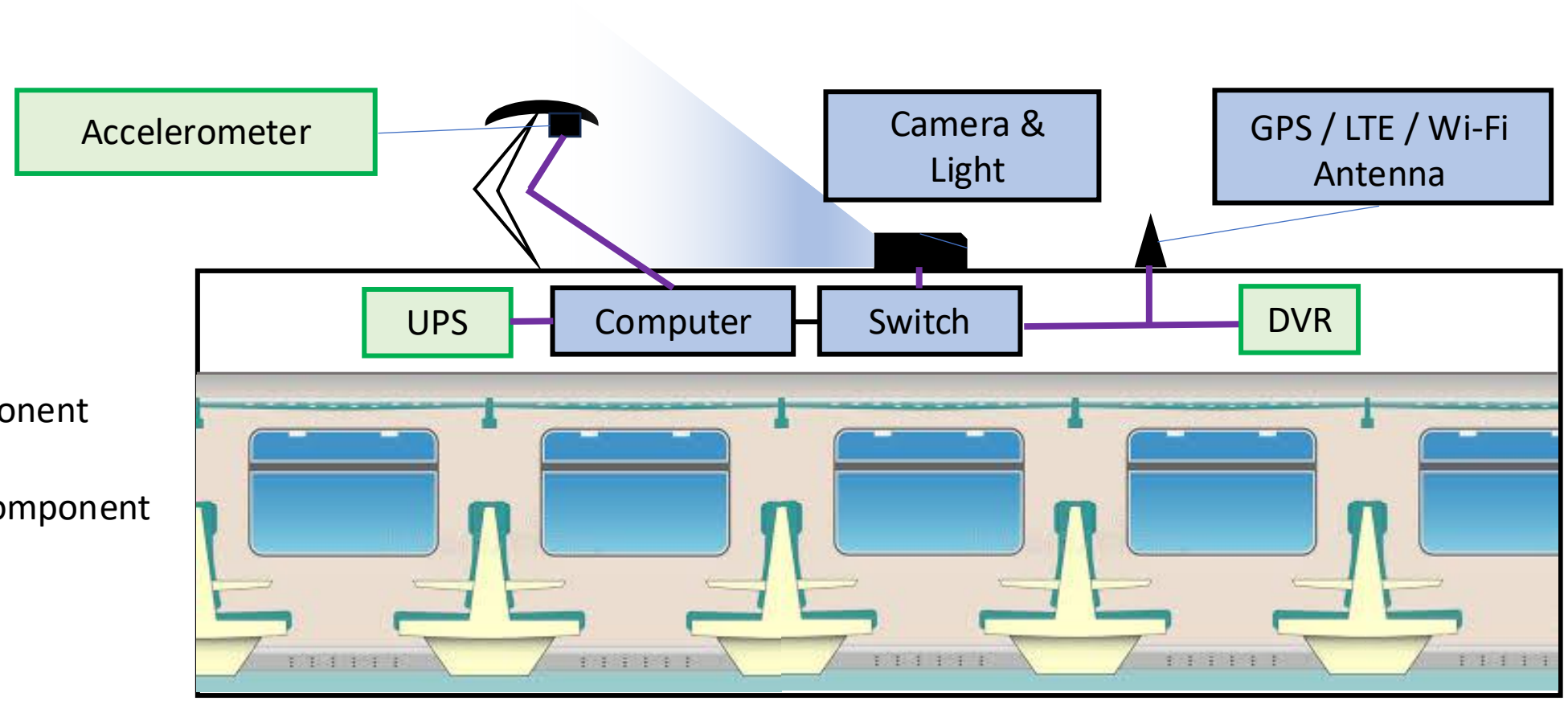
Investigating an alert will present users with everything the system has discovered. In this example, the pan was under height.

Users can ‘approve’ or ‘reject’ the alert.

Further contextual data



OLErt - Hardware



Legend

Core component

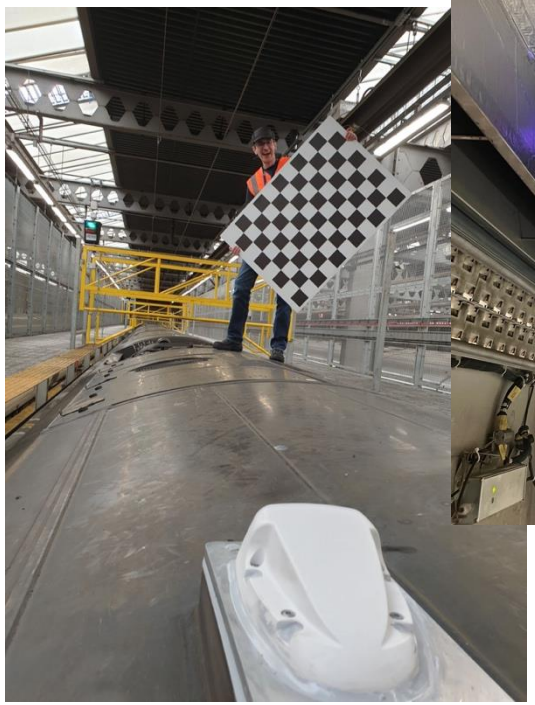
Optional component

OLErt – Installation Process

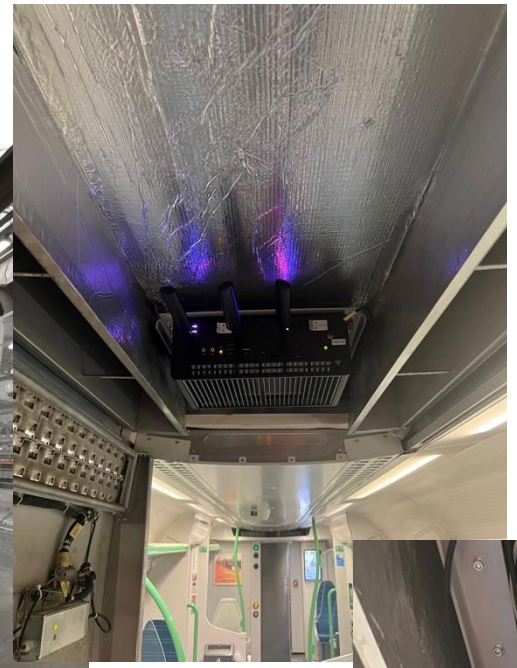
Process:

- Hardware is pre-assembled by Incremental & Belvoir
- OLErt software is installed and bench tested by Incremental
- Operational system and hardware packaged and shipped to customer site
- Hardware installed on train by Incremental, Belvoir with our customer
- Incremental remotely conducts system and deployment testing
- Calibration process undertaken to validate data measurement accuracy (using Mentor data where available)
- OLErt is live and begins in-service data collection and analysis as trains operate across the network

Images from recent installation by Govia Thameslink Railway



Vivotek Camera is installed on top of the train



Antenna installed above processor

Processor
installed in roof cavity of the train

Example accelerometer fitment

Mentor Train Comparison

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Mentor Train Comparison

One problem in common

The overall aim of NR's Mentor Train is to monitor infrastructure (OLE) and detect an anomalies which could then turn into problems.

OLErt has the same aim.

Two very different solutions

The Mentor train is specialist, modified unit, whose sole purpose is for inspecting infrastructure. It runs at various times throughout the year.

OLErt is much less obtrusive, and could potentially run on every single train on the network, every day.

Achieving a true comparison

To make the comparison accurate and true, we ensured the camera measurements (such as frame rates) were aligned with Mentor.

Once we were working with the same metrics, then we could compare the outcome more accurately and fairly.

A very positive outcome

The exercise was to compare key metrics such as height and stagger.

From here could look at the overall averages and directly compare the two solutions as if placed side by side.

The results…>

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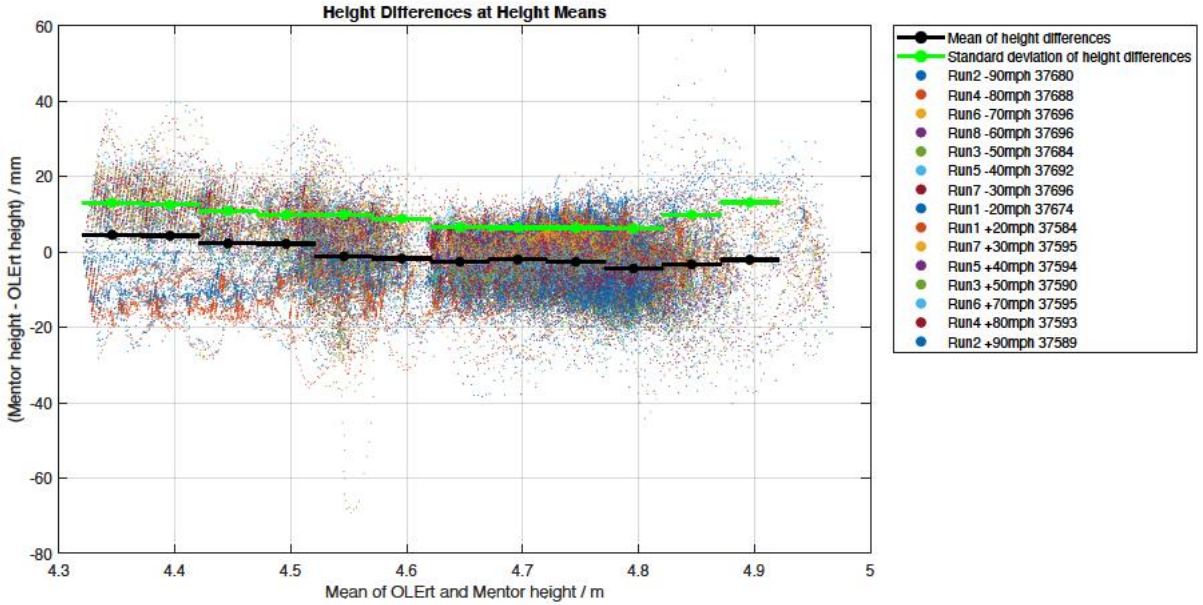
Mentor Train Comparison

Height comparison

Here we measured the height of the pan over the course of a journey.



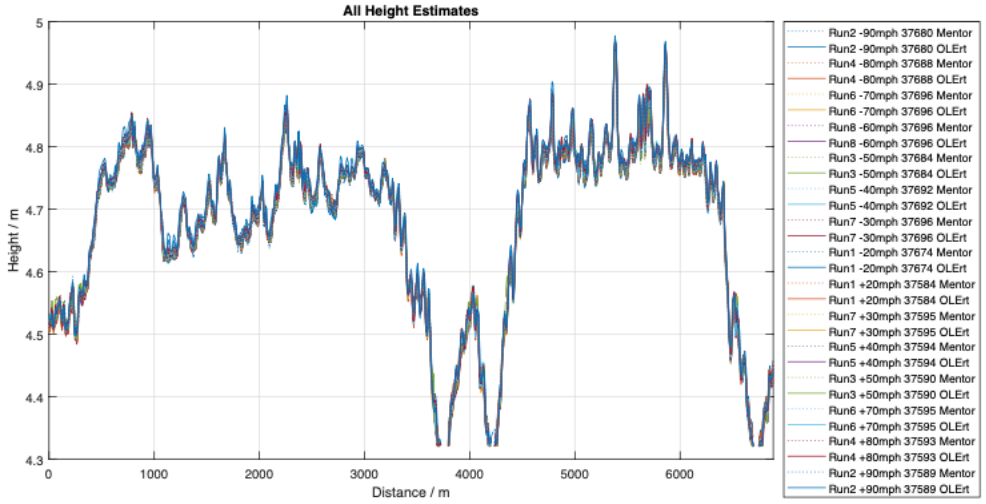


Figure 2: All 15 runs aligned by their position along the track.

97.9% of OLErt's height measurements were within 20mm of MENTOR'S.

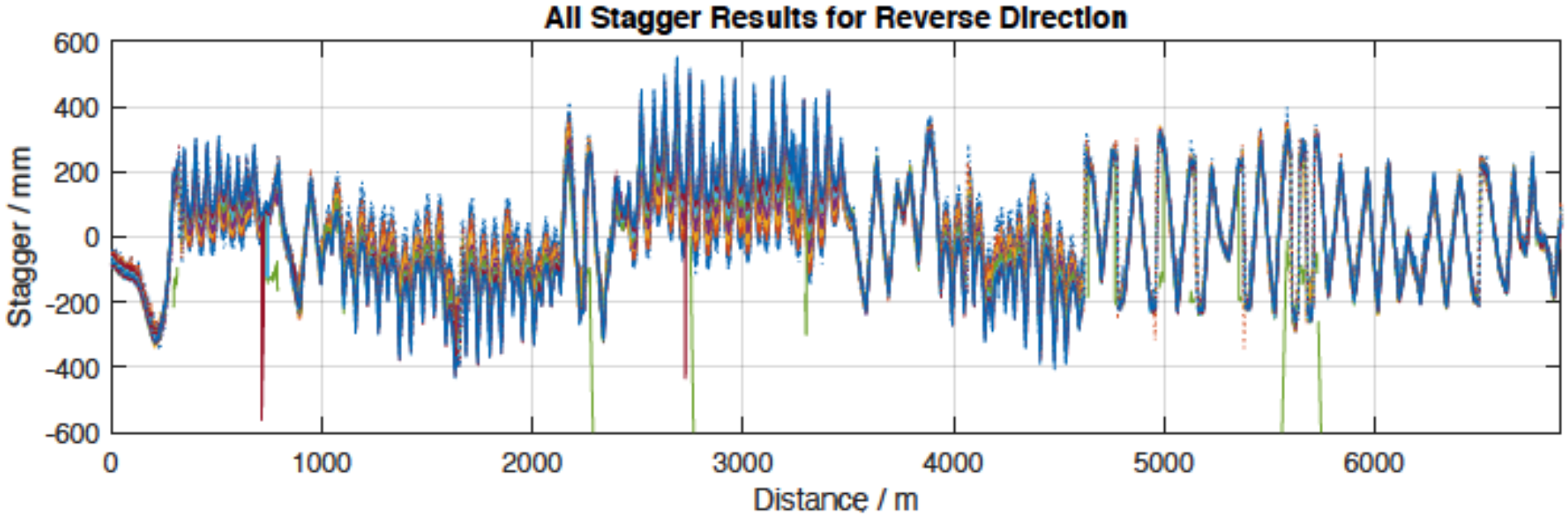
99.3% of OLErt's height measurements were within 25mm of MENTOR'S.

-2mm – the mean difference between OLErt and MENTOR.

Mentor Train Comparison

Stagger comparison

Here we measured the stagger of the cable on the pan over the course of a journey.



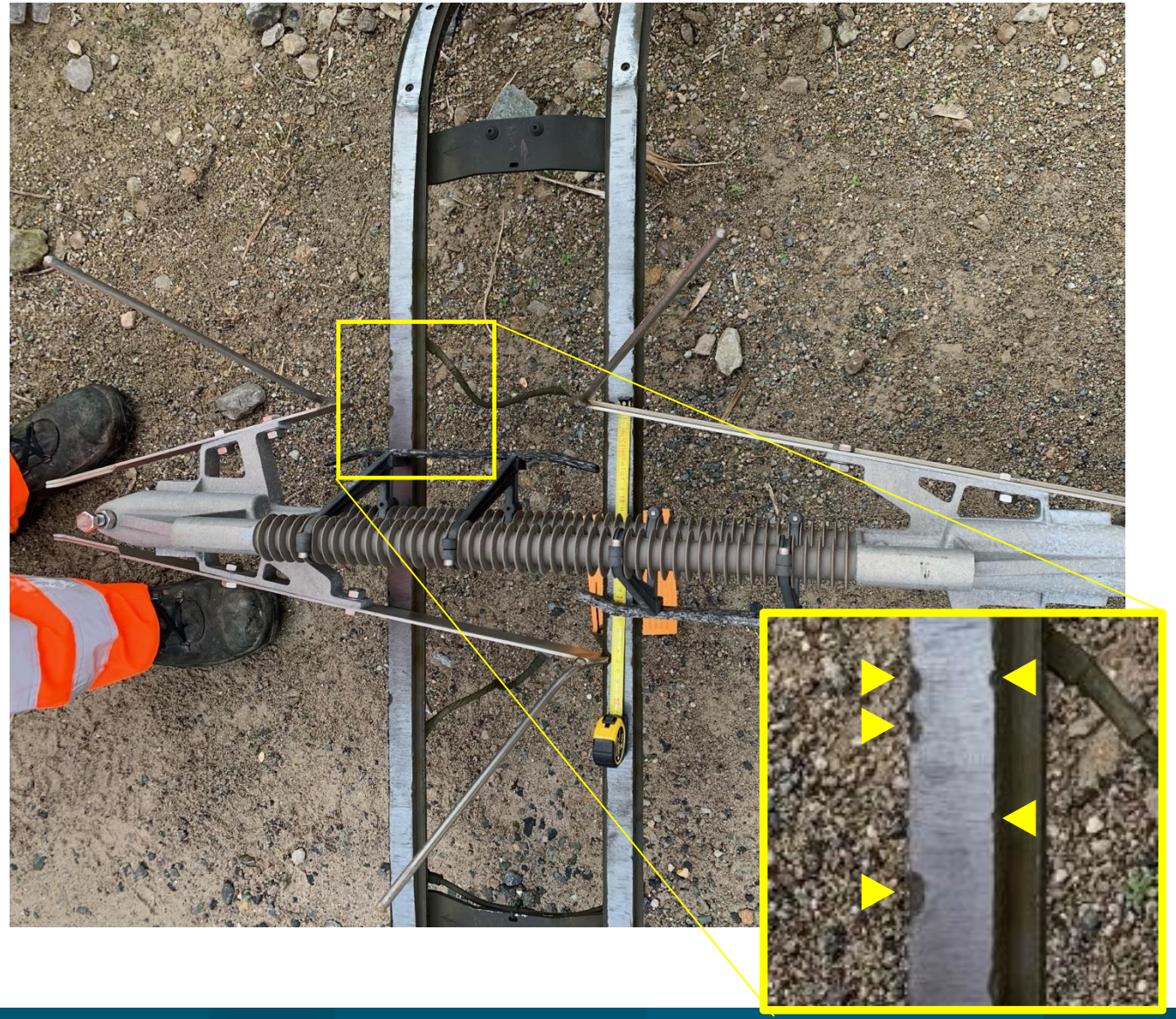
96.7% of OLErt's stagger measurements were within 20mm of MENTOR'S.

99.4% of OLErt's stagger measurements were within 100mm of MENTOR'S.

0.005mm – the mean difference between OLErt and MENTOR.

OLErt – Real World Use Cases

1) Heathrow Express – Damaged Pan



Damage Reports

Problem: An ongoing issue with pan damage to certain Heathrow Express units.

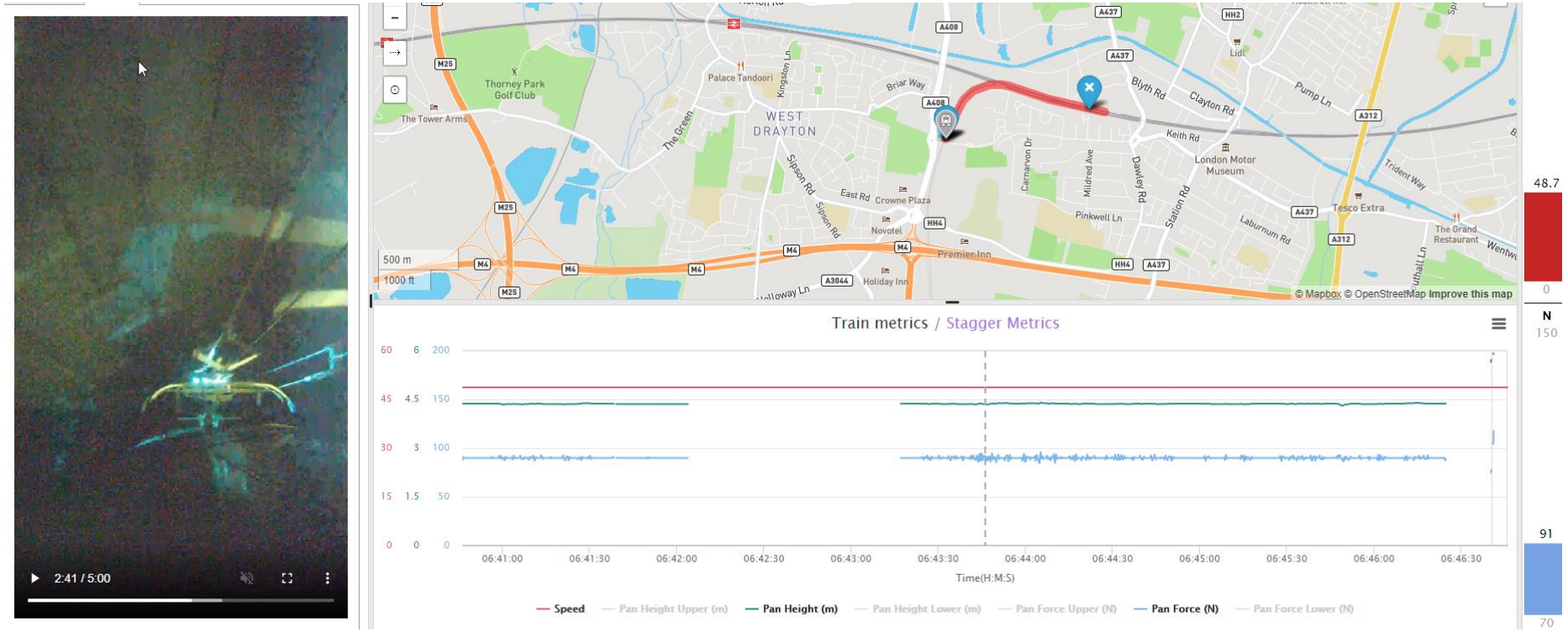
The damage was identified manually at depots on units running a specific route; therefore, the indications pointed to a possible infrastructure defect on the short section running to Terminal 5 which only a handful of Hex units use .
The damaged pan head was taken to NR and matched to one of the section insulators at their training school.

These Section Insulators are used within the Heathrow tunnels, however location identification of the problematic Sectional Insulator was virtually impossible as manual inspections during train operation was not possible.

Solution: Fit OLErt to a number of units to identify the problem... (see next slide for details)

OLErt Diagnostics

Using OLErt we were able to pinpoint the exact location of impact. NR took a possession at the earliest opportunity and rectified the fault. This type of defect could not have been picked up by a visual track walk.



As a result of the accurate pan exam documentation, GWR and NR have been able to work together and save considerable costs locating this infrastructure defect.

OLErt – Real World Use Cases

2) Kings Cross – Retrospective Dewirement Investigation

Damage Reports

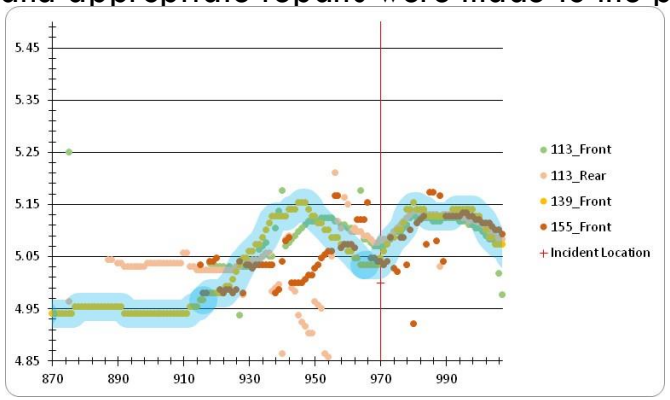
Explosion captured by unit 700011, 45 prior to dewirement

Govia Thameslink Railway approached Incremental following an OLE dewirement outside Kings Cross station.

Incremental were provided with historic video footage from journeys made by several different units along the same piece of track in the days running up to the incident.

The graphic to the left showed an explosion from the unit involved in the incident around 45 minutes prior to the event.

Further analysis conducted via OLErt highlighted that there was no deviation from the “norm” on the OLE profile and therefore the customer was able to target fault identification through panhead inspections and appropriate repairs were made to the panhead.



OLE height profiles mapped

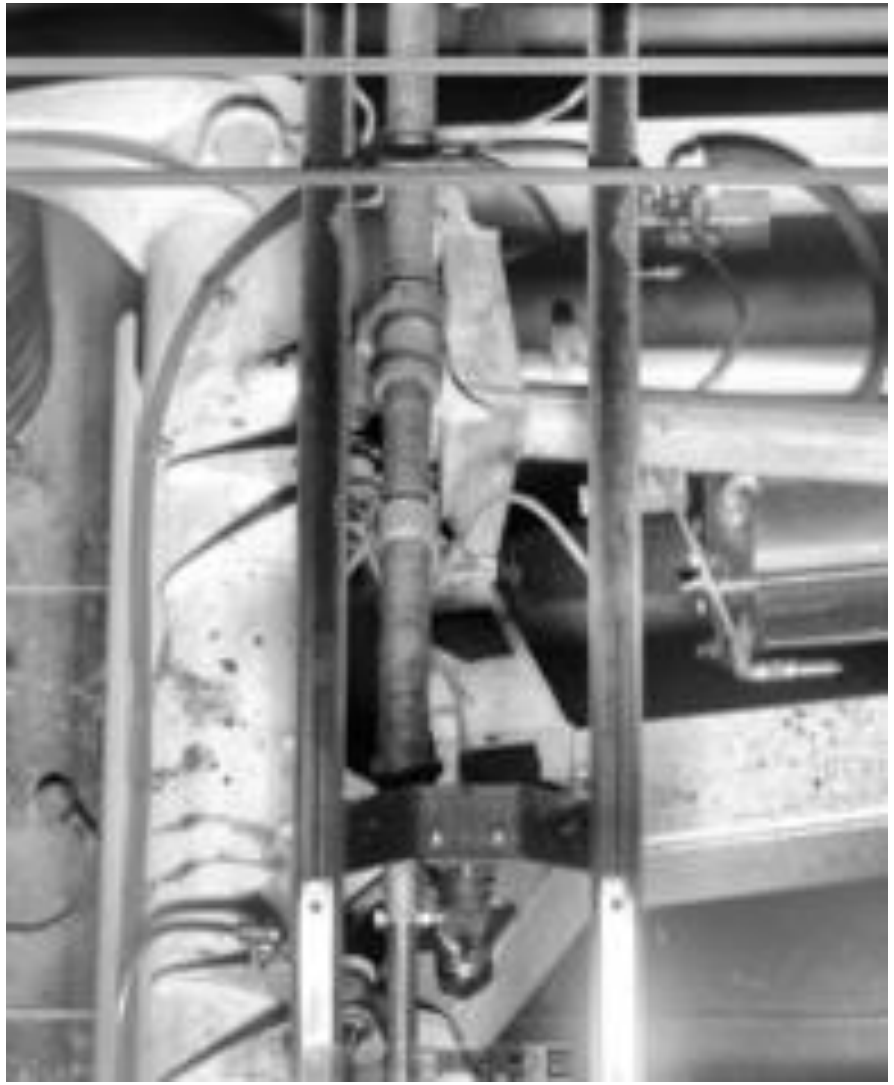
OLErt – Real World Use Cases

3) GWR Paddington – Airpoint Junction Pantograph Damage

Pantograph Damage

- Lineside cameras (PanVue) identified damage to pantographs between Paddington and Airport Junction but limited means to identify the cause
- OLErt consulted and identified several clusters of arc alerts, some of which were at registration arms
- Specific location details provided (W3W, ELR and mileage or lat/long), issue remediated after targeted visual inspection

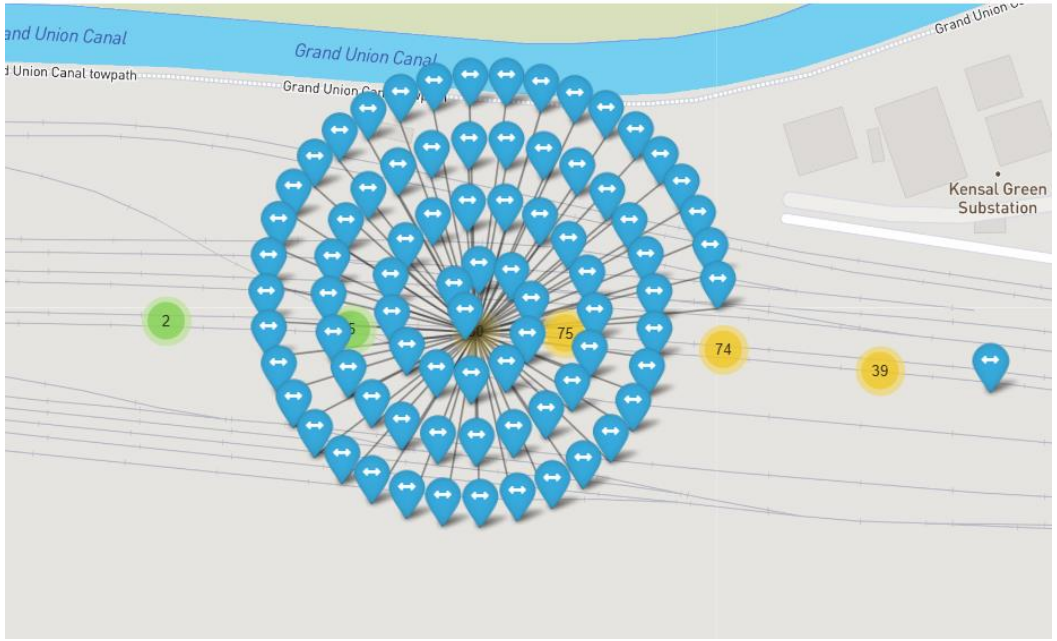
OLE height profiles mapped



OLE height profiles mapped

OLErt – Real World Use Cases

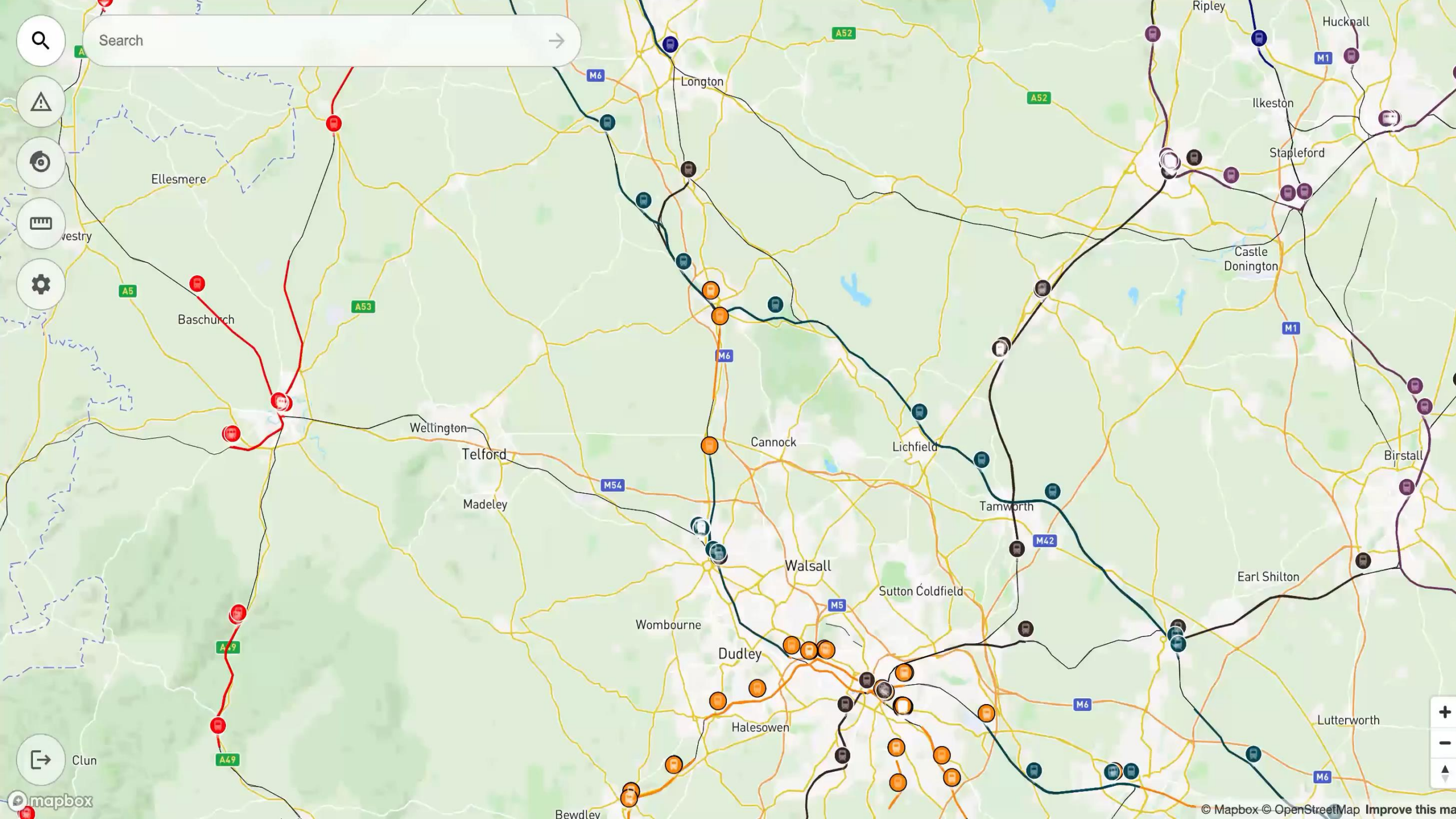
4) GWR Excessive side wear



OLE height profiles mapped

OLE height profiles mapped


RAPPORT


Search
Ripley
Hucknall
Longton
Ilkeston
Stapleford
Ellesmere
Castle Donington
Baschurch
Wellington
Telford
Cannock
Lichfield
Birstall
Madeley
Tamworth
Walsall
Earl Shilton
Sutton Coldfield
Wombourne
Dudley
Halesowen
Lutterworth
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M6
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A5
A53
M54
M42
M5
A49
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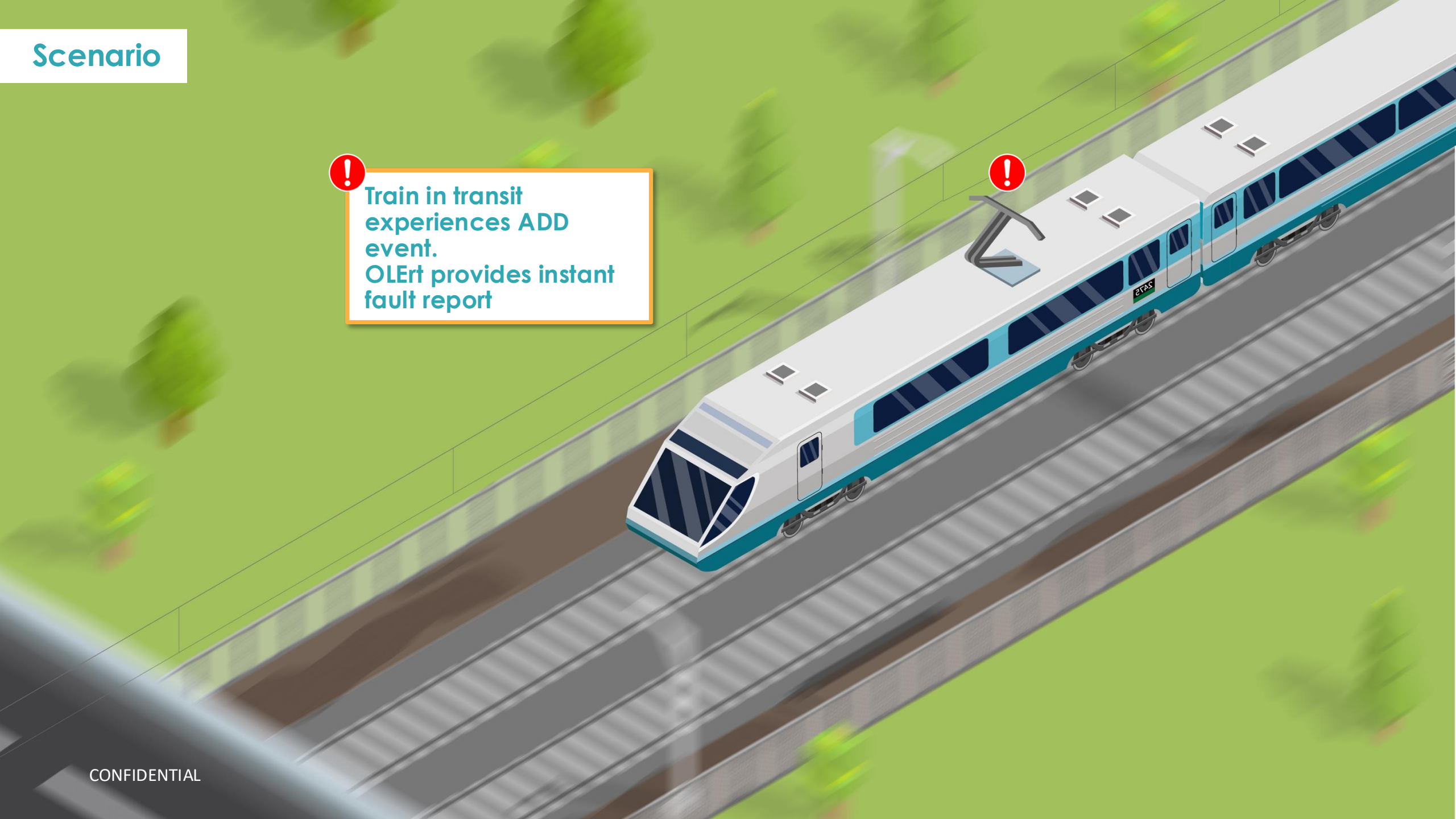
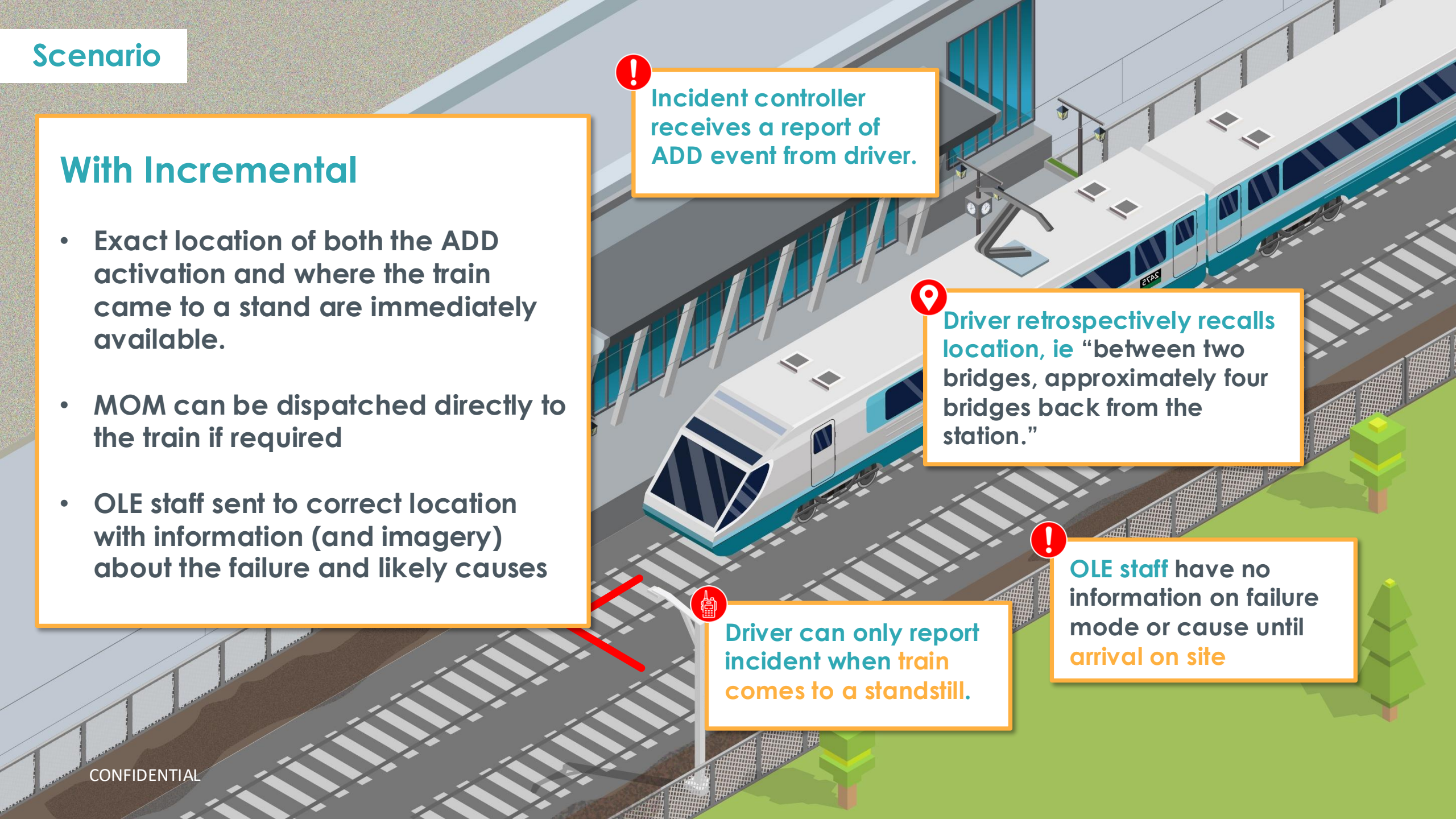
Scenario



Scenario

With Incremental

- Exact location of both the ADD activation and where the train came to a stand are immediately available.
- MOM can be dispatched directly to the train if required
- OLE staff sent to correct location with information (and imagery) about the failure and likely causes



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