



AIVR Service Definition

Document

COMMERCIAL IN CONFIDENCE

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Imagery captured by **AIVR**

AIVR Information

AIVR Summary

AIVR (Automatic Intelligent Video Review) enables simple capture of a range of video and other critical data from in-service and measurement vehicles which is rapidly and automatically transmitted to the AIVR platform. Data is accessed via the secure online AIVR dashboard for safer and more efficient methods of monitoring and surveying with AIVR analytics and Machine Learning applied to derive further insight. The AIVR platform can also make the video and data available to other systems for viewing, analysis or to be downloaded in open standard formats.

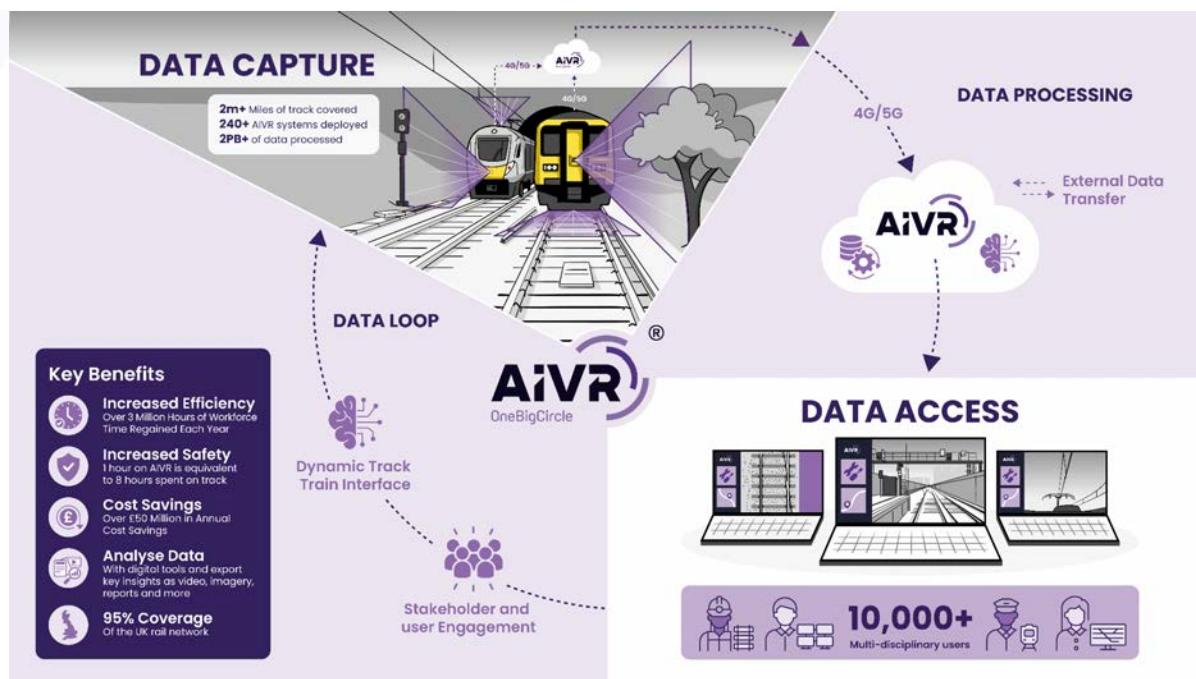


Figure 1: High level overview showing the process of capturing data, transmitting this to the cloud and making this data accessible to review and analyse in the AIVR Platform.

AIVR Summary

There are currently a range of vehicles installed with (or integrated with) AIVR equipment providing imagery of rail systems/providing data formats detailed below:

- **Forward Facing imagery** - visible imagery of the lineside environment can be captured using temporary or permanently installed devices, assisting with a variety of use cases such as signal sighting, site safety and planning, and balance weight monitoring.
- **OLE** - AIVR can provide dynamic imagery of the pantograph and its interaction with the OLE system through either integrations with existing cameras or installations of visible, Infra-Red, or Corona cameras.
- **AIVR Focus** - line-scanning cameras capture and present high-resolution imagery of the track in a bespoke Rail Inspection Interface in the AIVR Platform, to assist with remote

inspection and surveys of the railhead and track, S&C, conductor rail, and further track assets.

- **Geometry** - OBC have fitted Unattended Geometry Measurement Systems (UGMS) to a number of measurement trains to enable users to access recorded geometry data in conjunction with automatically synchronised video data directly via the AIVR Platform.
- **Thermal** - permanent installations or portable tail lamp units are able to provide thermal data capture of the conductor rail. A combination of contextual visible imagery and thermal data is captured to help detect and identify potential temperature exceedances across the conductor rail.
- **Shoe Monitoring** - provision of conductor rail visual geometry & shoe monitoring system provides in-service imagery of the shoe in contact with the conductor rail. Issues such as arcing or the shoe departing from the conductor rail can be assessed in AIVR.
- **DepotMATE (Visible and Thermal)** - DepotMATE is a lightweight rolling stock monitoring solution which captures visible and thermal data to support on-site staff to remotely and safely monitor passing rolling stock. The system is flexibly designed to allow for easy integration and customisation of various sensors, and can be deployed on a temporary basis or as a permanent installation.

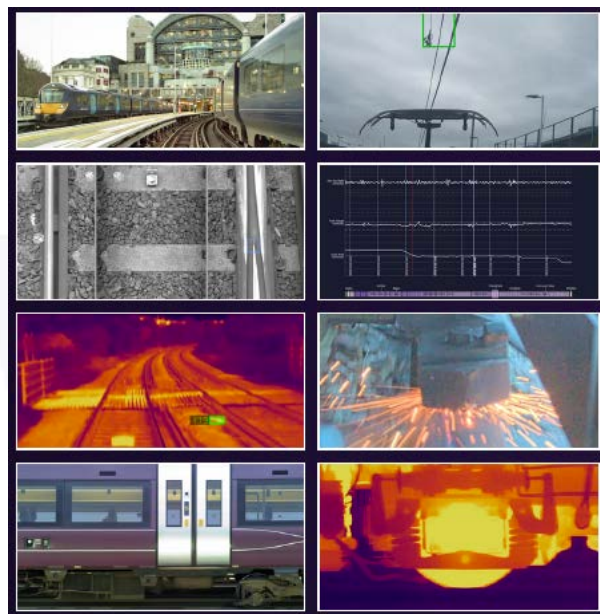


Figure 2: AIVR Data Capture

AIVR Platform - Key Features

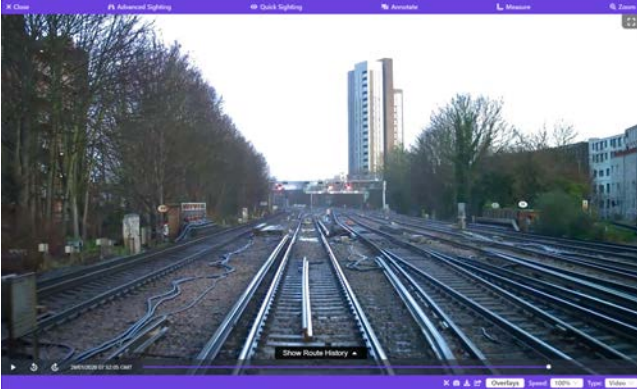
There are currently a range of vehicles installed with (or integrated with) AIVR equipment providing imagery of rail systems/providing data formats detailed below:

The video and data is transmitted to the secure AIVR cloud based video platform. The platform is horizontally scalable ensuring that there is no limit to the amount that can be processed in parallel and no limit to the number of users accessing the data. AIVR is proven in the UK on a national scale providing coverage across 95% of all Network Rail infrastructure - over 2,000,000 miles.

The AIVR dashboard enables anyone with an Internet connection the ability to instantly review the video through a simple interface in any web browser. This provides crucial up to date footage of the rail infrastructure and environment in high definition video making it ideal for aiding with challenges including:

- Vegetation management
- Driver training and route familiarisation
- Site survey
- Works review
- Asset inspection
- Incident management
- Driver rough ride review

The table below further details some features available in the AIVR Platform:

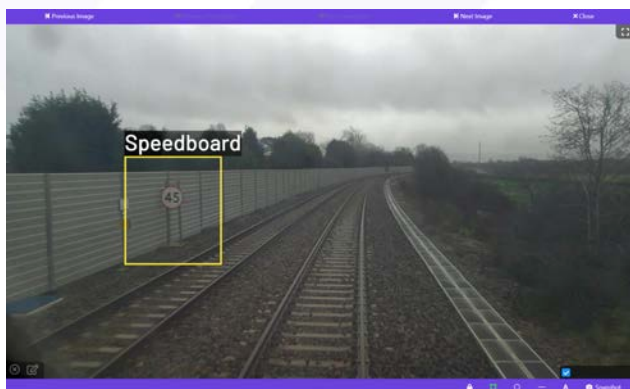
Feature	Description
Playback and review 	• Instantly stream video - no need to download entire file. • Skip, slow motion, scrub through video to quickly find area of interest.
GPS and telemetry data ROUTE POSITION (ESTIMATE) ELR: XTD TRACK: 2100 (DOWN) MILE: 4 CHAIN: 31 SPEED, BEARING & ALTITUDE 47 MPH (GPS) Southeast 6m	• Mapping information automatically displays geographical position. • Telemetry from AIVR accelerometer available.

Measurement and inspection tools



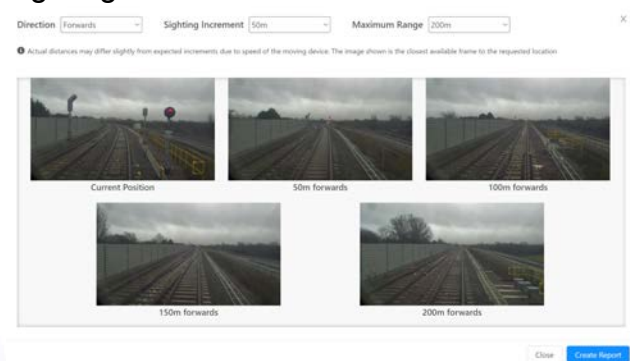
- Ability to measure from track to points of interest.
- No extra plug-ins required, all works in browser.

Annotation tools



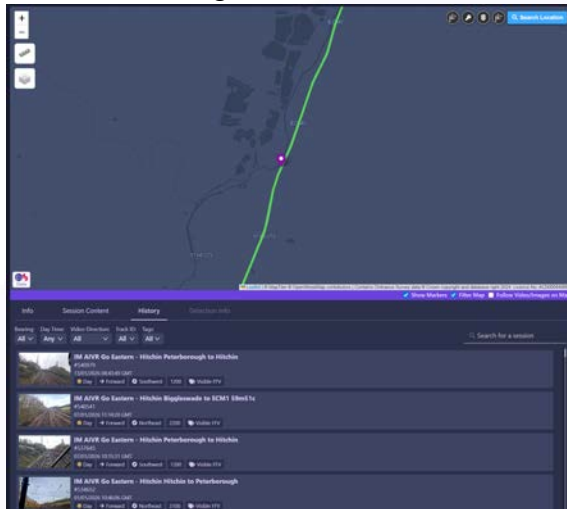
- Ability to markup assets, structure IDs, or relevant points of interest.
- Any annotations or measurements can be made available to colleagues for collaborative working.

Sighting tools



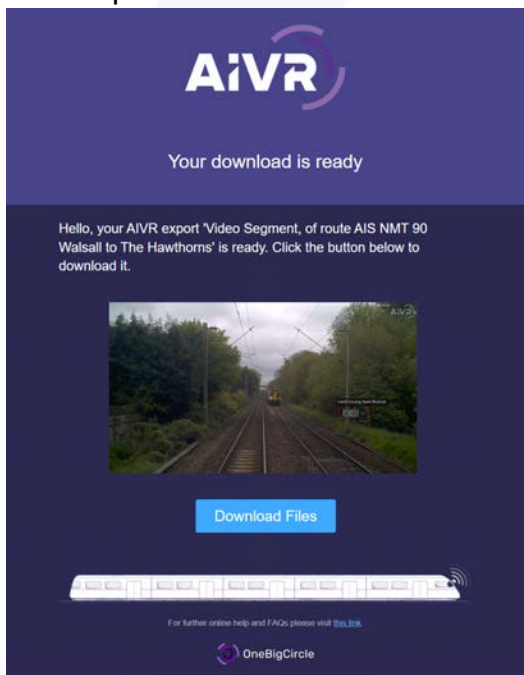
- Ability to move forwards and backwards in the video by distance increments to assist with sighting activities.
- Automatic generation of a PDF report.

Historical change review



- Instantly review previous runs at same position.
- Identify changes over time.

Data exports



- Ability to select an area of interest and download via email, including any annotation or measurements.
- Available in a variety of formats (PNG, MP4, PDF, CSV)

Automatically sync and share video.

- Can automatically generate and sync video file to other common cloud platform storage e.g, AWS, Azure, GCP.
- Video file in open format available to play in standard players and editors.

Measurement Accuracy

If the user is able to calibrate the measurement tool pixel accurately the accuracy of the measurement will only be dependent on the resolution of the image at a distance not being able to distinguish exactly where the measurement position is.

If we assume that the user gets the calibration out by one pixel in every direction, the accuracy loss would be as follows:

Distance from in-cab AIVR	Accuracy if calibration is out by 1 pixel in each direction
5 metres	X=0m (0%), Y=0.01m (0%), Z=0.02m (0%)
10 metres	X=0.01m (0%), Y=0.01m (0%), Z=0.05m (1%)
20 metres	X=0.01m (0%), Y=0.02m (0%), Z=0.14m (1%)
50 metres	X=0.03m (0%), Y=0.03m (0%), Z=0.7m (1%)
100 metres	X=0.07m (0%), Y=0.06m (0%), Z=2.57m (3%)
200 metres	X=0.14m (0%), Y=0.11m (0%), Z=10m (5%)