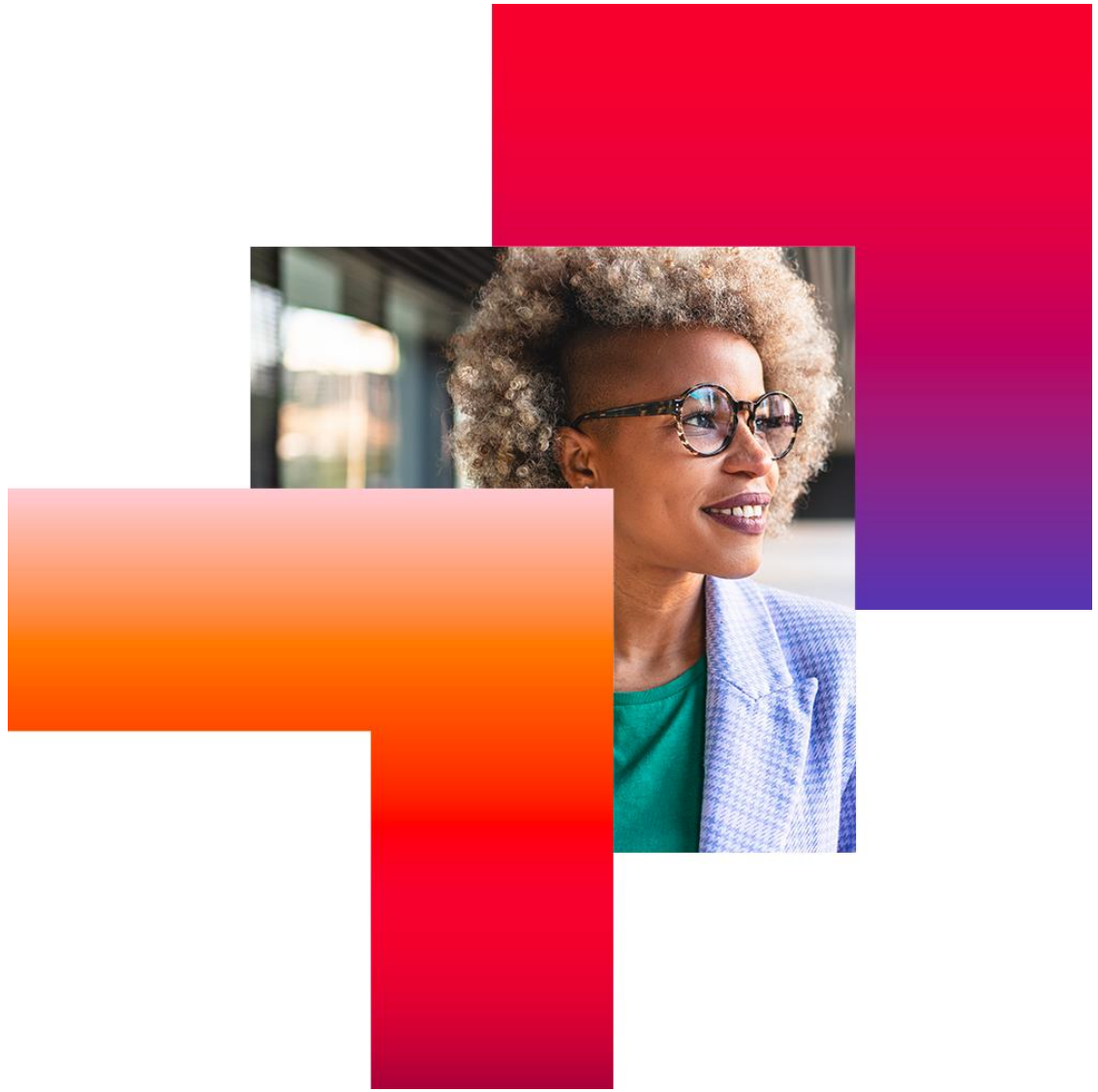
Satellites f**o**r **D**igitalization **O**f **R**ailways



Alison Hopkin

FOSS4G:UK South-West 2024

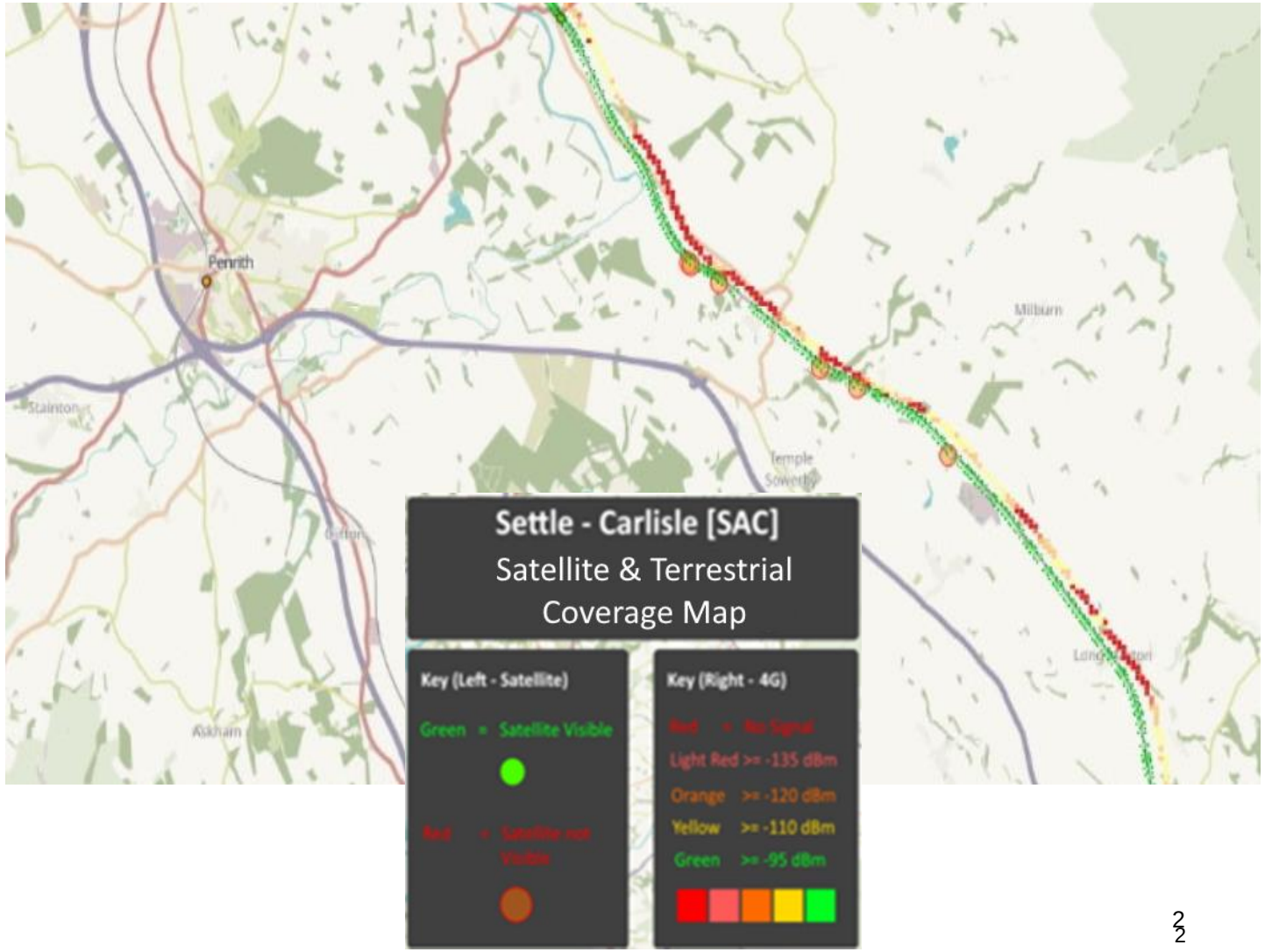
12th November 2024

CGI

What is SODOR?

‘The Satellites for Digitalisation of Railways’

- European Space Agency project led by CGI which aims to demonstrate the way new constellations of communication satellites can fill gaps in terrestrial coverage and provide additional capacity to improve safety and provide travellers with better connectivity.

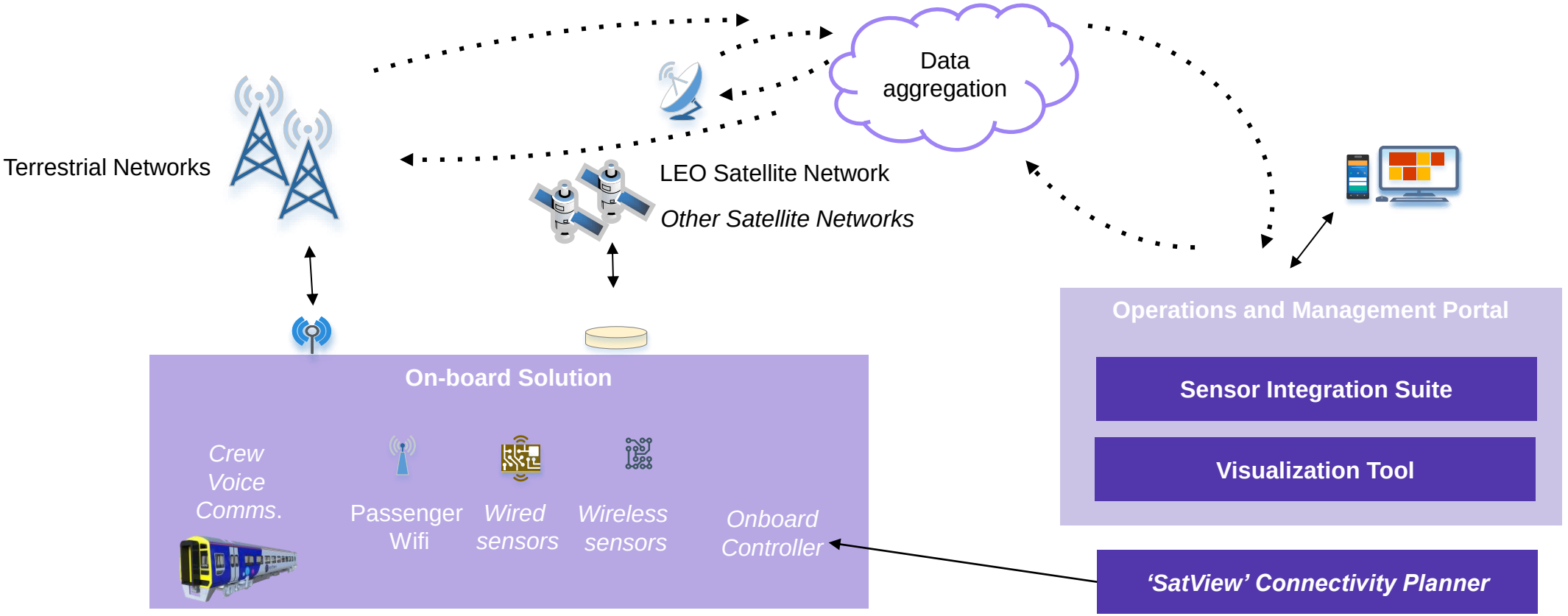


SODOR project

- CGI are leading a consortium to develop a Proof Of Concept combining satellite and terrestrial networks
  - Partners include Network Rail and three UK Train Operating Companies
  - Successfully 1st demonstration of a rail-based HBR service (OneWeb) on North York Moors Railway in Oct ’23

SODOR Architecture

- The architecture is very flexible to specific customer needs with many optional components (shown in italics)
- CGI are supplier-agnostic and SODOR components are also designed to be able to integrate with other components from outside the current SODOR programme

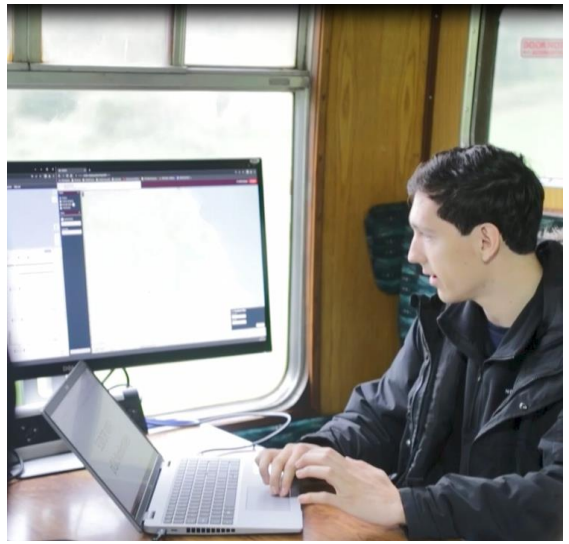


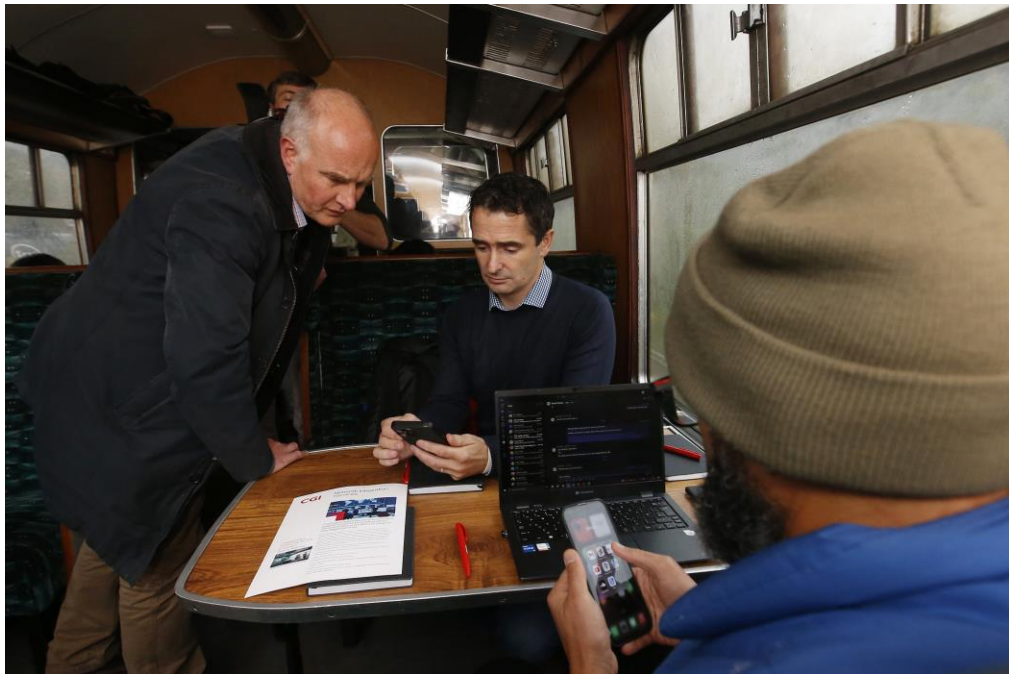
North Yorks Moors Railway Trial

- North York Moors Railway is an excellent test environment with a demanding environment similar to rural operational railway lines and where it is more practical to do a longer period of testing
- The raft has been designed to allow testing the effectiveness of the SODOR solution on various lines without the requirement to undertake structural modifications of the trains
    - It has been designed to support multiple terminals and other equipment – only a small proportion of the space is actually being used for the equipment in the trial

The Results

- In test runs, the satellite network achieved ~99% coverage. This compares to system based on terrestrial network coverage averaging around 60%.
- The Satellite network provided very good performance sufficient to provide good connectivity for >100 simulated active users
- Achieved 78 MBps downlink, 15 MBps uplink (max available on test package).
- Latency: Round trip time of 170ms, similar to terrestrial routing solutions in practice
- All this was achieved in poor weather conditions with frequent rain (sometimes very heavy) and cloud cover!





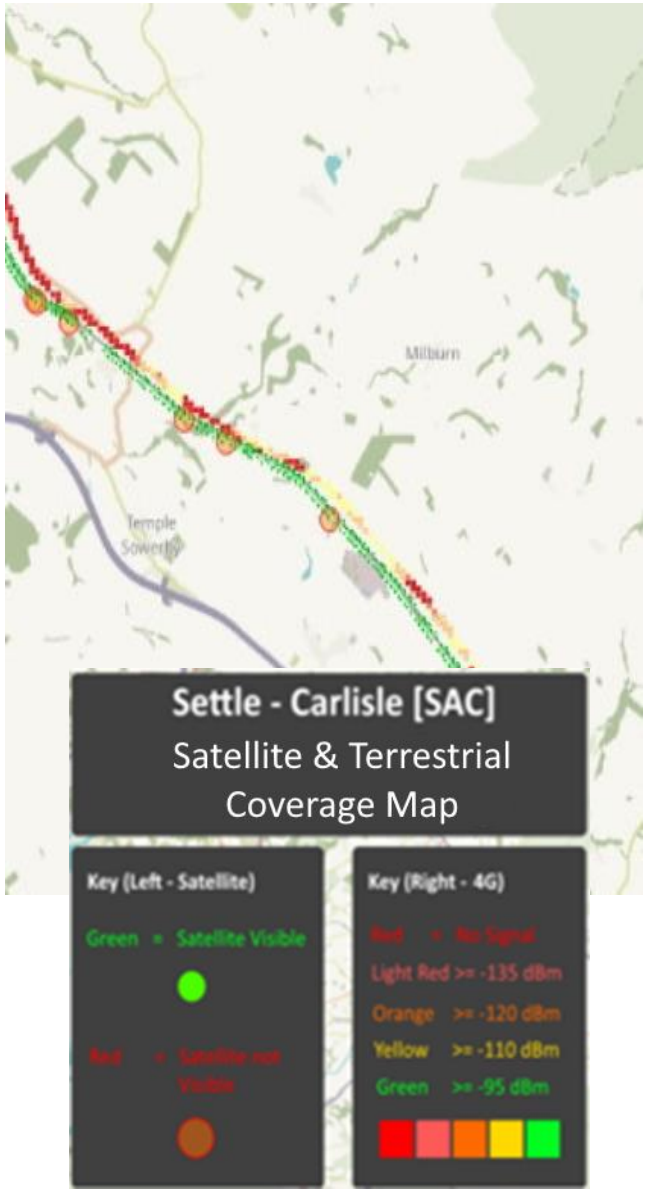
Connectivity planning

LiDAR data used to analyse and identify hazards and blockages to line of sight for satellite communication paths

- Identify how much of the train route is visible
- Select best satellite to use for connectivity

GeoData360 workflow analysis:

- Output in two formats
  - One for direct use by portal
  - One for display in eg QGIS



GeoData360 data pipeline

Acquisition → Ingestion → Processing → Delivery → Users

Satellites & aircraft
- Imagery
- Data products

Satellite networks

Mobile/IOT sensors
- In situ readings
- Continuous monitoring

5G networks

Users & systems
- Reference data
- Historical data
- Manually-created data

Fixed data networks

CGI GeoData360 cloud platform

Satellite networks

Global users

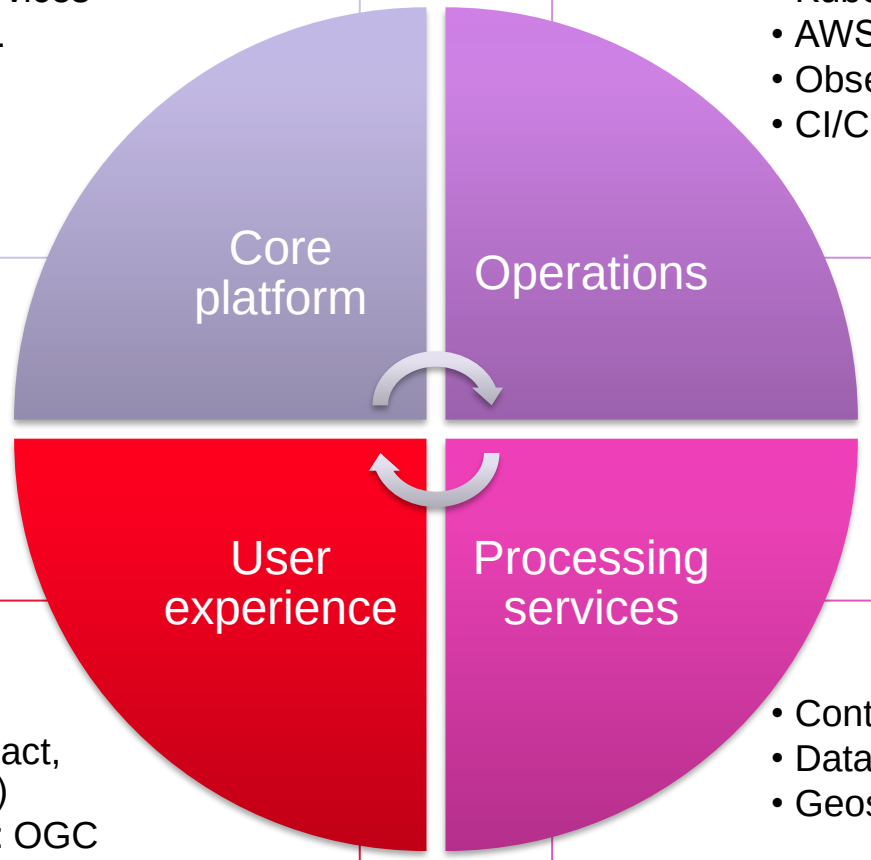
5G networks

Mobile users

Fixed data networks

Fixed users

GeoData360: Key technologies



- Cloud-native services
- Java, Python, …
- HTTP, gRPC

- Kubernetes
- AWS, Azure, …
- Observability
- CI/CD

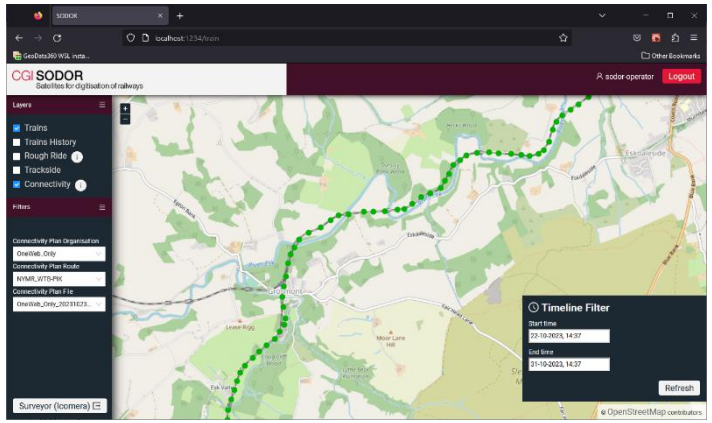
- Geospatial web applications (React, OpenLayers, …)
- Standardisation: OGC APIs

- Containerisation
- Data science & analytics
- Geospatial tooling

Portal

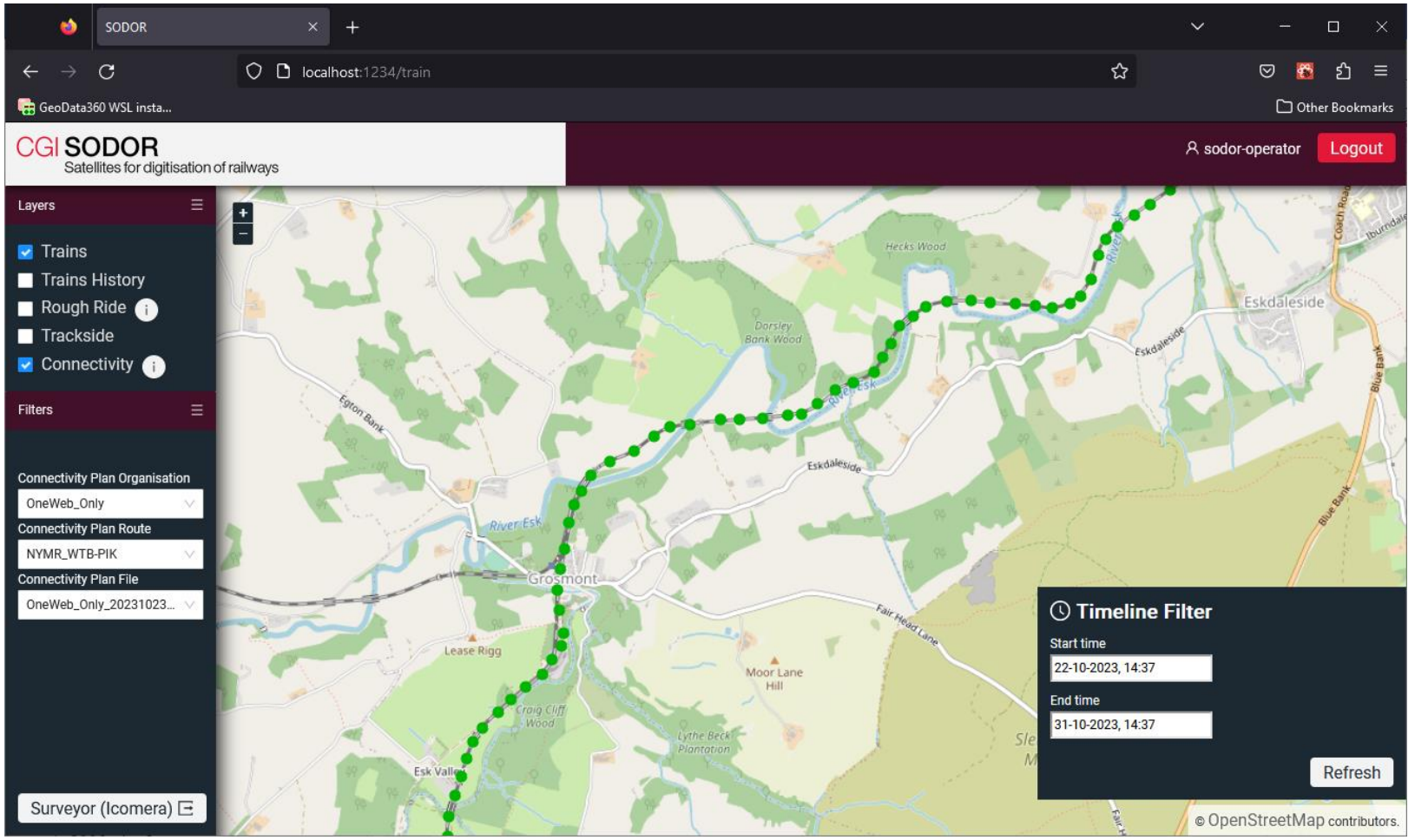
Developed using:

- React
- OpenLayers

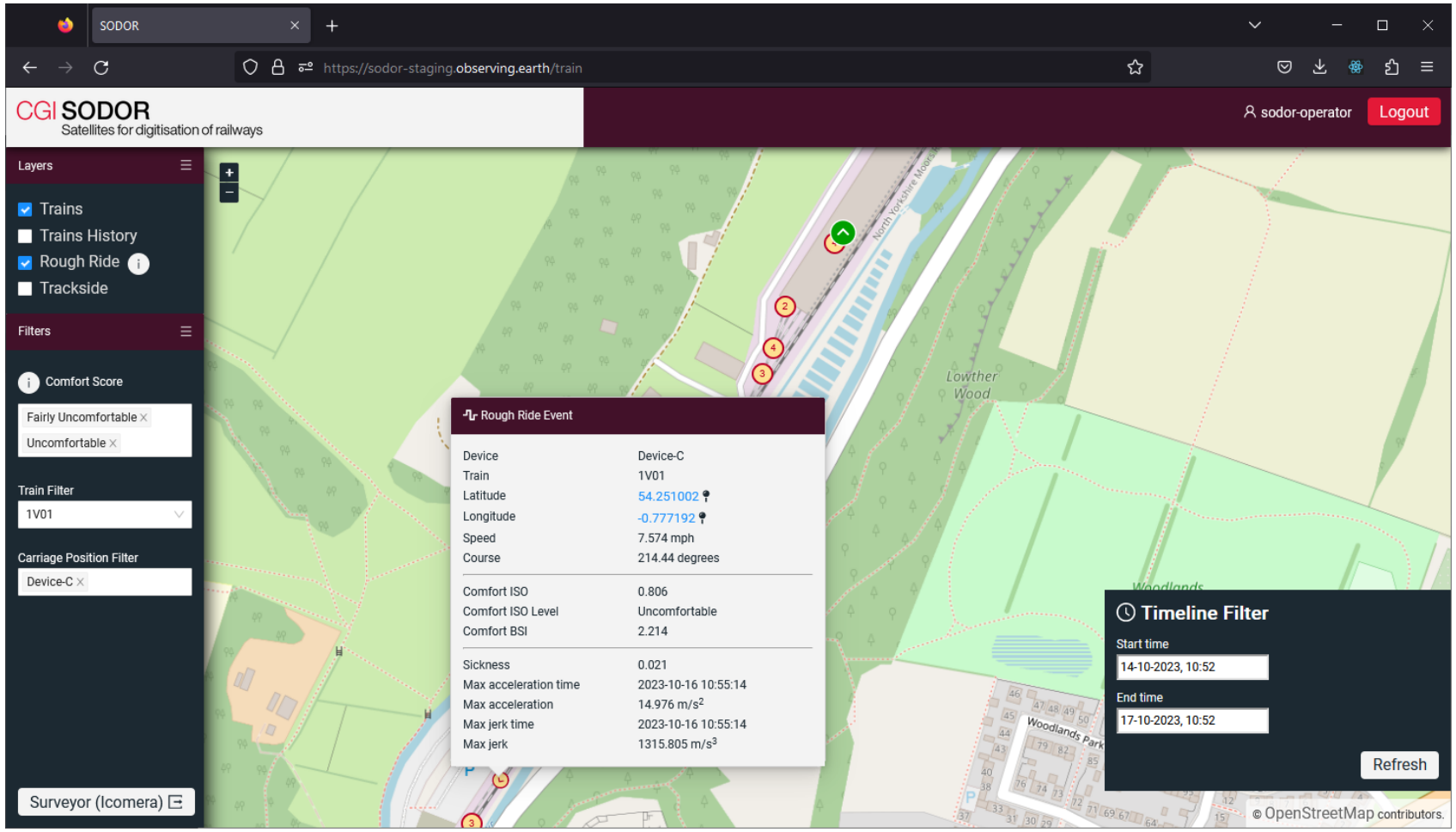


- Connects to a custom API written in Java
- Some endpoints backed by a PostgreSQL database
- Others come directly from SensorInsights360 (CGI product built on FOSS)

Satellite Connectivity



Displaying Rough Ride Events



Insights you can act on

Founded in 1976, CGI is among the largest IT and business consulting services firms in the world.

We are insights-driven and outcomes-based to help accelerate returns on your investments. Across hundreds of locations worldwide, we provide comprehensive, scalable and sustainable IT and business consulting services that are informed globally and delivered locally.

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