

R2DATO-project

... and development of autonomous technology for Oslo trams



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R2DATO is testing technology for safer and more autonomous tram operations

Key benefits make the project relevant for Sporveien beyond the development of new technology

WHAT IS R2DATO?

Rail to Digital and Automated up to Autonomous Train Operations

A Europe's Rail flagship project developing technologies for digital, automated, and future autonomous train and tram operations.

SPORVEIEN'S ROLE

Oslo serves as the test arena. The technology is being tested on SL18 trams in depots and in regular passenger service, providing experience from a demanding urban environment and real-world operations.

SAFER OPERATIONS



Detecting hazards earlier and reducing the risk of incidents, adding an extra layer of safety to Oslo's already safe tram operations.

SUSTAINABILITY



Supporting more energy-efficient and environmentally sustainable operations.

EFFICIENCY

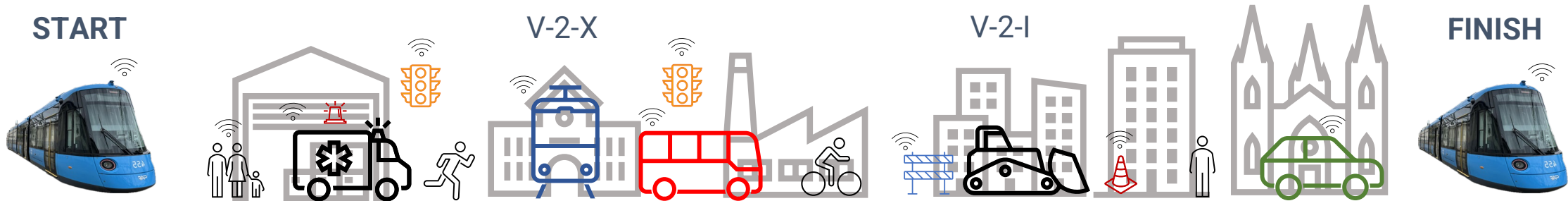


Providing better decision support and more predictable operations.

ECONOMY



More public transport for the same amount of money through smarter operations.



Sporveien is part of an international innovation ecosystem

27 main beneficiaries and partners, supported by 45 affiliated entities across 12 EU countries, Norway and Switzerland

Sporveien Trikken and Jernbanedirektoratet are key players from Norway

The Norwegian R2DATO team, led by the Norwegian Railway Directorate, brings together key national stakeholders.

- **Jernbanedirektoratet** the Norwegian Railway Directorate -
- **Bane NOR SF** Railway infrastructure manager
- **NTNU** technical university in Trondheim
- **Norwegian Computing Centre (NR)** research institute
- **NORCE** Independent research institute
- **SINTEF** Research and Innovation organization



R2DATO Consortium in Oslo

The tram has been transformed into a test platform



Holtet depot as test site for autonomous technology development

Outdoors depot at Holtet suits excellent for testing in different operational conditions

Sporveien Depot at Holtet

Serves as dedicated test site for verification and demonstration activities.

Closed area with no public access

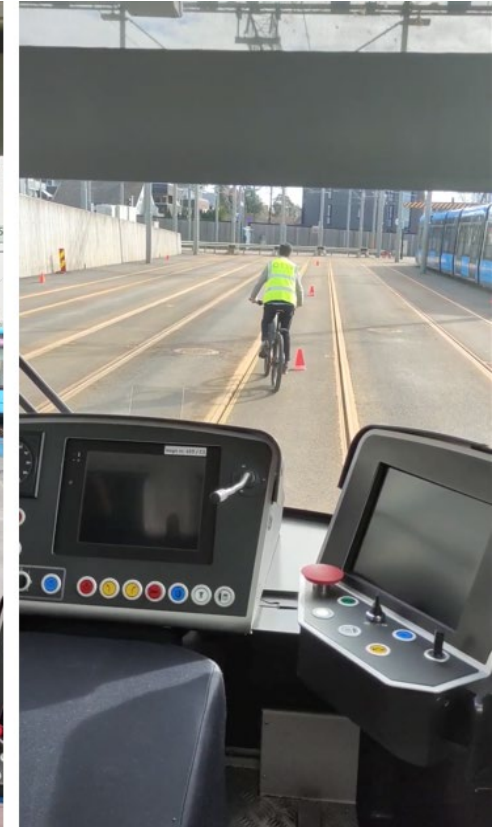
No public access with many options for various testing scenarios

The outdoors depot

Suits for simulation of use cases under varying light and weather conditions

CERES –operational central

The operational center with direct view to the test tracks.



Data collection and machine learning

Tram 455 serves as a real-world data collection platform, supporting the development and validation of autonomous tram technologies.



Sensors as the eyes of the tram

Sensors are the eyes of the tram, enabling it to perceive and understand its surroundings in real time.

Data collection and storage

Operational data from Tram 455 are recorded and stored on onboard hard drives for subsequent analysis and technology validation.

Machine learning and data processing

Machine learning uses the data to identify patterns, recognize objects, and improve the tram's ability to understand and respond to its environment.

Cybersecurity

Cybersecurity is embedded throughout the project, aligned with industry standards such as IEC 62443 and railway safety and security best practices.

We have established an operational test platform for remote operation and autonomous functions.

Sporveien has progressed from platform development to technology validation

TEST PLATFORM

Modification of two newly procured vehicles

Modified for remote operation and autonomous functions

DATA COLLECTION

Operational data collection with Tram 455

Data collection during commercial operations with “Data-tram” started in March 2025

COMMUNICATION AND DISSEMINATION ACTIVITIES

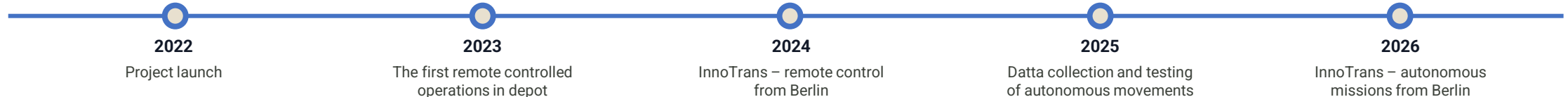
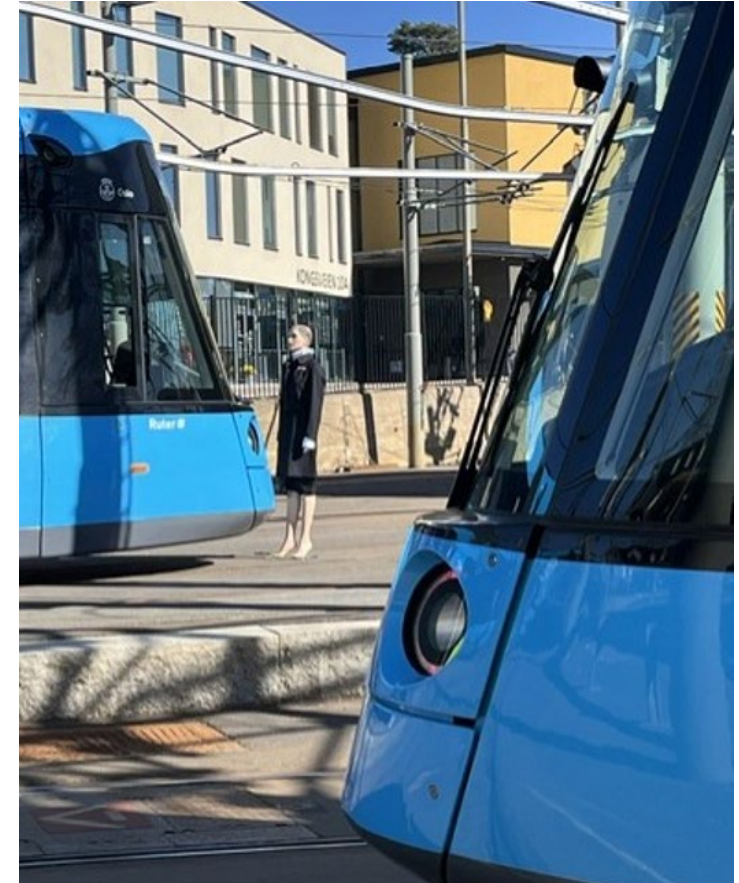
Two successful InnoTrans presentations

Putting Oslo and R2DATO on the European rail innovation map

TECHNOLOGY VALIDATION

Remote control and autonomous movements

Remote control and autonomous missions validated at Holtet depot



Benefits starts much sooner than with full autonomy

The Sporveien ambition is conditional autonomy, with benefits already being realized through driver assistance and partial autonomy

Can largely be introduced within today's regulatory framework

Driver assistance and partial autonomy can be introduced gradually, delivering benefits well before full autonomy becomes a reality.

Requires further regulatory framework development

Sporveien is an active contributor to the development of regulations tailored to tram operations.

→ *Ambition 2030*



Level 0 - No Driving Automation

The tram operator performs all driving tasks, with no automated control of vehicle movement



Level 1 – Driver Assistance

The tram operator remains in full control, assistance systems provide warnings, monitoring, or limited support.



Level 2 – Partial Driving Automation

The system can perform selected driving tasks, but the driver must always be ready to take over.



Level 3 – Conditional Driving Automation

The system performs the driving task under defined conditions; the driver must take over when requested.



Level 4 – High Driving Automation

The system operates fully autonomously without a driver, but only within a defined operational area.



Level 5 – Full Driving Automation

The system operates fully autonomously in all environments without a driver.

What needs to be in place for success?

INTERNALLY IN SPORVEIEN

Program organization

A dedicated team with a clear mandate, budget, and governance structure, not a side project.

Expertise

AI, sensor technology, legal frameworks, insurance, and change management must be developed together.

Data platform

Operational data are collected from day one and used for learning, testing, validation, and documentation.

Engagement and trust

Employees, trade unions, passengers, and policymakers are engaged from an early stage.

Autonomous operations require a coordinated effort

- *Technology, organisation, and enabling frameworks must evolve in parallel to ensure safe and scalable deployment.*
- *Success is not about a single technology demonstration, but about building the capabilities and frameworks needed to deploy the technology safely and at scale.*

EXTERNAL FRAMEWORK

Regulatory readiness

A predictable process with regulatory authorities and clear frameworks for testing and piloting.

Infrastructure

Sensors, depot and base areas, test environments, and digital twins must be prioritized.

Supplier management

Partners and contracts must ensure access to data, software updates, and long-term support.

EU and Nordic cooperation

EU and Nordic networks, and standardisation provide the foundation for scalable deployment.



Automation through R2DATO that supports driver

From manual driving towards advanced driver assistance, while the driver retains responsibility and decision-making authority

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