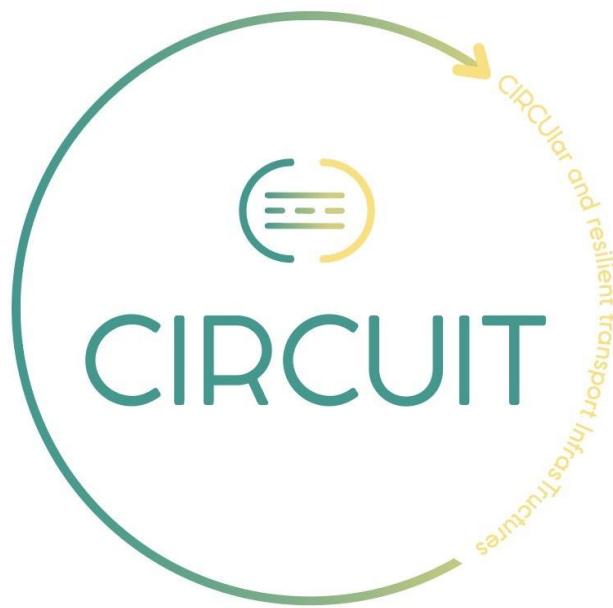




Deliverable 2.4

Real-Time Traffic Management on Smart Mobility Systems

Work Package: WP2 — Smart & Resilient Infrastructure | Date: May 2025 | Authors: Universidad de Cantabria (lead)

Context

Intelligent Transport Systems (ITS) are reshaping how road networks are managed — moving from reactive incident response to real-time adaptive control, predictive analytics and connected mobility ecosystems.

This deliverable provides a comprehensive state of the art on real-time traffic management technologies and their integration into smart mobility systems. It also presents a concrete case study: the design, simulation and real-world validation of an automatic wrong-way vehicle detection system on the A-8 motorway in Cantabria, Spain — a road safety application developed within the CIRCUIT project.

At a Glance

Technologies covered: ITS, V2X, 5G, LIDAR, CCTV, ANPR, IoT

Emerging trends: Digital Twins, edge computing, AI algorithms

Case study site: A-8 motorway, Islares, Cantabria, Spain

Detection target: Wrong-way vehicle incidents

Validation method: Microsimulation + real-scale field testing



Key Findings

 Advanced Traffic Management Systems (ATMS) now combine adaptive signal control, dynamic lane management, reversible lanes and HOV/bus priority — all controlled in real time from centralised Urban Traffic Control Centres (UTC).

 V2X communication (V2V, V2I, V2P, V2N) is the critical connectivity layer enabling cooperative ITS. Combined with 5G, it enables sub-100ms response times for safety-critical applications.

 Emerging trends include Digital Twins of entire road networks for real-time simulation, edge computing for on-site decision-making, self-learning traffic algorithms and embedded cybersecurity as an infrastructure layer.

 Case study — A-8 motorway: A wrong-way vehicle detection system was designed using LIDAR sensors, HDR cameras and ANPR technology. Operational logic was validated through microsimulation before real-scale controlled testing. The system detects incidents within seconds and triggers automated alerts.

 Road safety data shows wrong-way driving incidents cause disproportionately severe accidents. Automated detection combined with variable message signs and direct driver alerts represents a high-impact, cost-effective intervention.

Takeaways for Practitioners

1. Prioritise ITS deployment on high-risk motorway sections — the A-8 case study demonstrates that automated detection systems can be designed, validated and deployed at relatively low cost with significant safety impact.
2. Use microsimulation to validate operational logic before field deployment — it significantly reduces testing risk and accelerates the design-to-deployment cycle.
3. Plan for cybersecurity from the outset: as ITS systems become more connected, operational reliability depends as much on data security as on hardware performance.
4. Align ITS investments with Digital Twin strategies — real-time traffic data feeds directly into digital network models, creating compounding value across traffic, safety and maintenance management.

Full deliverable (open access): www.circuitproject.eu/resources