FinEst Centre
for Smart Cities

SMART CITY CHALLENGE 2025
Solution idea for the city challenges

Max 3 pages
send to smartcity@taltech.ee by Nov 30, 2025

Solution Idea Title (max 5 words, no acronyms) - **Digital Traffic Layer for Autonomy**

Planned pilot project duration – 24 months

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1. Which urban challenge or problem are you planning to provide a solution to?

- Which city challenge/-s proposed by the cities / counties you are targeting? NB! Please choose one from the list of urban challenges chosen for the Smart City Challenge 2025, i.e. Round 5.
  Infrastructure for Autonomous Mobility

2. The solution you are proposing

- What is the solution you are proposing for the challenge above?
- How does it solve the city challenge you target?

The proposed solution establishes a unified, real-time data infrastructure that transforms heterogeneous city traffic data into machine-readable formats suitable for autonomous vehicles. We aggregate inputs from public, municipal and enterprise-specific sources and harmonise them into a reliable, standardised digital layer that AVs can directly interpret. The solution is open and extensible, allowing future data providers to be integrated regardless of their original format. Advanced AI methods are applied to clean, structure and interpret complex mobility datasets, while highly secure IoT components ensure trustworthy communication for safety-critical infrastructure such as traffic lights and roadside units. The resulting end-to-end system enables cities to operate AV-ready infrastructure and to pilot real autonomous mobility services. The solution will be validated in real urban environments using different autonomous vehicle platforms, including an autonomous shuttle and a self-driving passenger car, demonstrating interoperability, scalability, and readiness for broader deployment.

In the specific context of Tartu, the solution overcomes one of the city's most critical bottlenecks: the inability of autonomous vehicles to reliably interpret existing traffic-light infrastructure. By equipping traffic lights at intersections with machine-readable, standardised V2X-enabled components and providing a high-quality, structured data feed, Tartu can replace today's error-prone camera-based light detection with a robust digital signal channel. This ensures that AVs—whether autonomous shuttles, taxis, delivery robots, or full-size city buses—receive trustworthy information about signal phases, priority rules, and situational changes in real time. The harmonised and securely managed data layer allows any future AV operator to integrate into the city's infrastructure using the same standardised interface, significantly lowering

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deployment barriers and making Tartu an attractive environment for piloting and scaling autonomous mobility services. Through this approach, the city gains a future-proof, interoperable backbone that supports safe driverless operation and accelerates the transition toward sustainable, low-emission transport.

3. Innovation and piloting of your pilot solution.

- What are the best solutions available now that solve the challenge you target? (There are some solutions there for sure) How will your solution be better? What is the innovation in it?
- What do the cities need for piloting the proposed solution? How the piloting could work?
- Please provide short information about the capabilities of the research and development proposed team. Your team should have members from TalTech as well for sure. In case you do not have them yet, which skills would you need from TalTech.

Compared to existing V2I and smart intersections, our solution goes beyond a single technology stack by aggregating heterogeneous data sources, including both direct infrastructure signals (e.g. traffic lights, sensors) and noisy inputs such as cameras and third-party feeds. All these streams are harmonised into a unified, machine-readable data layer that autonomous vehicles can access through a simple, standardised interface. This significantly lowers the barrier for different AV operators to deploy services, as they do not need to integrate separately with each data source or vendor. On top of the core data layer, we apply AI methods to large mobility datasets to enable added-value services such as traffic flow optimisation, load prediction, and AV-specific situational insights. The result is an open, scalable, and future-proof infrastructure that supports both current AV pilots and the gradual roll-out of city-scale autonomous mobility. We address a city-level solution that supports infrastructure with different technology levels, for example, by upgrading existing traffic lights with additional software or hardware, without forcing the city to replace the entire device or system.

For piloting the proposed solution, cities need agreements with the main traffic infrastructure owners and operators to enable access, or are (in principle) ready to incorporate additional software/hardware to traffic-light controllers, sensor feeds, and other mobility-related data streams. A suitable legal framework (usually depending on the level of government laws) must be in place to authorize autonomous vehicle operations within a defined pilot area in a clearly specified ODD (operational design domain).

The TalTech Robotics and Autonomous Vehicles research group has strong expertise in autonomous driving systems, sensor fusion, V2X communication, digital twins, and cyber-physical system validation, with extensive experience from projects such as Iseauto, SafeAV, Xtrust, and multiple industry pilots. The team combines capabilities in AI-based perception, embedded systems, robotics software engineering (Autoware, ROS2), and smart-city mobility experimentation. For this project, we can additionally involve TalTech specialists in IoT security, traffic engineering, and large-scale data platforms to complement the core competencies of our AV research group.

4. Expected impact of your pilot solution.

- What is the potential impact for city environments, sustainability and citizens?

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The proposed solution significantly increases the city's readiness for autonomous vehicle pilots and, ultimately, full-scale deployment by providing a robust V2I-enabled infrastructure that AVs can reliably integrate with. By offering a standardised, machine-readable interface for traffic lights and mobility data, the city becomes an attractive partner for developers of autonomous shuttles, robotaxis, last-mile delivery robots, and other emerging mobility services, who can begin testing and operating with minimal integration effort. This lowers the barriers for innovation, accelerates the arrival of new mobility services, and strengthens the city's position as a preferred testbed for cutting-edge technology. As readiness grows, so does the city's overall innovation potential and international reputation, making it an appealing environment for startups, technology companies, and research-intensive experiments. In the long term, such a future-proof infrastructure can also influence companies' decisions to establish local development teams and deepen collaboration with the city's research ecosystem. From a sustainability perspective, the solution supports a shift toward cleaner and more efficient mobility by reducing reliance on private cars and enabling low-emission autonomous public transport and last-mile services. Better traffic flow, fewer unnecessary stops at intersections, and improved coordination between vehicles and infrastructure contribute to lower CO_2 emissions and reduced noise pollution. For citizens, this means safer intersections, more reliable mobility options, and improved accessibility for people who currently lack convenient transport choices. Overall, the city becomes cleaner, safer, and more inclusive as autonomous mobility services scale.

Disclaimer: by submitting this form you will give the FinEst Centre for Smart Cities the right to share this idea with cities and other researchers, companies through FinEst Centre homepage. If this idea is selected, the FinEst Centre for Smart Cities has the right to implement this idea with offering you an active role in conducting the pilot. If this pilot is selected then the financing is an investment by the FinEst Centre for Smart Cities.

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