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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) – Scalable Autonomous Mobility Infrastructure

Planned pilot project duration – 24 months

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

Infrastructure for Autonomous Mobility, Tartu City, Estonia

2. The solution you are proposing

We propose deploying an integrated multi-technology solution built on i) C-V2X–based infrastructure, ii) DSRC based infrastructure to broadly enable both direct and network-assisted communication between vehicles, and roadside infrastructure including traffic lights, 5G base stations etc., thereby supporting a reliable data and communication network towards autonomous driving. The easy to scale infrastructure will include Roadside Units (RSUs) and the required transmission protocols and messages, such as Signal Phase and Timing (SPaT). While the primary infrastructure will rely on C-V2X RSUs, many commercially available models, such as the Cohda MK6 RSU, Commsignia ITS-RS4, and ETTIFOS SIRIUS, also support DSRC and C-V2X LTE or 5G network connectivity. This multi-technology capability provides flexibility, allowing the deployment to be tailored to Tartu city and other cities preferences, available resources, and long-term strategy. Note that the selection of RSUs will adhere to EU security guidelines, ensuring procurement from vendors that meet compliance requirements. The RSUs will be integrated with the traffic light controllers currently deployed in Tartu, e.g., Swarco ITC-3. The solution's key components include:

- **Reliable and Low-Latency Communication:**

Use standardized PC5 interface for direct V2V/V2I communication and Uu interface for V2N connectivity, enabling safety-critical operations and higher automation levels (Level 4–5).

- **Machine-Readable Traffic Lights:**

Connect RSUs to either NTCIP-compliant traffic light controllers (e.g., Swarco ITC-3) or through middleware, if needed, to transmit SPaT, i.e., traffic light status information, data for autonomous vehicles.

- **Aggregated Mobility Data Collection:**

Our solution will collect additional data to remove the existing fragmentation and use the existing data

Aggregate the mobility pattern data from the connected vehicles via V2N to a central server. Enhance weak data using sensor fusion and AI-based intersection analysis (e.g., YOLOv11 instance segmentation). The mobility pattern analysis will incorporate data from C-V2X–connected vehicles, high-precision positioning information (building on TalTech teams extensive experience in vehicle positioning from European projects such as 5G-ROUTES, LATEST5S, 5G-BALTICS), and state-of-the-art intersection-level mobility pattern data obtained through AI-based instance-segmentation frameworks. V2N

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enables aggregated data collection and analysis from the connected vehicles, which allows city-level data-driven planning for traffic optimization, climate impact modeling, and decision-making.

How does it solve the challenge

Problems highlighted in the challenge	Proposed Solution
Outdated infrastructure that does not support essential protocols such as C-V2X	Scalable and reliable multi-technology (e.g., C-V2X, DSRC) infrastructure (including RSUs and enabling necessary transmission protocols)
Unreliable and non machine-readable traffic-light reading technologies	Machine-readable traffic lights connected to the RSUs and transmitting its status to the vehicles through SPaT message
Fragmented, scattered, and incomplete mobility-pattern data	Aggregated multi-modal mobility-pattern data.
Reducing dependency on private cars and growing CO_2 emissions. Barriers for piloting new transport services and limits innovation.	Integrated, standards-based scalable infrastructure and mobility data collection enable piloting sustainable autonomous mobility services, supports shifting away from private car dependency, and contributes to decreasing CO_2 emissions.

3. Innovation and piloting of your pilot solution.

3.1 Novelty: Camera-based traffic light detection fails under adverse weather conditions. Data is scattered and lacks resolution for advanced planning. The lack of robust architecture (e.g., C-V2X) and central server, reduces the safety of autonomous vehicles, central server fusion and data collection, and machine readability. The proposed solution introduces machine-readable infrastructure with C-V2X, robust data fusion, and AI-driven mobility pattern analysis. This enables reliable autonomous operation and city-scale data-driven governance. The solution will be based on standard specifications e.g., 3GPP, ETSI, IEEE, etc., to ensure interoperability. In addition, it will be designed to be scalable and cost-efficient. The pilots will take place in 1) Tartu, 2) at least one city outside of Estonia (e.g., Slovenia, Barcelona, etc.,) features: dense RSU deployment in the area of the pilot, SPaT integration with traffic controllers, V2X communication (PC5 + Uu), and advanced data analytics for mobility patterns at central server.

3.2 What do cities need for piloting the solution: The support of the city is essential for the successful piloting of the solution. Access to maps and traffic-light controllers is required to integrate the infrastructure RSUs with both the traffic lights and the Traffic Management Center (TMC). Close collaboration with the city's management and authorities is therefore critical to ensure seamless infrastructure integration and to enable the collection and consolidation of data into central management system for effective city-level planning and decision-making. In addition, the city's permission and active support are necessary for deploying the infrastructure and ensuring the overall success of the pilot.

3.3 Team The team is primarily composed of TalTech researchers and TRAFFEST (represented by the CEO Viljar Nurme) along with Tartu city and at least 1-2 cities outside of Estonia. The team consists of experts contributing to infrastructure for autonomous mobility. The TalTech team has extensive relevant experience delivering solutions at TRL 7 in numerous EU and international projects. These include coordinating the 5G-BALTICS project, which enabled uninterrupted 5G connectivity across the 667 km Baltic corridor, and serving as the technical lead in 5G-ROUTES, where we developed and deployed connected automated mobility solutions for smart mobility between Finland, Estonia, and Latvia. The key team members are: Tenured Professor Muhammad Mahtab Alam, Head of the Communication Systems Research Group; Tenured Professor Yannick Le Moullec, Head of the Cognitive Electronics Research Group; Wireless Communication Researcher Osama Elgarhy; and 3GPP Solution Expert Margus Rohtla.

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4. Expected impact of your pilot solution.

	Short-Term (by end of project, within the selected pilot area in Tartu and selected pilot area of second city)	**Long-term** (5 years after project end, across 5 cities in Europe)
City Environment and sustainability	-Decrease average intersection delay by 8 to 12% in pilot area, enabled by SPaT-supported signal coordination and improved mobility flow -Decrease CO_2 emissions by 3 to 5% in pilot area (measured reductions in idling times and improved vehicle throughput) -Increase share of automated or connected mobility services operating in pilot area from 0% baseline to ≥ 2 operational C-V2X-enabled services (e.g. automated shuttle, remote-supervised vehicle)	-Decrease congestion by 10 to 18% in deployment corridors across ≥5 European cities -Decrease CO_2 emissions by 5 to 10% where solution is deployed -Increase adoption of cooperative automated mobility services in at least five European cities
Citizens	-Decrease conflict events at intersections by 15 to 20% (measured through AI-based intersection analytics and vehicle telemetry) -Increase in perceived safety among residents participating in surveys by ≥ 20% compared to baseline -Decrease time-to-cross for vulnerable road users by 10%, supported by machine-readable infrastructure and optimized signal timing	-Decrease urban intersection accidents by 15 to 25% across deployment sites -Increase accessibility for reduced mobility users via 20 to 30% increase in use of automated or connected services -Decrease noise pollution in deployment corridors by 5% owing to smoother traffic flow
City Governance	-Increase data availability for decision-making from near 0 baseline to continuous intersection-level mobility analytics from ≥ 10 RSU-equipped intersections -Reduce operational workload for traffic-signal timing adjustments by 15% via automated data ingestion and analytics -Engage ≥ 4 industry partners during the project to strengthen innovation ecosystem and technology transfer pathway	- ≥5 municipalities use licensed versions of the solution -Decrease costs of manual traffic monitoring and planning by 20 to 30% -Cross-city data federation framework adopted by ≥3 cities that supports evidence-based mobility governance
Technological Leadership & Autonomous Mobility	- 10 to 15 C-V2X RSUs in Tartu that meet EU security requirements, establishing functional reference zone for autonomous mobility -Integration of SPaT data from at ≥ 80% of the traffic lights in pilot area -2 technology validation rounds with second city (outside Estonia) to confirm interoperability and scalability	- Revenue-generating product/service line with annual licensing revenue of 0.2 to 1 million EUR by 5th year after project - ≥ 150 certified RSUs across multiple cities using project's architecture to confirm scalability and standard compliance -Cooperative automated mobility use cases (e.g. automated shuttles or cooperative perception) in ≥5 cities

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