LINKS V2X ROAD SIDE UNIT

Rugged field-tested 5G-enabled device for sensors data processing and forwarding

SOLUTION

- LINKS RSU is a hybrid C-ITS and sensor data router supporting 5G connectivity and both ITS-G5 or C-V2x short-range communications.

- It can be equipped with a GPU based on NVIDIA architecture for on board data analysis:

    - GPU NVIDIA Volta™ a 384 core con 48 Tensor Core achieving 21 TOPS
    - CPU NVIDIA Carmel ARM® v8.2 64-bit a 6 core
    - 16 GB 128-bit of memory

- The software on the RSU is modular and can be easily managed using a flexible approach based on orchestration.

- The RSU can host third-parties containerized applications that can easily interact through RESTful APIs with the ITS communication stack developed by LINKS.

- The RSU can be remotely monitored and managed through a graphical dashboard.

- It supports a camera and a LiDAR that are used to gather information from the surroundings.

- It can automatically detect, track, and predict the movements of vehicles and vulnerable road users (VRUs) and provide various statistics such as vehicle classification and counting, etc.

- It is designed to provide the main services from Day 1 to Day 3 in a reliable and secure way. These services are implemented by LINKS, and they span from warning applications and event identification to collective perception and cooperative manoeuvring applications.

> LINKS V2X RSU Technology Readiness Level (TRL) = 7+

TEAM

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Connected Systems & Cybersecurity Research Domain

Broad experience in wireless, with a focus on vehicular-to-X communications. Documented achievements in hardware integration for 5G-enabled embedded devices. Strong skills in software development of CCAM-related applications and C-ITS services.

KEYWORDS

- Docker
- 5G
- Sensors
- V2X
- AI-enabled

OPPORTUNITIES

- Collaboration with companies for research and technology transfer.

- Promote the solution towards local agencies, smart cities, mobility, and transportation agencies.

- New projects and collaboration with scientific organizations increasing maturity and flexibility

VALUE PROPOSITION

Ready-to-use camera and LiDAR

- Integrated with camera and LiDAR with easy-to-use interfaces. It offers several wireless and wired interfaces for accommodating extra sensors.

On-board and/or edge-level data processing

- The embedded GPU enables the processing of the collected data directly on board, while the 5G connectivity ensures fast data transfer to the edge network server where processing can be executed on-demand.

Modular solution

- The RSU can be equipped only with a CPU or, alternatively, with different GPU models to reach the right target of processing capabilities.

Applications for Cooperative Mobility

- Availability of applications for cooperative mobility (e.g., collective perception, cooperative manoeuvring). Easy integration of additional applications.

- RSU is ready for interacting with edge servers for off-loading applications when needed.

Part of LINKS Vehicular Communication Ecosystem

- The ecosystem comprehends also On Board Unit; 5G, edge and cloud applications; applications for Cooperative Mobility; simulation environment.

Made in Italy

- Developed by an Italian research team with long and proven experience in the field (including the C-ITS stack)

Technologies are assuming increasing importance in shaping the future of cities. Cities are becoming smart, and the data collected from different sources are fundamental enablers of this process.
Smart city decision-makers can use data to monitor and anticipate urban phenomena in new ways, and efficiently manage urban activity providing public services (health, education, energy, transportation, etc.) that really meet the citizens' needs.

In this context, the transportation and mobility ecosystem has been revolutionized by intelligent transport systems (ITS).
The term Vehicle-to-X (V2X) refers to a transport system where the vehicles and the infrastructure are interconnected, providing real-time, highly reliable and actionable information flows to enable safety, mobility and environmental applications.
Connected V2X devices available on the market are chipsets, modules, On Board Units (OBU), Road Side Units (RSU) and LTE-V2X (source: 5GAA).
A Road Side Unit (RSU) collects traffic data from a static sensing area along a road and transmits data to traffic control devices as well as a central traffic management centre. These devices also serve as an information source for intelligent vehicles to collect future traffic information.

RSU Benefits

Road Side Units collect traffic data allowing more efficient and informed decision-making processes. Social, economic, and environmental impacts are foreseen:

> Increase road safety
> Improve urban logistics efficiency and social welfare
> Enhance economic productivity
> Reduce environmental impacts
> Transform public agency operations

MARKET

> V2X market trends

Connected vehicles are still an emerging technology. Even if connected cars services diffusion is still in its infancy, OEMs are exploring new opportunities and the enabled data-driven business models. The

	Value (in 2022)	Projection (2030)	CAGR (2022-2030)
Connected cars	USD 77 billion	USD 293 billion	18,1%
V2X	USD 2,6 billion	USD 38 billion	39,7%
Road Side Units	USD 1,1 billion	USD 2,5 billion	10,5%

Source: elaboration from fortune business insights, markets and markets, dataintelo

market related to V2X technology is going to be boosted by the increase in demand for connected vehicles. According to PwC and Statista, in 2021 connected cars were about 236 Million globally (76,08 Million in Europe), and this value is projected to increase more than threefold in the next years (forecast: 863 Million connected cars in 2035).
Between the two main segments of V2X devices (OBU and RSU), the OBU segment holds the largest share of the market, while the RSU is also expected to show good growth in the market due to the decreasing deployment costs, help in managing traffic flow and improving pedestrian and driver safety.

> Companies

Companies developing RSU solutions are active players in the V2X market. They include both big companies and SMEs and offer a wide spectrum of V2X solutions, including RSUs, OBUs, chipsets, applications and related services. They are mainly based in the USA, Asian countries (China, Taiwan) and central Europe. Only few Italian companies offer RSU solutions.
The value proposition of the RSUs available on the market focuses on:
- Technical features (e.g., the compliance with standards; security aspects; integration with GNSS; Wi-fi, Bluetooth, 5G technology support; possibility to analyse and elaborate data and provide statistics; etc)
- Functionalities / services (easiness of use; maintenance; support and assistance services).
The main innovative aspects of the LINKS RSU compared with these solutions are related to three main aspects:
- The presence of the GPU that allows on-board data analysis,
- The possibility to combine with cameras and LiDARs,
- The possibility to easily manage all the software using containerized applications and a completely programmable approach based on orchestration.
These features have been found only in a small number of commercial cases but generate high interest at the research level.

| Supported ETSI standard | ETSI C-ITS messages
ETSI EN 302 637-3 V1.3.1 (2019-04) / ETSI TS 103 831 V2.1.1 (2022-11) (DENM)
ETSI EN 302 637-2 V1.4.1 (2019-04) (CAM)
ETSI TS 103 301 V2.1.1 (2021-03) (SPATEM, MAPEM, IVIM, SREM, SSEM)
ETSI TS 103 324 V2.1.1 (2023-06) (CollectivePerceptionMessage)
ETSI TS 103 300-3 V2.2.1 (2023-02) (VAM)
ETSI TS 103916 (POIM for Parking Availability) - last available draft
ETSI TR 103 578 / ETSI TS 103 561 (MCM) - last available drafts | ETSI Security
ETSI TS 102 940 V2.1.1 (2021-07), ETSI TS 102 941 V2.2.1 (2022-11), ETSI TS 102 731 V2.0.0 (2022-11), ETSI TS 103 097 V2.1.1 (2021-10)

ETSI communication stack
ETSI EN 302 665 V1.1.1 (2010-09), ETSI EN 302 636, ETSI TS 103 248 V2.2.1 (2022-11) |