# LINKS V2X ON BOARD UNIT

Cutting-edge vehicular platform for testing high-end CCAM applications

**FONDAZIONE links**
PASSION FOR INNOVATION

## SOLUTION

> LINKS V2X OBU is a flexible research platform to be used for testing advanced CCAM use cases

> Main scope
> - support to the implementation of services from day 1 to day 3
> - testing innovative applications based on C-ITS messages and information received from roadside fixed sensors
> - experimenting new C-ITS messages or extension of existing ones

> Hardware platform with GPU based on NVIDIA® boards
> - Jetson Xavier™ NX board
> - Jetson Orin™ NX board (on-demand)

> Network Connectivity
> - Long-range: 5G Telit modem (4G/5G rel. 15)
> - Short-range: LTE-V2x or ETSI ITS G5 (IEEE 802.11p)

> uBlox GNSS receiver with RTK

> Additional interfaces: Ethernet; CAN-bus; WiFi/Bluetooth

> OBU specific software available:
> - Application for identifying relevant information for the vehicle event information and traffic light information
> - Vehicle data network interface: DBC-based for CAN-bus or protobuf-based

> Ongoing features development:
> - OBU configuration and management
> - HMI on Android-based device (visualization of other vehicles, visualization of traffic light information, event information, incident detection and road safety)

> **LINKS V2X OBU 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    > V2X
> 5G    > ITS G5
> GPU    > CCAM

## OPPORTUNITIES

> Collaboration with companies for research and technology transfer.

> Promote the solution towards OEMs, smart cities, mobility, and transportation agencies.

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

> Support to research centers for demonstrating advanced CCAM applications

## VALUE PROPOSITION

**Modular and flexible SW environment based on docker container**
> easy deployment through RESTful APIs

**C-ITS communication stack developed by LINKS for an automatic management of C-ITS messages**
> user interaction with the C-ITS stack based on RESTful APIs and JSON format
> supporting digital signature and interaction with the EU PKI for certificates retrieval
> compliant with the C-ROADS approach

**Hybrid communication supported**
> 4G/5G and ITS-G5/LTE-V2x

**Part of LINKS Vehicular Communication Ecosystem**
> The ecosystem comprehends also Road Side 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)

## V2X technologies

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 V2X On Board Unit (OBU) is a device installed in a vehicle that records traffic and driving data and can connect to roadside and satellite navigation systems. V2X technologies can enable vehicles to transmit data between vehicles and smart infrastructure using OBU.

### V2X OBU Benefits

V2X On Board Units allow real-time data collection and transmission between vehicles and infrastructure. Effects on road safety, traffic pollution and traffic congestion are foreseen, in particular it can:

> Influence driving behaviours
> Improve traffic efficiency
> Reduce accident events
> Reduce environmental impacts
> Optimise transport systems

## 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% |
| On Board Units | USD 2,1 billion | USD 6,2 billion | 14,4% |

*Source: elaboration from fortune business insights, markets and markets, Fact.MR*

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. The demand for OBU is fostered by several factors, in particular the take up of autonomous driving and the high adoption of ADAS (Advanced Driver Assistance Systems).

### > Companies

Companies developing V2X OBU 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. However, they are practically absent from the Italian market.

The value proposition of the V2X OBUs available on the market focuses on:
- Technical features (e.g., compliance with standards; security aspects; integration with GNSS; Wi-fi, Bluetooth, 5G technology support; connectivity ITS G5 (DSRC) / C-V2X; software modularity)
- Mobility functionalities (transport scheduling, collisions warnings, fit for vehicle fleets, etc.)
- Support services (maintenance; support and assistance services; statistics and reports)
- Other features (easiness of use; easy integration)

The main innovative aspects of the LINKS V2X OBU compared with these solutions are related to:
- Hybrid communication supported: 4G/5G and ITS-G5/LTE-V2x
- Integration of the GPU in the hardware platform
- C-ITS communication stack for an automatic management of C-ITS messages both CAM and DENM
- Software modularity based on docker containers support

These features have been found only in a small number of commercial cases.

| Supported ETSI standard | ETSI C-ITS messages<br>ETSI EN 302 637-3 V1.3.1 (2019-04) / ETSI TS 103 831 V2.1.1 (2022-11) (DENM)<br>ETSI EN 302 637-2 V1.4.1 (2019-04) (CAM)<br>ETSI TS 103 301 V2.1.1 (2021-03) (SPATEM, MAPEM, IVIM, SREM, SSEM)<br>ETSI TS 103 324 V2.1.1 (2023-06) (CollectivePerceptionMessage)<br>ETSI TS 103 300-3 V2.2.1 (2023-02) (VAM)<br>ETSI TS 103916 (POIM for Parking Availability) - last available draft<br>ETSI TR 103 578 / ETSI TS 103 561 (MCM) - last available drafts | ETSI Security<br>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)<br>ETSI communication stack<br>ETSI EN 302 665 V1.1.1 (2010-09), ETSI EN 302 636, ETSI TS 103 248 V2.2.1 (2022-11) |