

# V2X On-Board Unit

## OBU-352EC

C-V2X on-board unit, V2Xcast® ETSI C-ITS stack and SDK

## OBU-352ED

DSRC-V2X on-board unit, V2Xcast® ITS-G5 stack and SDK

## OBU-352UC

C-V2X on-board unit, V2Xcast® IEEE 1609/SAE J2735 stack and SDK

## OBU-352UD

DSRC-V2X on-board unit, V2Xcast® IEEE 1609/SAE J2735 stack and SDK



OBU-352 is the most advanced V2X on-board unit featuring a global V2X solution; the hardware supports either C-V2X or DSRC-V2X communication standards with appropriate V2X stack embedded, reducing the cost and complexity for global deployments.

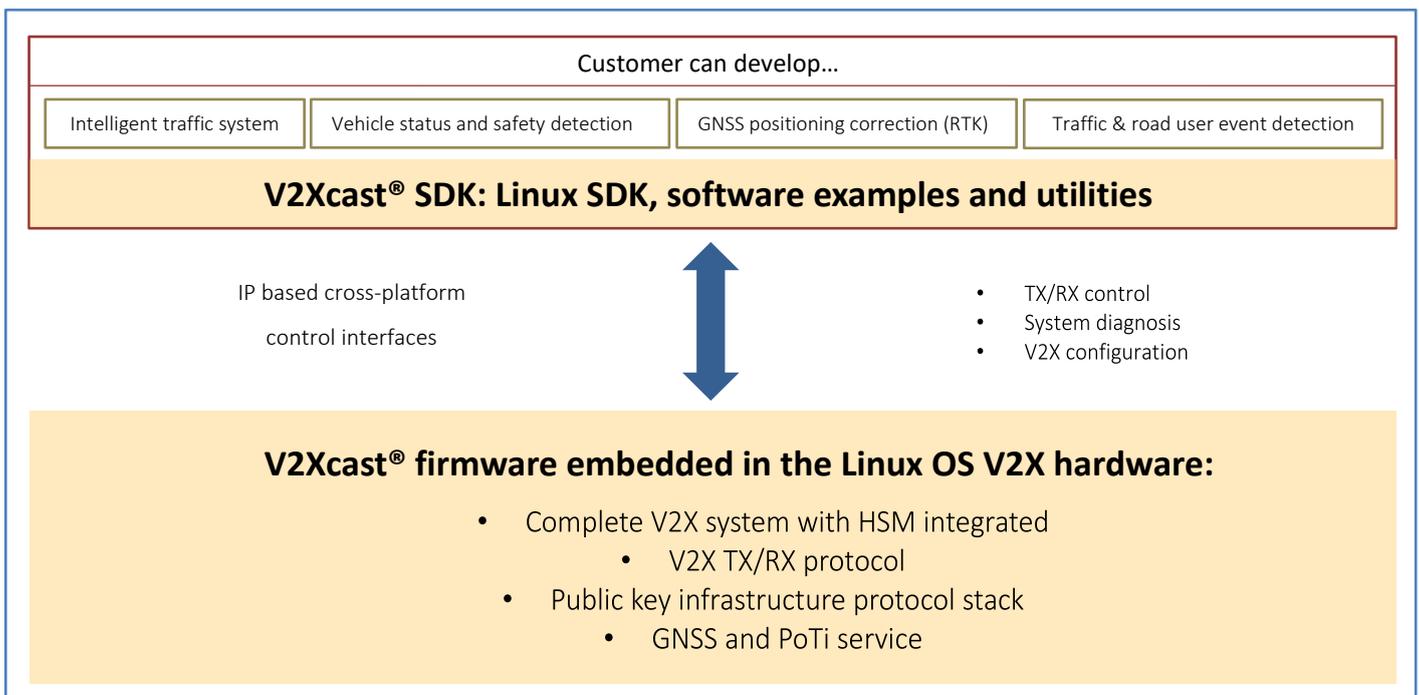
Unex's V2X on-board unit is a rugged design that can be retrofitted to vehicles for aftermarket deployment or field trials, and can also serve as a design reference for automotive production.

With embedded C-ITS or ITS-G5 or IEEE 1609/SAE J2735 V2X stack for DSRC-V2X or C-V2X (PC5), users can directly compose the ready-to-use J2735 or ITS Messages for secondary software development per service requirements, without the hassle of handling the V2X protocol details. Intuitive V2Xcast® services lower the software effort with consistent API, preserving the software value for future migration of computing host platform and communication standard.

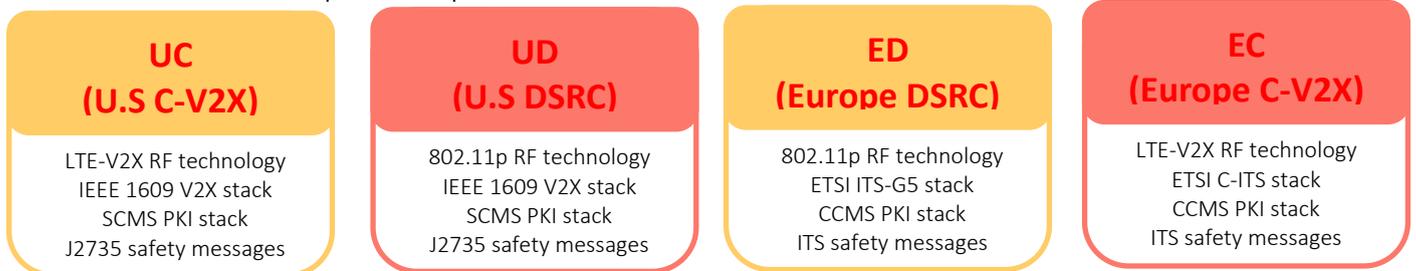
- ❖ Complete V2X system, containing CRATON2/PLUTON2 V2X chipsets, GNSS, eHSM, 256MB DDR3 RAM, 512MB NAND, and V2Xcast® software.
- ❖ A user-friendly V2Xcast® software contains:
  - ◆ Standard compliant V2X stacks embedded.
  - ◆ Consistent V2Xcast® APIs for Service, Tx/Rx, PoTi, J2735 or ITS-G5 compliant Messages encode/code for secondary development of your own applications.
  - ◆ Application example codes, including Event Detector to detect remote vehicle and roadside events, Traffic Signal Detector to detect current position's signal phase, RTK Sample Application to improve GNSS accuracy.

- ❖ Secured V2X communication supports SCMS or CCMS including the V2X PKI certificate management and the private key operation on the embedded Hardware Security Module (eHSM).
- ❖ Antenna detection and diagnose supported.
- ❖ Wide-ranged -40°C ~ +85°C operating temperature and detachable V2X/GNSS antennas support flexible aftermarket retrofit or field deployment.
- ❖ Innovative software-defined, OBU can flexibly shift between DSRC-V2X or C-V2X with one V2X stack (IEEE 1609 or ITS-G5 V2X standard) through firmware update.
- ❖ Lowest entry and total ownership cost: bundle license right to use the software on the hardware (per MAC address) at one fixed price, no extra license fee or royalty required.

## V2Xcast® Firmware



\*4 versions existed. Firmware update fee required.



Unex V2X platform SOM, OBU, RSU

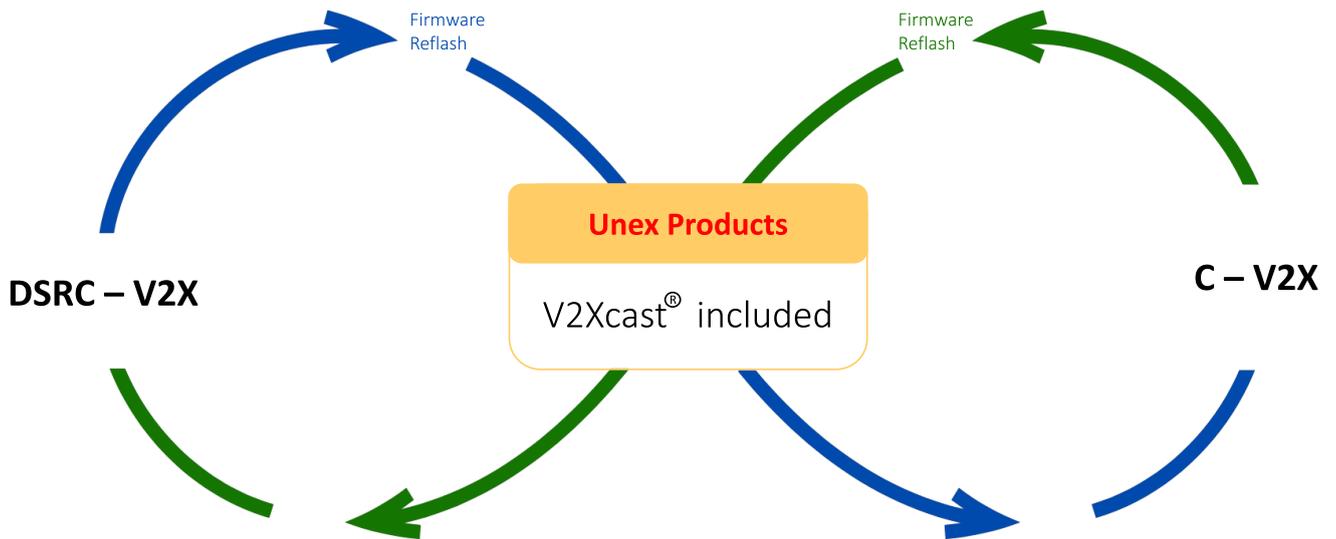
Unex's Software & SDK (V2Xcast®)

Custom's Add-on Software

## Software-defined Global V2X

Innovative software-defined design provides the highest application flexibility, the same OBU can flexibly shift between DSRC-V2X or C-V2X with one V2X stack (IEEE 1609 or ITS-G5 or C-ITS V2X standard) through firmware update to reduce the cost and complexity for global deployments.

Remarks: For shifting requirements from DSRC-V2X to C-V2X on the same MAC address (vice-versa) V2X hardware, extra license fee would be required.



# Applications

## vehicle retrofit aftermarket or field deployment

Standalone V2X OBU and develop the application software on OBU

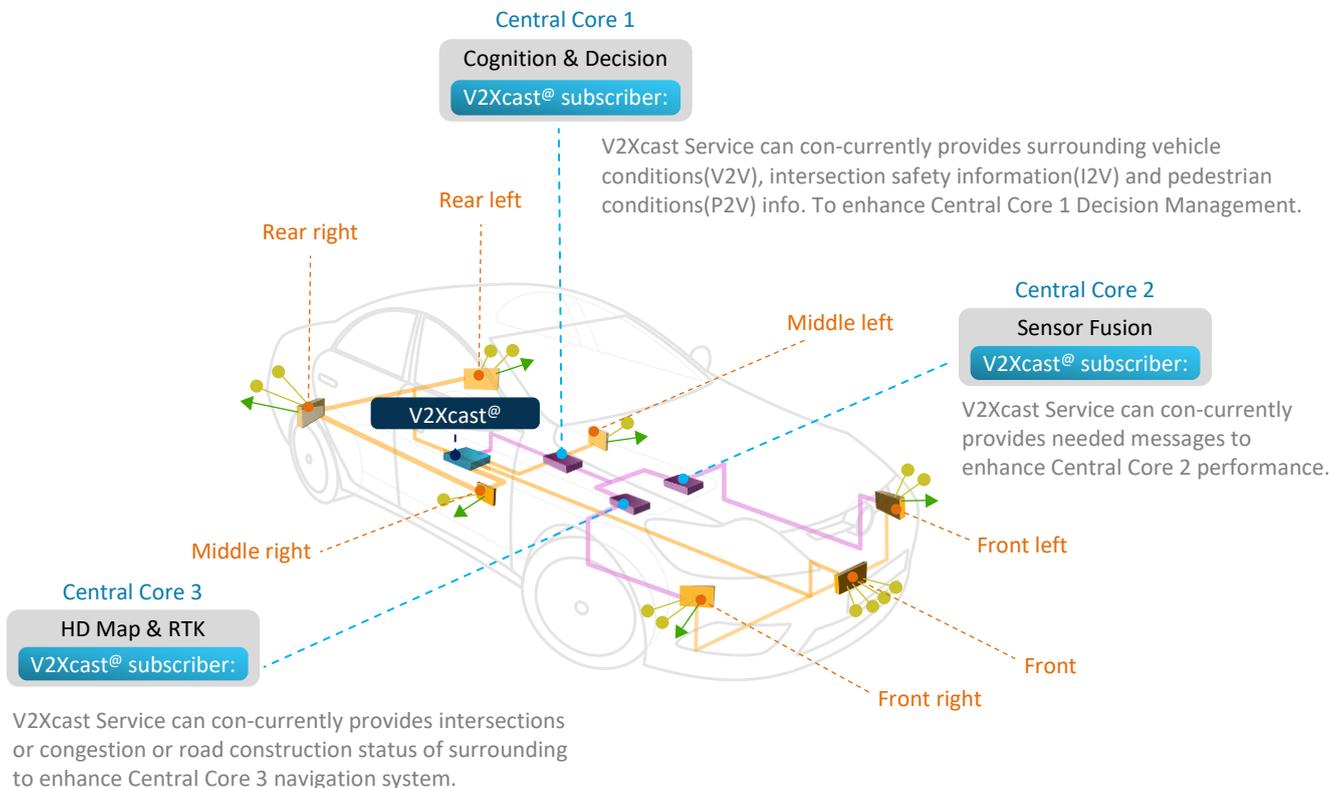


As an external V2X modem: connect V2X OBU to vehicle's existing application ECU through Ethernet and develop the application software



## Design reference for automotive production

Unique V2Xcast® software architecture supports various V2X applications. Multiple SDKs can be installed on collective ECUs, allowing advanced V2X sensor fusion applications on the existing central or edge ECUs of different generations of vehicle's E/E architecture.



# Specifications

## Chipset

- ❖ Autotalks® CRATON2 V2X communication processor
- ❖ Autotalks® PLUTON2 V2X RF Transceiver
- ❖ Embedded Hardware Secure Module (eHSM)
  - ◆ Dedicated ARM Cortex-M0 CPU
- ❖ GNSS module

## Operation System

Linux Yocto

## System Service

RS-232 console interface (baud rate 115200 bps)

## Antenna Detection/Diagnose

Supported

## System Memory

512MB NAND, 256MB DDR3

## Preloaded Firmware

- ❖ OBU-352EC: V2Xcast® ETSI C-ITS stack including LTE-V2X (PC5), CAM/DENM, GN/BTP, Security, PoTi, \*ETSI C-ITS standard over LTE-V2X is still draft only.
- ❖ OBU-352ED: V2Xcast® ITS-G5 stack including IEEE802.11p, Facility Message, GN/BTP, DCC, Security, PoTi, C2C-BSP
- ❖ OBU-352UC: V2Xcast® C-V2X stack including LTE-V2X (PC5), 1609.2, 1609.3, IEEE1609.2.1, SAE J2735, PoTi
- ❖ OBU-352UD: V2Xcast® IEEE1609/SAE J2735 stack for 802.11p WAVE including 1609.2, 1609.3, 1609.4, IEEE1609.2.1, SAE J2735, PoTi

## Development Tool

V2Xcast® SDK, including Tx/Rx, PoTi, J2735 or ITS-G5 compliant Message/Service and application example codes

## Hardware Security

- ❖ Dedicated ROM containing certified secure V2X signing firmware
- ❖ Secure encrypted off-chip storage of private keys
- ❖ Private material is inaccessible outside HSM
- ❖ Capable of >110 signatures / second, with <9ms signing latency for ECDSA NIST P256 or ECDSA Brainpool P256R1
- ❖ Line-rate ECDSA verification engine (>2500 ECDSA NIST P256 verifications / second)
- ❖ Tamper detection\*

## V2X

- ❖ Supported frequency band:
    - ◆ C-V2X: 5.895 ~ 5.925 GHz
    - ◆ DSRC-V2X: 5.850 ~ 5.925GHz
  - ❖ DSRC-V2X radio mode: 802.11p
  - ❖ C-V2X radio mode: 3GPP LTE-V2X Rel.14/15 PC5 sidelink 5.895 ~ 5.925 GHz
  - ❖ RF transmit power: max. +20dBm on antenna port, Class C RF spectrum mask compliant with margins
  - ❖ RF receive power: typ. < -92dBm
- Remarks: For legacy DSRC WAVE applications, (1) channel switch in 1609.4, (2) WSA broadcast, and (3) dual channel are not supported.

## GNSS

- ❖ Update rate: max. 10Hz
- ❖ Sensitivity:
  - ◆ Acquisition: -146dBm
  - ◆ Navigation: -158dBm
  - ◆ Tracking: -162dBm
- ❖ NMEA Standard: NMEA 0183
- ❖ Accuracy: 1.5m (CEP50 with SBAS)
- ❖ supports GPS/GLONASS constellations\*. SBAS like WAAS (US), is also supported.

### External GNSS Support\*(\*. Support by project)

NMEA input interface

## External Connector

- ❖ One integrated 20-pin I/O interface
  - ◆ Power 9-42V DC
  - ◆ Reset
  - ◆ One RS-232 for Console (baud rate 115200 bps)
  - ◆ One RS-232 for external GNSS NMEA input
  - ◆ One 1PPS input
  - ◆ Two CAN
  - ◆ One USB with USB bus power
  - ◆ Two GPIOs
- ❖ One Ethernet port
- ❖ One USB Mini-B port
- ❖ Two FAKRA Z RF port for V2X
- ❖ One FAKRA C RF port for GNSS

## On-Board Interface reserved

- ❖ One Mini PCIe slot (for LTE module) \*
  - ❖ One SIM slot\*
  - ❖ LED headers
  - ❖ Boot strapping DIP switch
  - ❖ JTAG 7-pin header
- (\* . Support by project)

## LED

### ❖ STATUS

- ◆ Start-up: Blinking Green
- ◆ Operational: Solid Green
- ◆ FW upgrade: Amber (R+G)
- ◆ Fault: Red

### ❖ PWR

- ❖ 1PPS
- ❖ EXT GNSS
- ❖ LTE WWAN
- ❖ LED0
- ❖ LED1

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## Antenna

- ❖ Two detachable FAKRA type Z V2X 5dBi Omni Dipole (for diversity)
- ❖ One detachable FAKRA type C active GNSS antenna, cable length: 3 meters

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## Operation Voltage

DC 9-42V ± 5%

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## Power Consumption

- ❖ 5V/USB power input: typical 0.53A/2.65W
- ❖ 12V/auto. ACC power input: typical 0.25A/3.0W

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## ESD Protection

IEC/EN 61000-4-2 level 4

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## Vehicle Regulation RF Regulation

- ❖ CE, FCC Class B, ISO7637-2, ISO 16750-2 (Q2/2024)
- ❖ E-Mark (Q2/2024)

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## Operation Temperature Range

ambient: -40°C ~ +85°C

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## Operating Humidity

10% ~ 95%, non-condensing

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## Storage Humidity

max. 95%, non-condensing

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## Housing

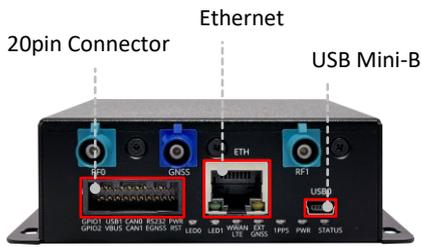
aluminum plate, thickness: 1.0mm

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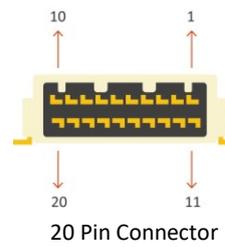
## Product Dimension

103mm (L) x 95mm(W) x 31mm (H)

## Input Output Interface



## Pin Definition



| Function       | Pin  |
|----------------|--|
| Console (DCE)  | TX(I)<br>RX(O)<br>GND                                  |
| Ext GNSS (DTE) | Ext_GNSS_TX(O)<br>Ext_GNSS_RX(I)<br>Ext_1PPS(I)<br>GND |
| CAN0           | CAN0_H<br>CAN0_L                                       |
| CAN1           | CAN1_H<br>CAN1_L                                       |
| USB            | USB_DP<br>USB_DN<br>USB5V<br>GND                       |
| GPIO           | GPIO1<br>GPIO2   |
| PWR            | POWER<br>RESET<br>GND                                  |

| Pin | Pin Name    | Type | Description                           |
|-----|-------------|------|---------------------------------------|
| 1   | POWER       | I    | 9-42V System main power               |
| 2   | RESET       | I    | Reboot the device with rising edge    |
| 3   | TX          | I    | Serial data from DTE                  |
| 4   | RX          | O    | Serial data to DTE                    |
| 5   | GND         | G    | Ground                                |
| 6   | CAN0_H      | I/O  | CAN0 High                             |
| 7   | CAN1_H      | I/O  | CAN1 High                             |
| 8   | USB_DP      | I/O  | USB Data +                            |
| 9   | USB_5V      | O    | 5V USB bus power                      |
| 10  | GPIO1       | I/O  | GPIO                                  |
| 11  | GND         | G    | Ground                                |
| 12  | EXT_1PPS    | I    | External 1PPS signal                  |
| 13  | EXT_GNSS_RX | I    | Serial data from external GNSS module |
| 14  | EXT_GNSS_TX | O    | Serial data to external GNSS module   |
| 15  | GND         | G    | Ground                                |
| 16  | CAN0_L      | I/O  | CAN0 Low                              |
| 17  | CAN1_L      | I/O  | CAN1 Low                              |
| 18  | USB_DN      | I/O  | USB Data -                            |
| 19  | GND         | G    | Ground                                |
| 20  | GPIO2       | I/O  | GPIO                                  |

# Product SKU and Ordering Information

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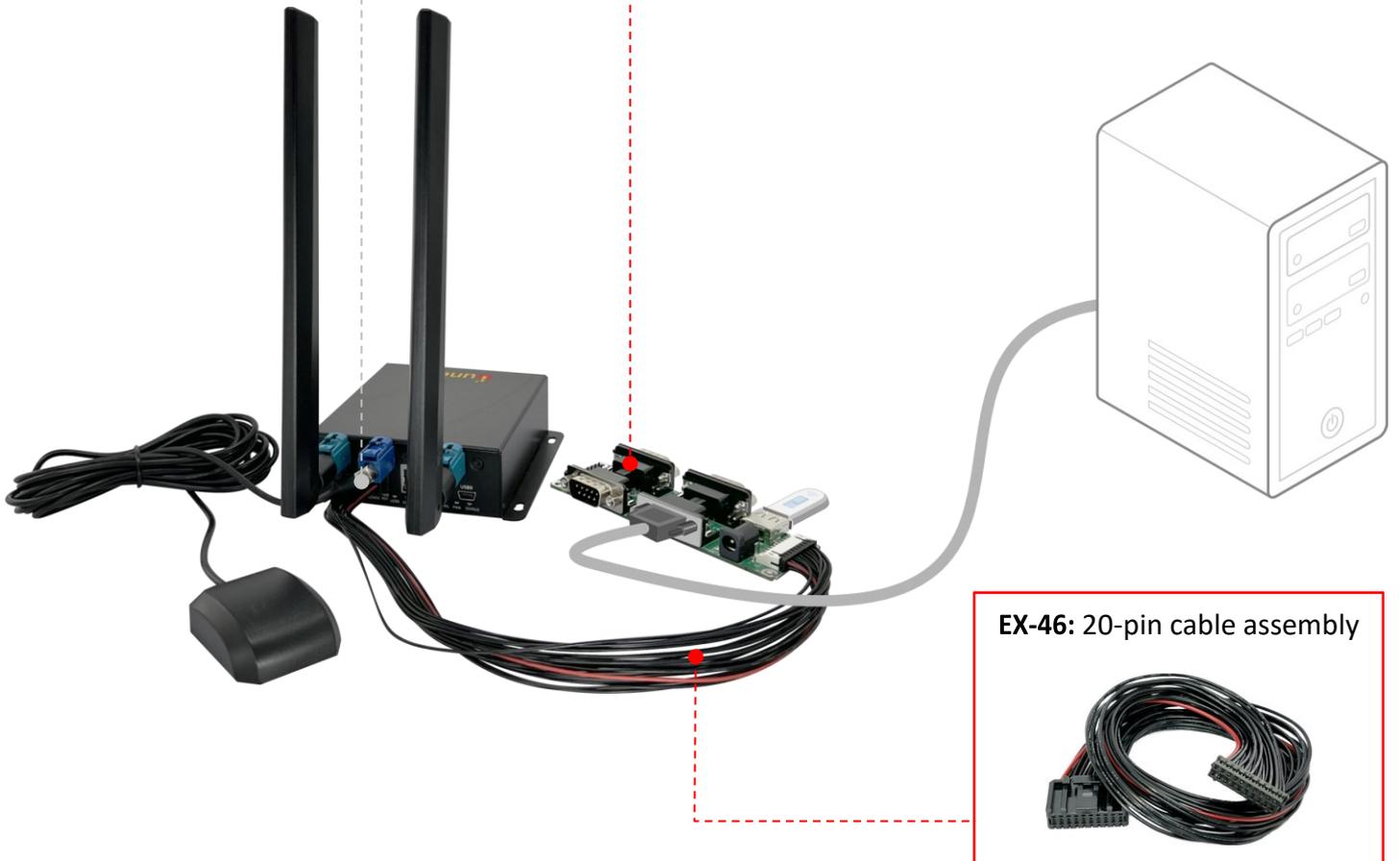
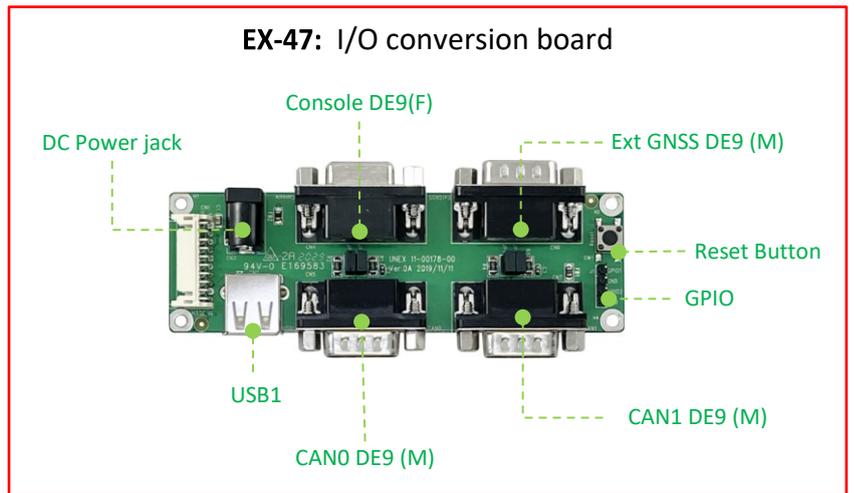
## OBU-352UD

DSRC-V2X on-board unit, V2Xcast® IEEE 1609/SAE J2735 stack and SDK

## OBU-352EC/OBU-352ED/OBU-352UC/OBU-352UD Package content

|  |  |
|--|--|
| <p>One OBU with pre-loaded V2X stack firmware<br/>(C-V2X or DSRC-V2X technology with one C-ITS or ITS-G5 or IEEE 1609/SAE J2735 V2X stack)</p>  | <p>One USB power supply unit</p>  |
| <p>Two V2X omni dipole detachable antennas, 5.9GHz FAKRA type Z</p>   | <p>Hardware / Software User's Guide and V2Xcast® SDK download e-mail link after shipping</p>                           |
| <p>One GNSS active detachable antenna, FAKRA type C, cable length 3 meters</p>    |  |

## Optional Accessory & Application Diagram



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