

**LTE-V RSU5201**

# **Product Description**

**Issue**      **01**

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# 1 About This Document

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## Overview

This document provides information about product features, main functions, technical specifications, and system networking.

Chapter	Description
2 Overview	Describes the product application background.
3 Product Features	Describe product features.
4 Technical Specifications	Describes hardware, software, and user interface specifications.
5 Product Functions	Describes main product functions.
6 System Networking	Describes product system networking modes.

## Change History

Version	Change Description	Date
First draft	First draft	2018-08-30
Draft A	1) Modify product name; 2) Released the first version.	2018-09-30
01	1) Modify figures in chapter 6; 2) Modify specifications	2019-01-03

# 2 Overview

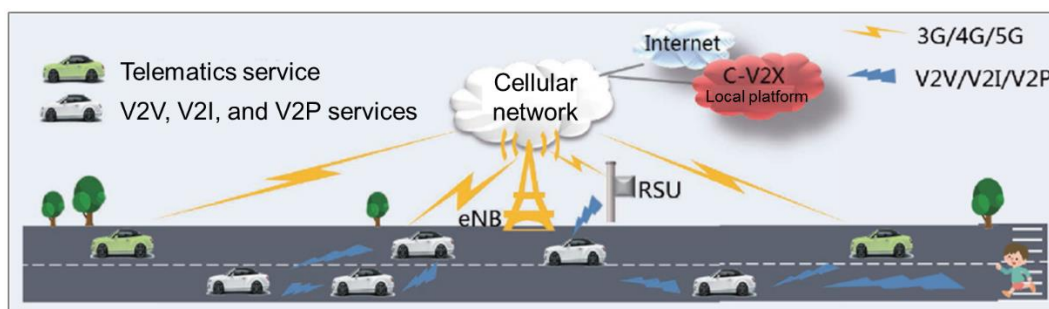
Vehicle-to-everything (V2X) is a next-generation wireless communications technology that connects vehicles to everything. V2X can connect a vehicle to any objects that can interact with the vehicle, including other vehicles, pedestrians, roadside infrastructure, and networks. V2X has the following information interaction modes: vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), vehicle-to-pedestrian (V2P), and vehicle-to-network (V2N), as shown in the following figure. V2X connects pedestrians, vehicles, roads, clouds, and other transportation elements, allowing vehicles to collect more information and promoting innovation and application of autonomous driving technologies. V2X also helps to build a smart transportation system, develop new models and forms for vehicle and transportation services, improve transportation efficiency, conserve resources, reduce pollution, avoid traffic accidents, and improve transportation management.

Cellular V2X (C-V2X) is a 3GPP-based global vehicle wireless communication technology that evolves from 4G and 5G. C-V2X includes LTE-V2X and 5G-V2X.

C-V2X provides two types of communication interfaces:

- The PC5 interface is a short-distance direct communication interface between vehicles, pedestrians, and roads, and includes the communication interface between road side units (RSUs) and vehicles (on-board units [OBU]). The PC5 interface supports V2X message broadcast (especially between vehicles), exchange of fast-changing dynamic information (such as location, speed, driving direction, and traffic condition), and advanced automatic driving applications, including platooning and sensor sharing.
- The Uu interface supports high-speed data transmission over a long distance between a terminal (RSU/OBU) and a base station. A terminal with cellular network access can download HD maps in real time or enjoy various entertainment services from the cloud through the Uu interface.

**Figure 2-1** V2X network structure



In a C-V2X system, an RSU receives real-time traffic information, including road conditions provided by traffic lights or application servers, and sends this information to vehicles immediately to avoid traffic accidents and improve transportation efficiency.

Huawei RSU is a roadside network device compliant with the 3GPP Release 14 LTE-V2X technology. This device supports low-latency V2X data broadcast, enables smart transportation, and autonomous driving, helping government agencies (transportation and public security), various industries, and operators coordinate with connected vehicles, improve transportation efficiency, and ensure transportation safety.

The following figure shows the appearance of Huawei RSU.

**Figure 2-2** RSU appearance



# 3 Product Features

Huawei RSU has the following features:

- **Uu and PC5 concurrency**  
Mode4-based PC5 communication is supported. Physical-layer transmission and reception compliant with 3GPP Release 14 are supported. The Global Navigation Satellite System (GNSS) is used for synchronization between RSUs, and between RSUs and OBUs over the PC5 interface.  
Various LTE frequency bands are supported, including LTE FDD band 3 and band 8, and LTE TDD band 39 and band 41.
- **GNSS-based positioning**  
Both BDS-based and GPS-based positioning are supported to improve positioning accuracy.
- **Secure communication over Uu and PC5 interfaces**  
Data is encrypted before transmission over PC5 and LTE Uu interfaces to ensure secure communication for RSUs.
- **Agile RSU deployment**  
RSUs can be deployed via wired or wireless connection and do not require trenches or cable routing.
- **Support for China's national standard DSMP protocol**
- **Interconnection with transportation infrastructure and application servers**  
Interconnection with traffic lights, cameras, and application servers to process traffic information in real time



#### **NOTE**

The PC5 interface supports the following resource allocation modes: Mode3 and Mode4.

- **Mode3:** The eNodeB allocates resources during scheduling.
- **Mode4:** RSUs and OBUs allocate resources independently without the eNodeB.

# 4 Technical Specifications

## 4.1 Frequency Bands

Table 4-1 Frequency bands

Frequency Band	RX Frequency Band (MHz)	TX Frequency Band (MHz)	Supported Bandwidth (MHz)
PC5	5875–5925	5875–5925	10 and 20
LTE band 3 (FDD)	1710–1785	1805–1880	5, 10, 15, and 20
LTE band 8 (FDD)	880–915	925–960	5 and 10
LTE band 39 (TDD)	1880–1920	1880–1920	5, 10, 15, and 20
LTE band 41 (TDD)	2545–2655	2545–2655	5, 10, 15, and 20

## 4.2 Performance Indicators

Table 4-2 Performance indicators

Item	Value
PC5 coverage*	$\leq 500$ m@PRR > 99% (Only one OBU communicates with the RSU within the RSU coverage.)
PC5 service latency	< 20 ms
PC5 peak rate	System bandwidth 10MHz: 15.84Mbps System bandwidth 20MHz: 31.7Mbps
LTE terminal access capability	Minimum terminal capability: CAT6



**NOTE**

- Condition of PC5 coverage: only one OBU communicates with RSU in the RSU's coverage. .

## 4.3 Transmit Power

**Table 4-3** Transmit power

RAT	Maximum Transmit Power
PC5	23 dBm±2 dB
LTE	23 dBm±2 dB

## 4.4 Power Consumption

**Table 4-4** Power consumption

Item	Maximum Power Consumption (W)
Overall power consumption	26

## 4.5 Ports

**Table 4-5** Ports

Item	Value
Transmission ports*	<ul style="list-style-type: none"> <li>• One electrical port and one optical port</li> </ul> Simultaneous data transmission over these ports is not supported. <ul style="list-style-type: none"> <li>• Rate: electrical port: 100 Mbit/s or 1000 Mbit/s; optical port: 1.25 Gbit/s</li> </ul>
Antenna ports	<ul style="list-style-type: none"> <li>• PC5 interface: 1T2R, external, omnidirectional</li> <li>• Uu interface: 1T2R, external, omnidirectional</li> <li>• GNSS: support for both GPS and BDS</li> </ul>
SIM card	One SIM card slot (anti-theft)

**NOTE**

- Electrical and optical ports cannot transmit data at the same time, but POE power supply and data transmission via optical port can coexist.

## 4.6 Power Supply

Table 4-6 Power supply

Item	Indicator
Input power	<ul style="list-style-type: none"> <li>• 110 V AC to 220 V AC, 50 Hz or 60 Hz</li> <li>• PoE: -48 V</li> </ul>

## 4.7 Equipment Specifications

Table 4-7 Equipment specifications

Item	Value
Dimensions (H x W x D)	180 mm x 240 mm x 81 mm (excluding antennas)
Antenna size (height x diameter)	<ul style="list-style-type: none"> <li>• PC5: 150 mm x <math>\Phi</math>24 mm (below the RSU)</li> <li>• LTE: 130 mm x <math>\Phi</math> 24 mm (above the RSU)</li> </ul>
Weight	$\leq$ 4.6 kg (excluding the power adapter)

## 4.8 Environmental Specifications

Table 4-8 Environmental specifications

Item	Value
Temperature	<ul style="list-style-type: none"> <li>• Operating temperature: -40°C to +60°C</li> <li>• Storage temperature: -40°C to +70°C</li> </ul>
Relative humidity	5% to 95%
IP rating	IP65 (ingress protection)

## 4.9 Standards

The RSU complies with 3GPP specifications, storage environment standards, transportation environment standards, shockproof protection standards, and electromagnetic compatibility standards listed in the following table.

**Table 4-9** Standards

Item	Standard
3GPP specifications	<ul style="list-style-type: none"> <li>• PC5: 3GPP Release 14</li> <li>• LTE: 3GPP Release 13/Release 14</li> </ul>
Storage environment	ETSI EN 300 019-1-1 Class 1.2: Weather protected, not temperature-controlled storage locations
Transportation environment	ETSI EN 300 019-1-2 Class 2.3: Public transportation
Shockproof environment	<ul style="list-style-type: none"> <li>• Meeting the requirements for the GR-63-CORE Zone 4 earthquake level</li> <li>• Meeting the requirements of China Telecommunication Standard YD5083</li> </ul>
Electromagnetic compatibility	<p>The RSU meets the electromagnetic compatibility requirements and complies with the following standards:</p> <ul style="list-style-type: none"> <li>• ETSI EN 300 386 V 1.3.1 (2001-09)</li> <li>• CISPR32 Class B</li> <li>• GB9254 Class B</li> <li>• IEC61000-3-2</li> <li>• IEC61000-3-3</li> <li>• IEC 61000-4-2</li> <li>• IEC 61000-4-3</li> <li>• IEC 61000-4-4</li> <li>• IEC 61000-4-6</li> <li>• IEC 61000-4-11</li> </ul>
Surge protection	IEC61000-4-5 surge immunity
Salt spray protection standard	IEC 68-2-11
Vibration / shock standard	ETSI 300 019-2-4

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# 5 Product Functions

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In a C-V2X system, an RSU receives real-time traffic information, including road conditions provided by signal controllers, cameras, and application servers, and sends this information to vehicles immediately to reduce or avoid traffic accidents and improve transportation efficiency.

The RSU has the following functions (which are detailed in examples in sections 5.1 "Traffic Light Information Sending" to 5.4 "Traffic Information "):

- Mode4-based standard PC5 interface communication, including:
  - GNSS-based synchronization between RSUs or between RSUs and OBUs over the PC5 interface
  - Pre-configuration of communication parameters, including bandwidth, frequency, and resource pool configuration
  - Physical-layer transmission and reception compliant with 3GPP Release 14 over the PC5 interface
- Local and remote RSU O&M
  - Local O&M (a supplement to remote O&M): RSU commissioning and fault locating
  - Remote O&M: management and monitoring of network quality and the device running status
- RSU network security

PC5 and LTE Uu interface security, RSU security, communication security between RSUs and upper-level network devices, and RSU O&M security
- Interconnection with NEs in the transportation industry

The RSU can be connected to traffic lights, cameras, and V2X private network servers to receive and process transportation information.
- Support for China's national standard DSMP protocol

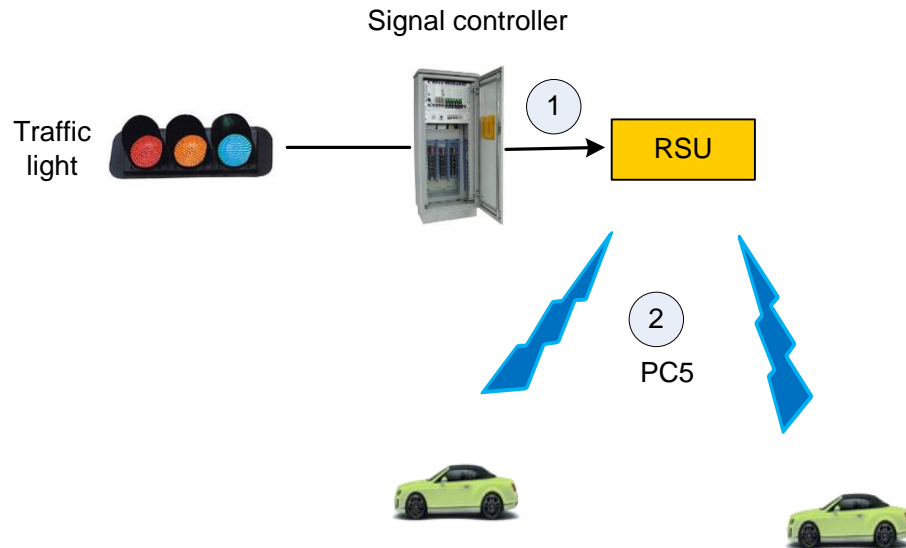
## 5.1 Traffic Light Information Sending

When vehicles are blocked or travel in bad weather conditions, they cannot determine the current and future traffic light statuses. The RSU periodically broadcasts the road and traffic light information at an intersection to surrounding vehicles. With this information, vehicles can learn traffic light statuses in different directions of the intersection and calculate the time they arrive at the intersection based on their location and a map. In this way, speed guidance based on traffic light statuses can be implemented.

Data flows for sending traffic light information are as follows:

- 1: The RSU receives the traffic light information sent by the local signal controller via wired or wireless connection.
- 2: The RSU sends the traffic light information to passing vehicles through V2X broadcast.

**Figure 5-1** Networking diagram for sending traffic light information



## 5.2 Traffic Information Broadcast

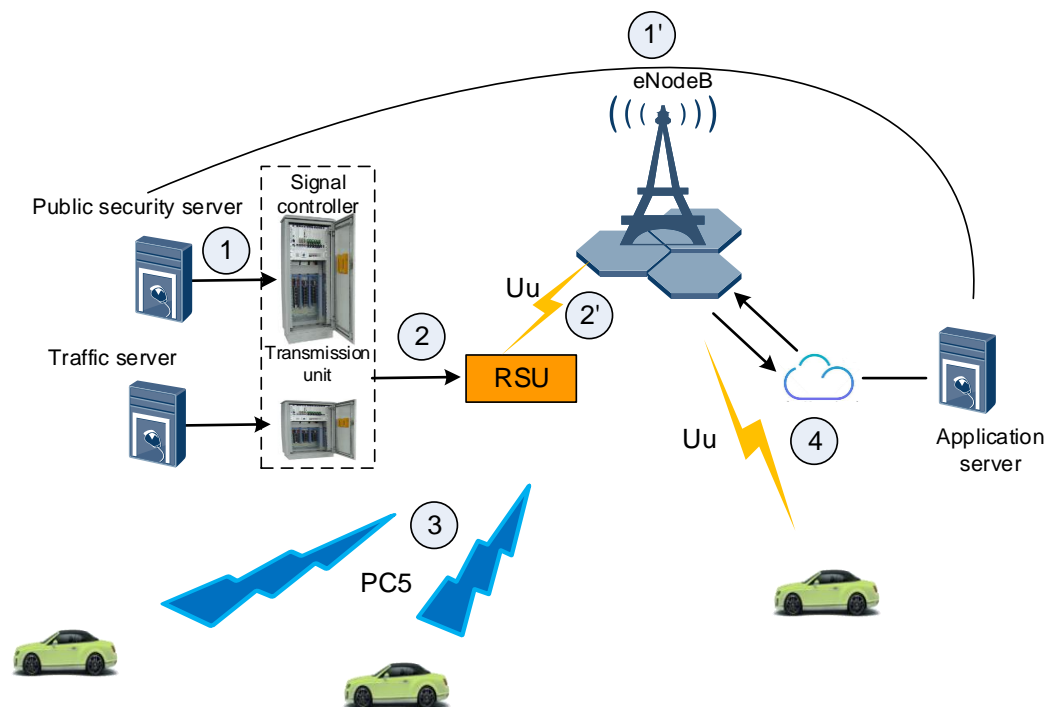
An application server of a transportation or public security department releases traffic information through RSUs (this information is transmitted to RSUs through signal controllers/transmission units or through application servers) to inform passing vehicles of road statuses and other traffic instructions.

Videos recorded at remote intersections are also a type of traffic information. Local RSUs receive these videos and transmit them to the service platform over the Uu interface. Remote vehicles sent video requests to the platform over the LTE Uu interface to view videos recorded in real time along specific road sections.

Data flows for traffic information broadcast are as follows:

- 1: An application server of a transportation or public security department releases traffic information to the signal controller or transmission unit.
- 1': The application server sends the traffic information to the application server on the operator platform.
- 2: The RSU receives the information from the signal controller or transmission unit.
- 2': The application server on the operator platform transmits the information to the corresponding RSU over the Uu interface.
- 3: The RSU broadcasts traffic information in V2X broadcast mode.
- 4: Remote vehicles send video requests to the operator platform over the Uu interface to view real-time videos recorded along specific road sections.

**Figure 5-2** Networking diagram of traffic information broadcast



### 5.3 Accident and Secondary Accident Prevention

RSUs collect and send real-time information of road accidents, natural disasters, and other emergencies to surrounding vehicles or vehicles in specific remote areas to prevent accidents or secondary accidents.

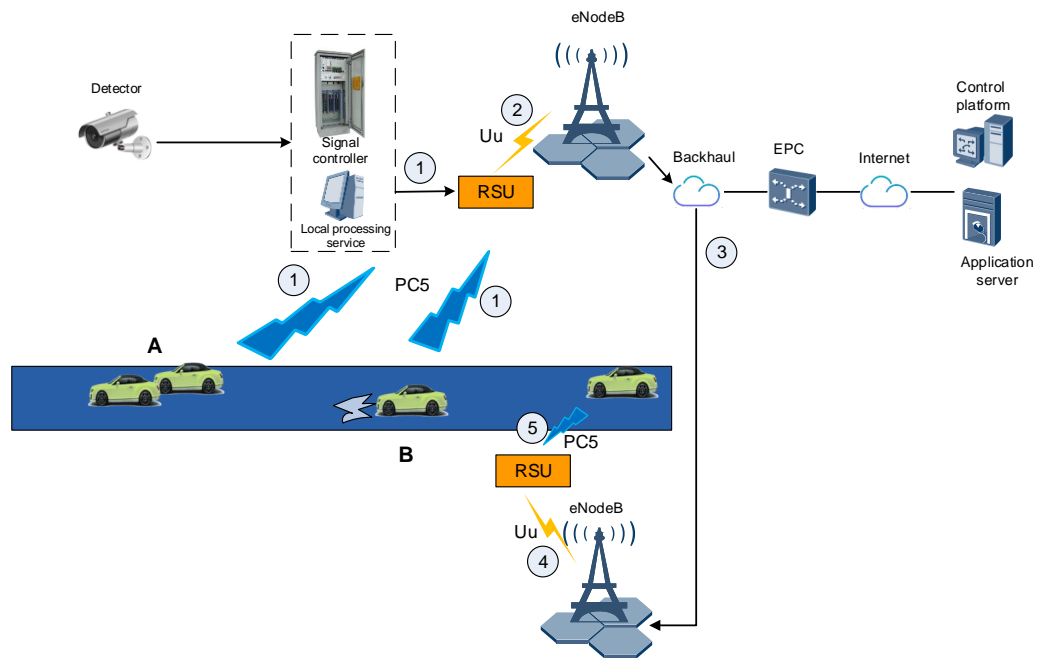
RSUs collect this information in the following methods:

- Roadside detection devices (for example, cameras) identify accidents or events that may cause accidents.
- Vehicles report accident information.
- Vehicles detect and report events that may cause accidents.

Data flows for accident and secondary accident prevention are as follows:

- 1: The RSU collects event information using the preceding methods.
- 2: The RSU forwards the information and sends the information to the service platform over the Uu interface.
- 3: The service platform determines the area for information forwarding and the corresponding remote RSU based on the event location and road information.
- 4: The remote RSU receives the corresponding event information over the Uu interface.
- 5: The remote RSU broadcasts event information to the area through V2X.

**Figure 5-3** Networking diagram of accident and secondary accident prevention



**NOTE**

- Event A is a traffic accident that affects transportation.
- Event B is a special road condition, such as a hole or ice, which threatens driving safety.

## 5.4 Traffic Information Forwarding

Transportation/public security departments can use RSUs to forward information broadcast by other V2X devices, so that they can analyze this information to learn road conditions.

There are two methods (which can be implemented simultaneously):

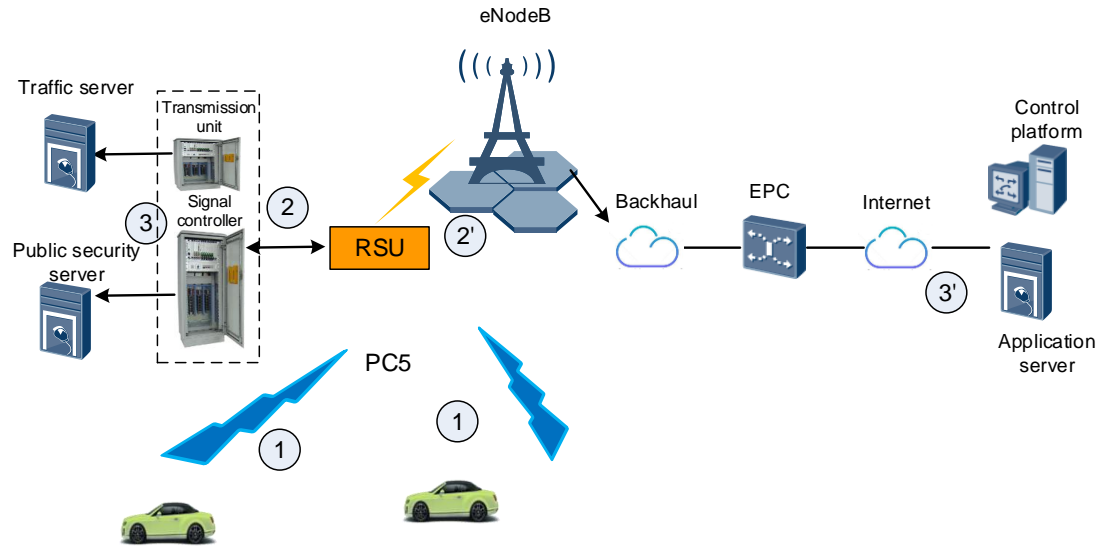
- RSUs forward the information to a signal controller. The signal controller transmits the information to the server of a public security department. Alternatively, RSUs directly forward the information to the server of a transportation department through the transmission unit.
- RSUs send the information to the operator network over the Uu interface and then to the operator platform.

Data flows for traffic information collection are as follows:

- 1: The RSU receives vehicle travelling information over the PC5 interface.
- 2: The RSU forwards the information to the traffic signal controller or transmission unit.
- 2': The RSU uploads the information to the service platform over the LTE Uu interface.
- 3: The signal controller or transmission unit reports the traffic information sent by the RSU to an application server of a transportation or public security department.
- 3': The base station uploads the information forwarded by the RSU to the application server through a network.



Figure 5-4 Networking diagram of traffic information forwarding



# 6 System Networking

RSUs support various networking modes for urban roads and highways.

## 6.1 Networking Modes for Urban Roads

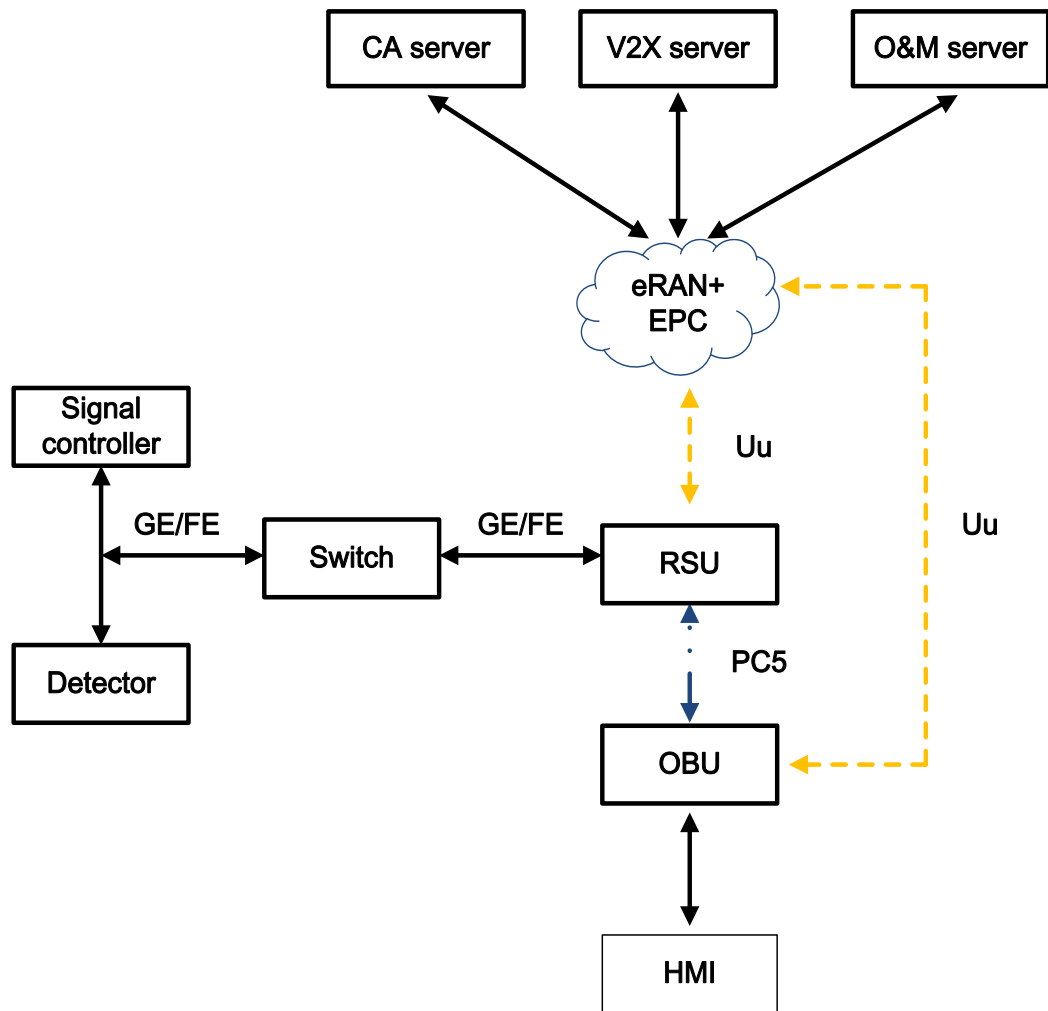
RSUs deployed along urban roads connect to signal controllers of traffic lights and cameras via wired connection to collect traffic information, collect traffic information delivered by V2X servers over the LTE Uu interface or private networks, and send this information to passing vehicles over the PC5 interface.

The following figures show the networking diagrams for urban roads (Figure 6-1 is public network mode. Figure 6-2 is private network mode). The following table lists the involved NEs and their functions.

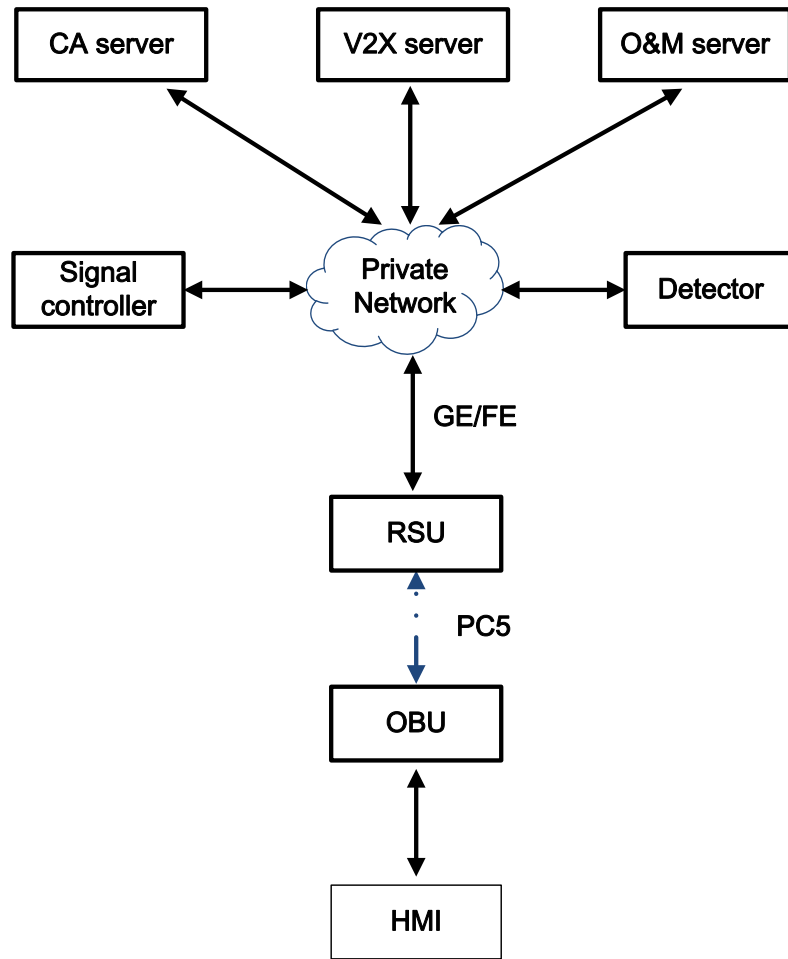
NE	Function
CA server	Manages, authenticates security certificates, and obtains RSU security certificates.
V2X server	Collects and analyzes ITS application services and data.
O&M server	Manages devices, configures air interface parameters, operates, and maintains RSUs.
eRAN+EPC	Provides LTE networks for information exchange between RSUs and the CA server, V2X server, and O&M server.
Private network	Transmits information between RSUs and the CA server, V2X server, and O&M server.
Signal controller	Receives information about the private network server, controls traffic facilities (such as traffic lights), and transmits traffic control information to RSUs.

NE	Function
RSU	Provides communication capabilities over the PC5 and Uu interfaces, distributes and supports low-latency V2X data broadcast, and provides basic application deployment capabilities.
Detector	Detects specific traffic events or traffic flow information. Detectors include cameras and sensors.
OBU	Receives the road condition information sent by RSUs, and the traffic control information sent by servers.
HMI	Human Machine Interaction

Figure 6-1 Urban road networking diagram (public network mode)



**Figure 6-2** Urban road networking diagram (private network mode)



## 6.2 Networking Modes for Highways

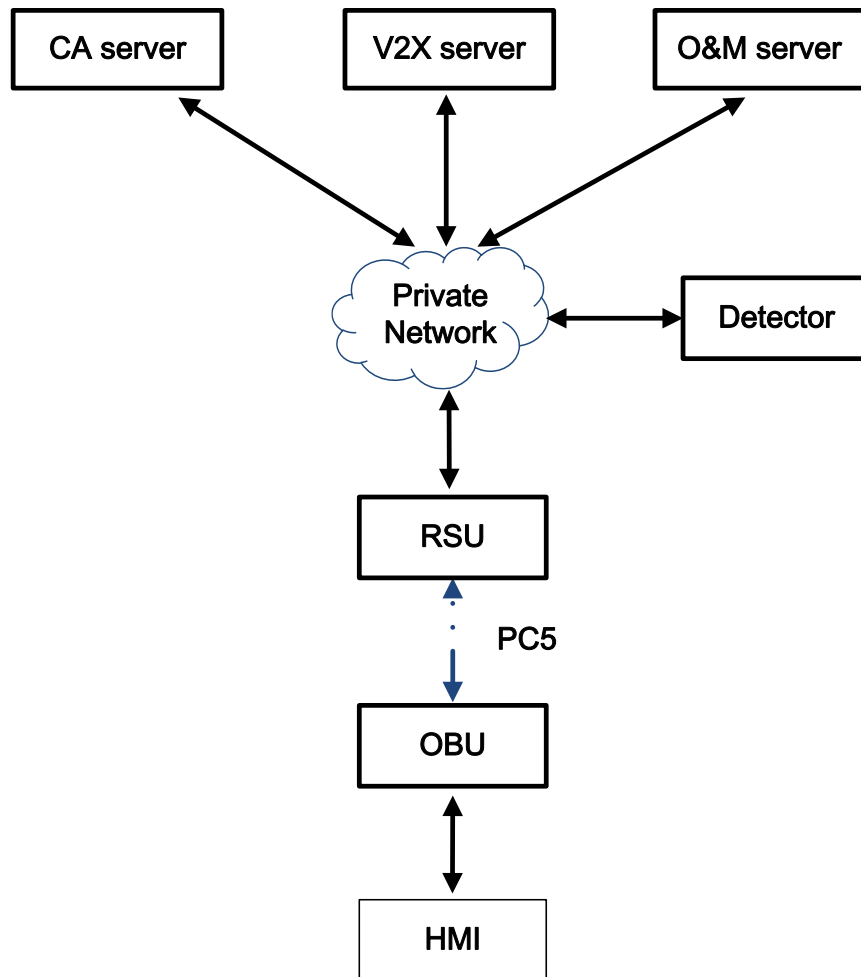
RSUs deployed along highways connect to cameras, V2X servers, and other servers via wired connection to collect real-time traffic information and send this information to passing vehicles over the PC5 interface.

The following figure shows the networking diagram for highways. The following table lists the involved NEs and functions.

NE	Function
CA server	Manages, authenticates security certificates, and obtains RSU security certificates.
V2X server	Collects and analyzes ITS application services and data.

NE	Function
O&M server	Manages devices, configures air interface parameters, operates, and maintains RSUs.
RSU	Provides communication capabilities over the PC5 interface, distributes and supports low-latency V2X data broadcast, and provides basic application deployment capabilities.
Detector	Detects specific traffic events or traffic flow information. Detectors include cameras and sensors.
OBU	Receives the road condition information sent by RSUs, and the traffic control information sent by servers.
HMI	Human Machine Interaction

Figure 6-3 Highway networking diagram



## 6.3 Networking Modes for Agile Deployment

In some areas, RSUs cannot be connected to signal controllers via wired connection due to construction restrictions (trenching digging or cabling is impossible). In this case, the agile deployment solution can be used to connect RSUs to signal controllers via wireless connection over the PC5 interface.

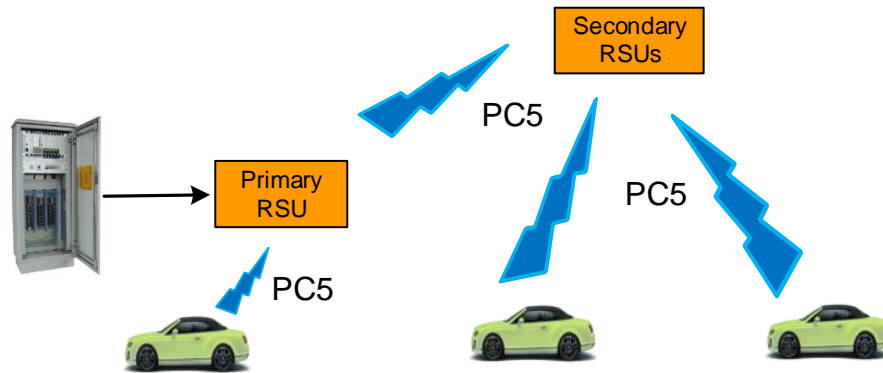
In agile deployment scenarios, 1 primary RSU (PRSU) and 1~4 secondary RSUs (SRSU) are deployed.

- Primary RSU connects to the signal controller via wired connection to exchange traffic information, such as traffic light statuses.
- Secondary RSUs are deployed on traffic light poles to exchange traffic information, such as traffic light statuses, with the primary RSU via wireless connection.

The following figure shows the typical networking diagram for this scenario.

- The primary RSU receives information from the signal controller, broadcasts the information to passing vehicles over the V2X PC5 interface, and transmits the information to secondary RSUs over the V2X PC5 interface.
- Secondary RSUs broadcast the information received from the signal controller, such as traffic light information, to passing vehicles over the V2X PC5 interface.

**Figure 6-4** Agile deployment networking diagram



# 7 Acronyms and Abbreviations

Acronym/Abbreviation	Full Name
3GPP	3rd Generation Partnership Project
<b>A</b>	
AC	alternating current
ACS	Auto Configuration Server
<b>B</b>	
BDS	BeiDou Navigation Satellite System
<b>C</b>	
CA	certificate authority
C-V2X	cellular vehicle-to-everything
<b>D</b>	
DSMP	DSRC Short Message Protocol
<b>G</b>	
GNSS	Global Navigation Satellite System
<b>H</b>	
HMI	Human Machine Interaction
<b>I</b>	
ITS	Intelligent Transportation System
<b>L</b>	
LTE	Long Term Evolution

Acronym/Abbreviation	Full Name
<b>O</b>	
OBU	on-board unit
<b>P</b>	
PoE	power over Ethernet
PRR	Packet Reception Ratio
PRSU	Primary RSU
<b>R</b>	
RSU	Road Side Unit
SRSU	Secondary RSU
<b>T</b>	
TCP	Transmission Control Protocol
<b>U</b>	
UDP	User Datagram Protocol
USIM	Universal Subscriber Identity Module
Uu	Uu interface
<b>V</b>	
V2I	vehicle to Infrastructure
V2N	vehicle-to-network
V2P	vehicle-to-pedestrian
V2V	vehicle-to-vehicle
V2X	vehicle-to-everything
<b>W</b>	
WebUI	Web User Interface