

DSRC On-board Unit for Multiple Services

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1. Introduction

The 5.8-GHz band DSRC (Dedicated Short Range Communication) system applied to ETC (Electronic Toll Collection) in 2001 has been studied for various advanced applications and services in both the public and private sector, resulting in the launch of pilot programs and experimental operations. We have developed a DSRC on-board unit conforming to the Standard Specification for ITS On-Board Unit which can support various types of services.

2. Specifications

Figure 1 shows the appearance of the DSRC on-board unit and its switch unit. Table 1 shows the specifications. The radio specifications conform to the DSRC Communication Standard ⁽¹⁾.



Fig. 1 Exterior of the DSRC on-board unit

Table 1 Specifications of the DSRC on-board unit

Item	Specification
Uplink Carrier Frequency	5815-5845 MHz
Downlink Carrier Frequency	5775-5805 MHz
Modulation Method	ASK, $\pi/4$ shift QPSK
Transmit Power	10 mW
Reception sensitivity	-60.5 dBm e.i.r.p.
Size (W × H × D)	93 × 28 × 136 mm
Power Consumption	DC12V, 0.5A
Interface	RS-232C, USB, CAN

ASK: Amplitude Shift Keying

QPSK: Quadrature Phase Shift Keying

3. Features

- (1) The on-board unit has been certified for EMV Level 1[†]. Standard IC credit cards can be used.

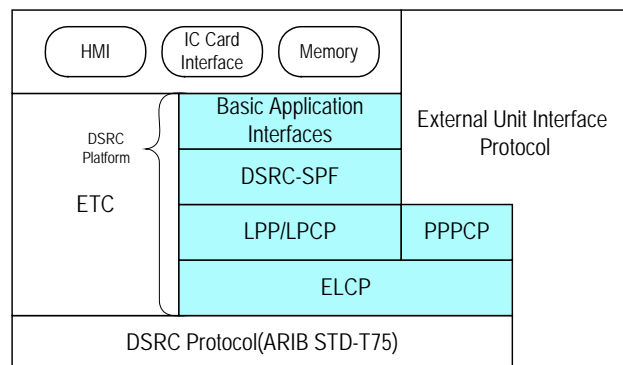
- (2) A voice processing circuit is built into the on-board unit. The unit alone can transmit speech data. Repeated reproduction and output stop can be controlled from the switch unit.
- (3) An RS-232C interface having the same communication protocol as the ETC on-board unit, CAN (Controller Area network) interface, and USB (Universal Serial Bus) interface for connection to the Internet are provided as external device connection interfaces. Car navigation systems can be easily connected to the unit.

4. DSRC Communication Platform

To support various types of DSRC-based services with a single on-board unit, a DSRC communication platform equipped with functions common to the services is necessary. This DSRC platform is designed for both fast connection in short range communication system and common usage such as Internet connections.

4.1 Protocol configuration

The DSRC-based services are designed on the premise of coexistence with ETC units. This on-board unit has the DSRC communication platform on the DSRC protocol⁽¹⁾ in the same way as the ETC (Fig. 2). The DSRC communication platform of this on-board unit consists of ELCP (External Link Control Protocol), which expands the functions of the DSRC protocol and executes common processing, LPP (Local Port Protocol) and LPCP (Local Port Control Protocol), which are local protocols⁽²⁾ for DSRC, DSRC-SPF (DSRC Security Platform) for common security, DSRC Basic Application



HMI: Human Machine Interface

Fig. 2 Protocol stack in the DSRC on-board unit

[†] IC card standard specification for credit cards established by Europay, MasterCard, and Visa.

Interfaces⁽³⁾ to enable the DSRC-based services, and PPPCP (Point-to-Point Protocol Control Protocol)⁽²⁾ for Internet communication.

The DSRC communication platform is designed on the basis of the fast connection concept characteristic to DSRC communication and similarity to Internet standards. For functionality, LPP/LPCP are equivalent to TCP/UDP, DSRC-SPF to SSL (Secure Socket Layer), and DSRC Basic Application Interfaces to FTP (File Transfer Protocol) and SNMP (Simple Network Management Protocol). These are standardized by a DSRC association and Mitsubishi Electric participated in the standardization phase, including contribution of providing technical support.

This on-board unit is equipped with an interface protocol for hooking up with external devices having a similar structure as the DSRC communication platform, thus allowing various devices such as car navigation systems and the like to be connected to this on-board unit.

4.2 Local Port Protocol

LPP/LPCP help optimize the resources of the on-board unit by providing the following for charging, making payments, and services while driving and providing common functions required for high-order applications:

- (1) Fast connection and application identification on the basis of the port No.
- (2) High-reliability communication by request response and retry functions
- (3) Large-capacity communication by division and assembly of communication messages

4.3 DSRC Basic Application Interfaces

The on-board unit comes with six basic applications⁽³⁾ in a full-function mode. The respective applications provided on the unit have the following features.

- (1) OBU (On Board Unit) Identification Communication Application: The identification data registered in the on-board unit are held securely and output to the road-side systems.

- (2) OBU Basic Indication Application: The results of service transactions are notified with functions such as speech and car navigation combined.
- (3) OBU Indication and Response Application: The intention of the driver is checked by functions such as switches and car navigation combined.
- (4) IC Card Access Application: Command send/receive operation with the IC card is performed in accordance with the IC card interface EMV level 1 specification.
- (5) OBU Memory Access Application: The on-board unit memory control can be operated from the car navigation system by the external unit interface protocol.
- (6) Push Type Information Delivery Application: Fast and large-capacity data transmission is attained by using a large-capacity double buffer. Arbitrary registration of application types and contents types to be received can be made.

5. Examples of Services

Various types of ITS services can be delivered by this on-board unit, such as ETC, sound guidance, payment of parking fees, provision of traffic information and collection of traffic-congestion information on the road, and connection to Internet information sources. The on-board unit is expected to be widely used as an on-board communication unit for services to improve road traffic safety, including a safe driving support system which is expected to be introduced after pilot tests in the future.

References:

- (1) Dedicated Short-Range Communication System, ARIB STD-T75, Association of Radio Industries and Businesses.
- (2) DSRC Application Sub-Layer, ARIB STD-T88, Association of Radio Industries and Businesses.
- (3) Guideline for DSRC Basic Application Interfaces, ITS FORUM RC-004, ITS Info-communications Forum.