Experimental Communication Messages Guideline of BICYCLE/PEDESTRIAN Accident Prevention Support System

ITS FORUM RC-016 Version 1.0

Established on March 29, 2022

ITS Info-communications Forum of Japan

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Revision History

Version	Date	Chapter/Section	Reason	Revised Content
1.0	March 29, 2022	Establishment	Newly established	

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Introduction

This document establishes experimental communication message Guideline to provide notification to roadside units (RSUs, infrastructure) and vehicles regarding the presence of bicycles and pedestrians using wireless communications (700 MHz band and Bluetooth®) in order to prevent accidents involving bicycles and pedestrians. In particular, it is anticipated that the system will prevent accidents where a bicycle or pedestrian suddenly emerges from an intersection (broadside collision) not equipped with a traffic signal, and it is also expected that the system will be effective in various other situations such as preventing contact when overtaking a vehicle and overlooking vehicles and so on in the vicinity when turning left or right.

These Guideline may also be used for potential applications, if any, other than accident prevention (such as autonomous driving support and monitoring support).

We hope that these Guideline will be fully verified through demonstration tests of the relevant systems and that various activities for practical application will be undertaken.

Contents

Chapter 1. General Matters

1.1 Overview

These Guideline establish message specifications for conducting demonstration trials intended to achieve systems that support the prevention of traffic accidents involving bicycles and pedestrians (referred to as "Bicycle and Pedestrian Accident Prevention Support Systems") through wireless communications among bicycles, pedestrians, roadside units (RSUs, infrastructure), and vehicles.

1.2 Scope of Application

Systems covered by these Guideline are expected to be systems that comprise bicycles, pedestrians, RSUs, and vehicles and conduct wireless communications among them. Information relating to bicycles and pedestrians will be directly transmitted from bicycles and pedestrians to vehicles, i.e., B2V/P2V communications, or information will be transmitted via RSUs, i.e., B2I2V/P2I2V. Transmissions in the opposite direction are also possible. Of these communications, B2I/P2I and B2V/P2V messages transmitted by bicycles and pedestrians and I2V messages transmitted by RSUs are within the scope of application of these Guideline, and it is expected that the standards on message transmitted by RSUs referenced above or existing standards on inter-vehicle communication messages will be used for other messages. (Reference Material [3])

It is assumed that wireless systems are based on existing standards, and this is outside the scope of these Guideline. See below for details.

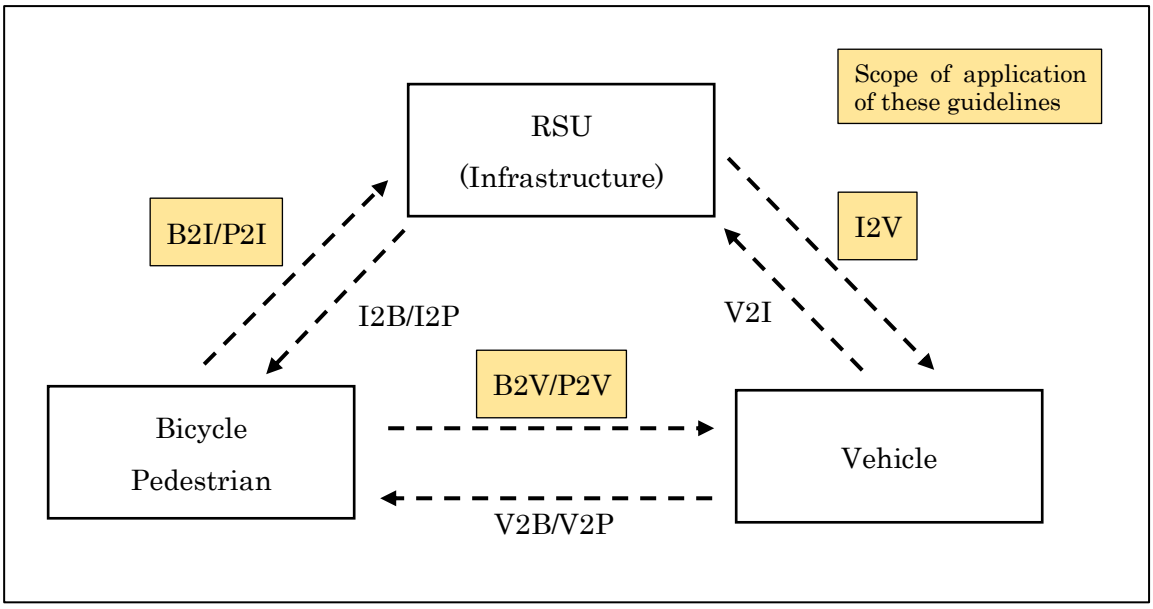


Figure 1-1. Covered Systems and Scope of Application of These Guideline

Reference Materials

[1] 700 MHz Band Intelligent Transport Systems ARIB Standard, ARIB STD-T109 Ver. 1.3

[2] 700 MHz Band Intelligent Transport Systems – Extended Functions Guideline, ITS Forum RC-010 Ver. 1.1

[3] 700 MHz Band Intelligent Transport Systems – Experimental Guideline for Inter-vehicle Communication Messages, ITS Forum RC-013 Ver. 1.1

[4] Bluetooth® Technology Core Specification

https: //www.bluetooth.com/ja-jp/specifications/specs/core-specification/

1.4 Terms and Abbreviations

1.4.1 Terms

- **Roadside unit (RSUs, infrastructure)**: A general term for a device installed on the roadside for receiving, detecting, and transmitting information regarding the presence of bicycles and pedestrians for use with covered systems.
- **Target**: A general term for bicycles, pedestrians, vehicles, and so on treated as transmission subjects by RSUs.
- **Target information**: Information on the presence of a target.
- **B2V, I2V, P2I2V, etc.**: A transmission to any of the bicycle, pedestrian, vehicle, or RSUs (infrastructure). For example, a transmission from a bicycle to a vehicle is B2V, a transmission from a vehicle to a pedestrian is V2P, and a transmission from a bicycle to a vehicle via a RSUs is B2I2V.
- **Message**: Application data exchanged between an application and communications protocol.
- **Message set**: An aggregation of message specifications defined for the relevant application.
- **Data frame (DF)**: A unit of data that comprises a message. Made up of one or more data elements. There are also cases where a message comprises multiple data frames or data elements.
- **Data element (DE)**: The smallest unit of data that comprises a message.
- **Common service standard**: A standard for a service (service system) defined by a standards or specifications organization or the like. See Reference Material [3].
- **Individual service standard**: A standard for a service (service system) defined by an individual company, specific alliance, or the like. See Reference Material [3].
- **Individual application**: Application software that performs operations defined by an individual service standard. See Reference Material [3].

1.4.2 Abbreviations

- **AoA**: Angle of Arrival
- **BLE**: Bluetooth Low Energy

・**GAP**: Generic Access Profile

・**GNSS**: Global Navigation Satellite System

・**HMI**: Human Machine Interface

・**LED**: Light Emitting Diode

・**ToF**: Time of Flight

Chapter 2. System Overview

This chapter provides an overview of Bicycle and Pedestrian Accident Prevention Support Systems.

2.1 System Structure

Figure 2-1 shows the system structure of the Bicycle and Pedestrian Accident Prevention Support Systems. The system is made up of bicycles, pedestrians, RSUs, and vehicles.

Bicycles, pedestrians, and vehicles acquire their own presence information from GNSS receivers and various sensors including accelerometers and notify others in their vicinity wirelessly (corresponding to V2V and so on in the figure).

RSUs acquire target presence information (“target information”) concerning bicycles, pedestrians, vehicles, and so on from wireless units and roadside sensors and notify others in the vicinity using wireless communications and HMI such as LED display units. In addition, information is shared with other RSUs, cloud servers, and so on using external interfaces connecting to external networks such as the Internet.

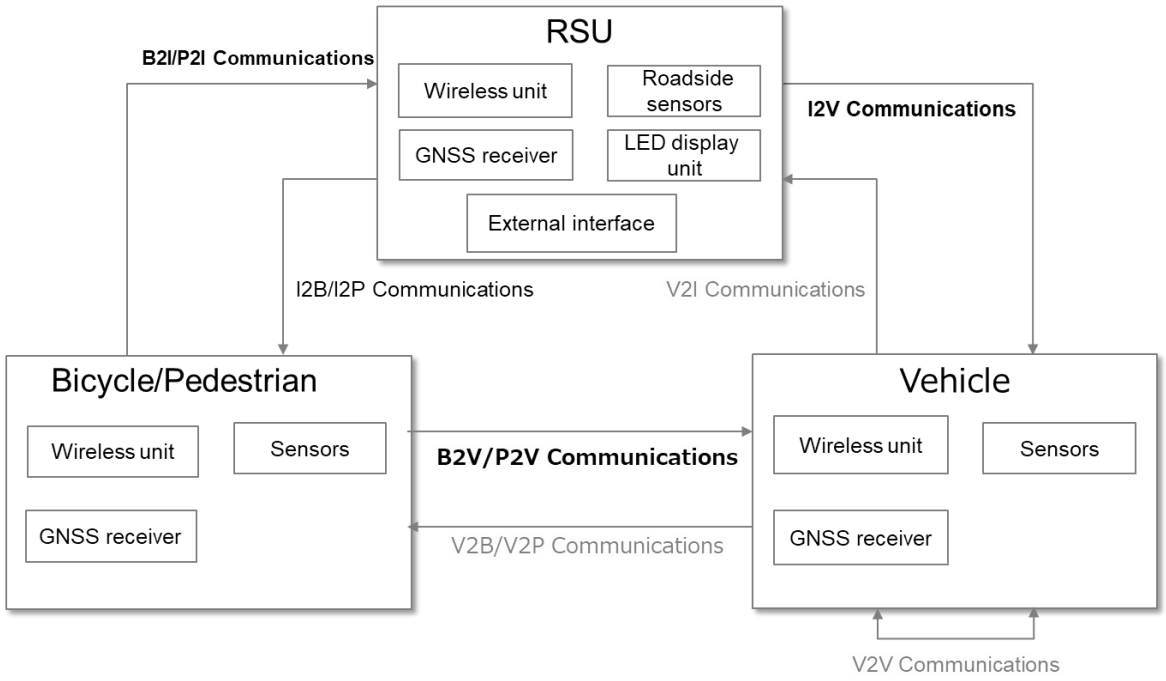


Figure 2-1. System Structure Conceptual Diagram

2.2 Use Cases

The system will be used to prevent accidents involving bicycles and pedestrians. The following use cases are anticipated.

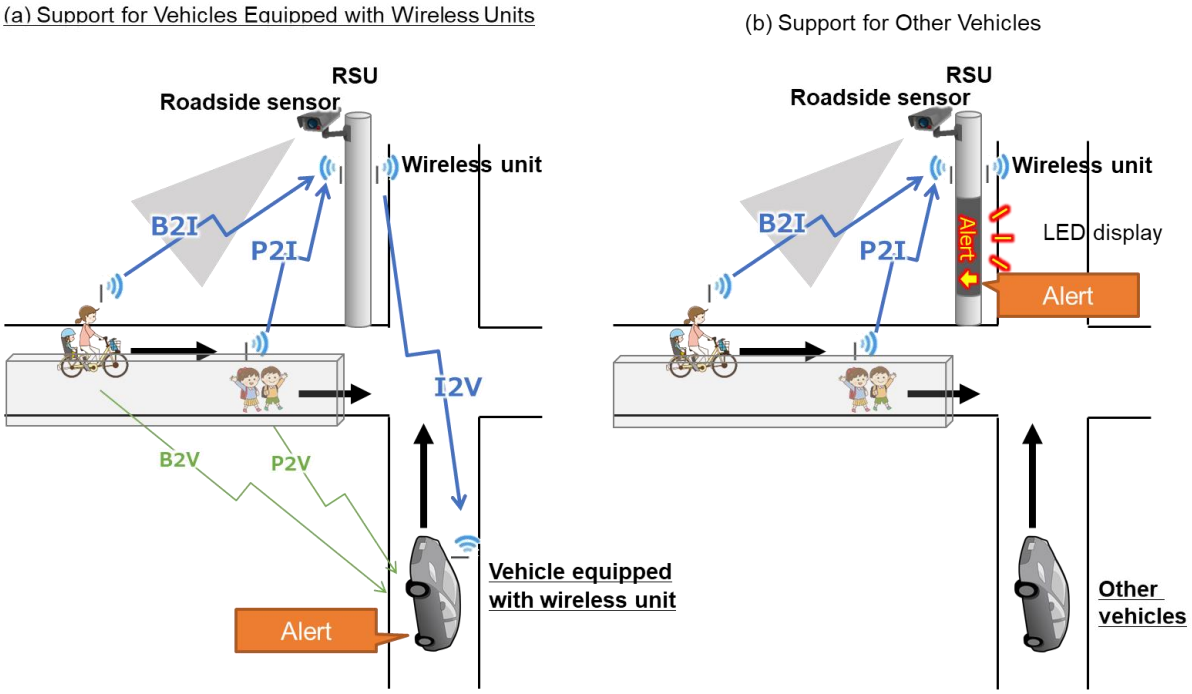
(a) Prevention of accidents involving an oncoming vehicle when entering an intersection without a traffic signal

(b) Prevention of accidents involving contact with an oncoming vehicle or other object when overtaking a vehicle to the front

(c) Prevention of accidents involving an oncoming vehicles when turning right across traffic

(d) Prevention of entrapment-type accidents when a vehicle hits a motorcycle or bicycle while turning left

Figure 2-2 provides an overview of the prevention of a typical accident that may occur at an intersection that does not have a traffic signal as described in (a). The system helps prevent accidents by notify bicycles, pedestrians, and vehicles about target information that is not visible from the intersection and alerting them. It is expected that the means of notification will be radio communication for vehicles equipped with radio devices and LED displays on RSUs and the like for other vehicles.



(a) Support to vehicles equipped with radio devices (b) Support to other vehicles

Figure 2-2. Conceptual Diagram of Prevention of Broadside Accidents

2.3 Use Cases Other Than Accident Prevention Support

Experimenters may investigate expanded applications of the system other than accident prevention. Some possible examples include use cases for support for watching over children and the elderly using external networks and for mitigating traffic congestion by providing information regarding road construction, stopped vehicles, and so on.

2.4 Structural Elements of Target Information

The structural elements of target information included with messages is as follows.

(a) Target ID

A unique ID is assigned to each target.

(b) Information generation time

Since it is assumed that information will arrive from multiple communication paths with different delay times, the information generation time is defined by the time when the GNSS receiver or roadside sensors acquires the presence information.

(c) Position information

Since use in various environments is anticipated, expressed by absolute coordinates (longitude and latitude).

(d) Status information

Refers to the target speed, heading angle, acceleration, and so on.

(e) Attribute information

Refers to the target size classification and role classification.

2.5 Supplementation and Integration of Target Information by RSUs

2.5.1 Overview

Since the RSUs used with the system can handle target information obtained from multiple information sources whose detection ranges overlap including bicycles, pedestrians, vehicles, and roadside sensors, depending on the unit configuration, it may occur that multiple target information associated with a single target is in the RSU's possession. In this case, it is necessary to implement a process that supplements and integrates target information. Figure 2-3 is a conceptual diagram of this.

Supplementary processing refers to the process of adding information held by a RSU in cases where the target information acquired by the RSU from a bicycle or pedestrian is not sufficient.

Integration processing refers to the process of integrating multiple items of information obtained from a bicycle, pedestrian, or vehicle and a roadside sensor into the same item of information when the information concerns the same target.

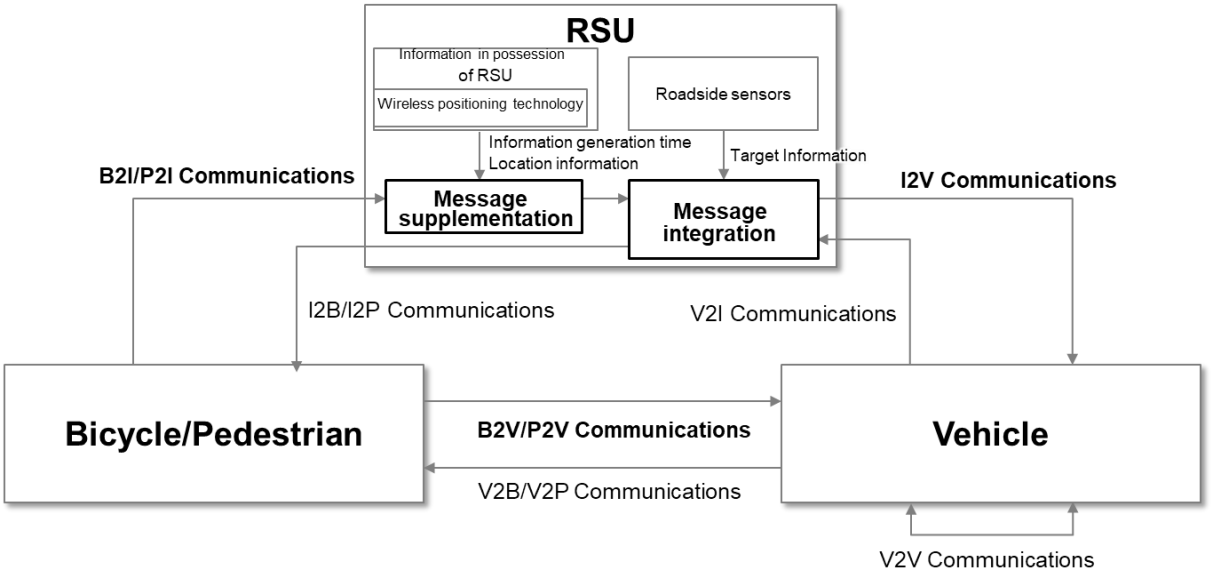


Figure 2-3. Conceptual Diagram of Supplementary and Integrative Processing

2.5.2 Categorizing Bicycle and Pedestrian Transmission Information by Level

Bicycle and pedestrian transmission information is categorized according to the message specification level so that information can be provided for the purpose of creating an appropriate structure according to the various use cases. A RSU receives level information from bicycles and pedestrians and performs supplementary and integrative processing of information that is insufficient. For accident prevention support, which is the primary focus of this system, it is desirable that the level be at least level 4.

Table 2-1. Bicycle and Pedestrian Transmission Information Level Definitions

		Level 1	Level 2	Level 3	Level 4	Level 5
Target ID		○	○	○	○	○
Information generation time		-	-	-	-	○
Position information		-	-	-	○	○
Status information	Speed	-	○	○	○	○
	Heading	-	-	○	○	○
	Acceleration	-	○	○	○	○
Attribute information		○	○	○	○	○

2.5.3 Message Supplementation

The RSU adds missing information to acquired messages. The added information is as follows.

(a) Information generation time

The RSU calculates the information generation time using the time information in its possession and the system delay time and adds it to the message. Refer to Appendix 1 for a definition of system delay time.

(b) Position information

The RSU uses wireless positioning technology such as distance measurement and estimation of direction of arrival using wireless communications, estimates the position of the bicycle or pedestrian, and adds this information to the message. Examples of wireless positioning technology includes technology that combines BLE ToF distance measurement and AoA, but the details are not covered in this document.

2.5.4 Message Integration

Multiple messages referring to the same target are consolidated. The process is performed as follows.

1. Identification processing

   Information acquired through wireless communications and information acquired from roadside sensors are compared and a determination whether the information concerns the same target is made. The detailed algorithm is not discussed in this document.

2. Integration processing

   Multiple identified messages are integrated to a single message. Information is selected and discarded so that the most effective information for each component element of the target information remains. Refer to Appendix 2 for information on the detailed policy.

3. Addition of supplementary and integrated information

   Information on whether there is supplementary or integrated information and integrated supplementary information are added to the transmission message as a history of the supplementation and integration processing. Refer to Chapter 4 for details.

Chapter 3. Bicycle and Pedestrian Transmission Message Specifications

This chapter defines the experimental message specifications for transmitting information regarding the presence of a bicycle or pedestrian to RSUs and vehicles.

3.1 Relationship between the Layer Structure and These Guideline

3.1.1 Radio Communications Method

These Guideline anticipate that the 700 MHz band ITS system or Bluetooth® will be the radio communications method used by bicycles and pedestrians.

In the case where the 700 MHz band is used, communications are carried out in accordance with the inter-vehicle communications format described in ARIB STD-T109 (Reference Material [1]) and ITS Forum RC-010 (Reference Material [2]).

In the case where Bluetooth® is used, the Extended Advertising (Bluetooth 5.0 or higher) described in the Bluetooth Low Energy GAP is used. The reason why Extended Advertising is used is that there are restrictions on the data set size, as described below, but for experimental purposes, the standard Advertising (Bluetooth 4.2, etc.) may be used.

For details concerning Bluetooth® and Bluetooth Low Energy, refer to the Bluetooth® Technology Core Specification (Reference Material [4]).

3.1.2 Message Specifications Defined in These Guideline

In the case of both the 700 MHz band and Bluetooth®, the message specifications comply with ITS Forum RC-013 (Reference Material [3]). For additional data items used by bicycles and pedestrians not specified in that guideline, use a free field specified in the guideline.

The layer structure relating to bicycle and pedestrian messages is shown in Figure 3-1.

3.1.3 Transmission Cycle

Messages from bicycles and pedestrians are transmitted via periodic broadcasts to RSUs and vehicles. The transmission cycle is fundamentally 100 ms at a minimum, and it is recommended that a cycle that is a multiple of 100 ms be used, depending on the experiment.

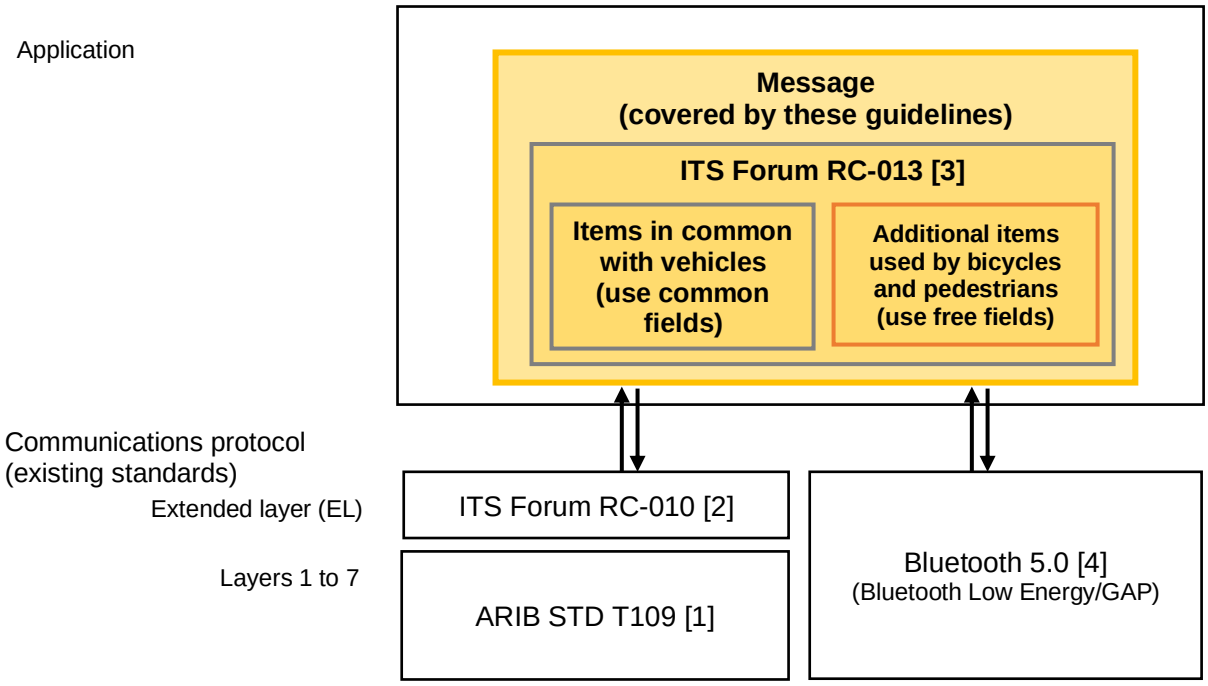


Figure 3-1. Layer Structure Relating to Bicycle and Pedestrian Messages in These Guideline

3.1.4 Security Requirements

Practical application of the services provided by the system require security to prevent data tampering and spoofing and ensure the integrity of data, and consequently, specific message encryption processing is necessary. These Guideline do not contain any provisions regarding encryption methods, but it is recommended that appropriate security be ensured even during experimentation according to the conditions.

3.2 Message Specifications

To ensure the interoperability of the specifications of messages transmitted from bicycles and pedestrians with existing standards, messages comply with RC-013, and bicycle and pedestrian data as well as data unique to the system are extended using the free fields under RC-013.

Items whose value assignment is TBD in the message definition set forth below are optional under these Guideline for experiments.

3.2.1 Common Fields

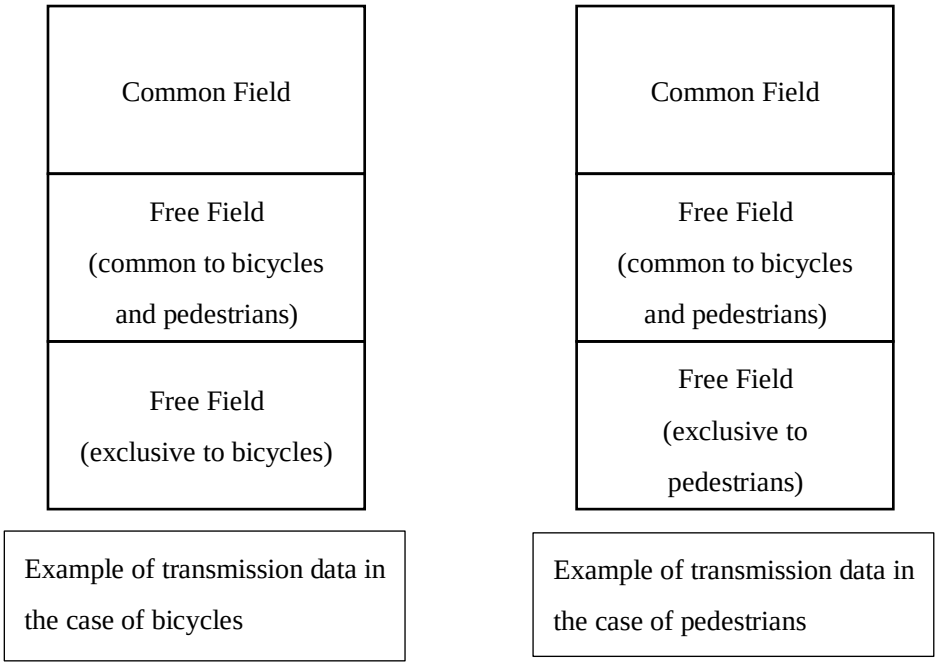
The common fields comply with RC-013 mentioned above, and the corresponding date is specified as set forth below according to the corresponding level of bicycles and pedestrians. DF/DE, which is optional under RC-013, can be selected according to the individual device specifications, and therefore, is not discussed in these Guideline.

Table 3-1. RC-013 Correspondence Table in Each Category

	Data Frame	Data Element	Data Length	Level 1	Level 2	Level 3	Level 4	Level 5
Common App Data Field (excluding optional fields)	DF_CommonFieldManag	DE_CommonServiceStandardID	3	Possible	Possible	Possible	Possible	Possible
		DE_MessageID	2	Possible	Possible	Possible	Possible	Possible
		DE_VersionInformation	3	Possible	Possible	Possible	Possible	Possible
		DE_VehicleID	32	Possible	Possible	Possible	Possible	Possible
		DE_IncrementCounter	8	Possible	Possible	Possible	Possible	Possible
		DE_CommonAppDataLength	8	Possible	Possible	Possible	Possible	Possible
		DE_OptionFlag	8	Possible	Possible	Possible	Possible	Possible
	DF_TimeInformation	DE_LeapSecondCorrectionInformation	1	0 Fixed	0 Fixed	0 Fixed	0 Fixed	Possible
		DE_Time(Hours)	7	RC-013 Undetermined	RC-013 Undetermined	RC-013 Undetermined	RC-013 Undetermined	Possible
		DE_Time(Minutes)	8	RC-013 Undetermined	RC-013 Undetermined	RC-013 Undetermined	RC-013 Undetermined	Possible
		DE_Time(Seconds)	16	RC-013 Undetermined	RC-013 Undetermined	RC-013 Undetermined	RC-013 Undetermined	Possible
	DF_LocationInformation	DE_Latitude	32	RC-013 Undetermined	RC-013 Undetermined	RC-013 Undetermined	Possible	Possible
		DE_Longitude	32	RC-013 Undetermined	RC-013 Undetermined	RC-013 Undetermined	Possible	Possible
		DE_Elevation (Arbitrary)	16	RC-013 Undetermined	RC-013 Undetermined	RC-013 Undetermined	Arbitrary	Arbitrary
		DE_PositionConfidence	4	RC-013 Undetermined	RC-013 Undetermined	RC-013 Undetermined	Possible	Possible
		DE_ElevationConfidence (Arbitrary)	4	RC-013 Undetermined	RC-013 Undetermined	RC-013 Undetermined	Arbitrary	Arbitrary
	DF_VehicleStatusInforma	DE_VehicleSpeed	16	RC-013 Undetermined	Possible	Possible	Possible	Possible
		DE_Heading	16	RC-013 Undetermined	RC-013 Undetermined	Possible	Possible	Possible
		DE_Forward/RearAcceleration	16	RC-013 Undetermined	Possible	Possible	Possible	Possible
		DE_SpeedConfidence	3	RC-013 Undetermined	Possible	Possible	Possible	Possible
		DE_HeadingConfidence	3	RC-013 Undetermined	RC-013 Undetermined	Possible	Possible	Possible
		DE_Forward/RearAccelerationConfiden ce	3	RC-013 Undetermined	Possible	Possible	Possible	Possible
		DE_TransmissionState(Arbitrary)	3	RC-013 Undetermined	Possible	Arbitrary	Arbitrary	Arbitrary
		DE_SteeringWheelAngle(Arbitrary)	12	RC-013 Undetermined	RC-013 Undetermined	Arbitrary	Arbitrary	Arbitrary
	DF_VehicleAttributeInfor	DE_VehicleSizeClassification	4	Possible	Possible	Possible	Possible	Possible
		DE_VehicleRoleClassification	4	Possible	Possible	Possible	Possible	Possible
		DE_VehicleWidth(Arbitrary)	10	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary
		DE_VehicleLength(Arbitrary)	14	Arbitrary	Arbitrary	Arbitrary	Arbitrary	Arbitrary

3.2.2 Free Fields

Free fields are defined as fields that are common to both bicycles and pedestrians used by the system as well as dedicated fields for bicycles and pedestrians in consideration of future extendibility to their respective services. It is anticipated that bicycles and pedestrians will have common fields and will each have their own exclusive fields.



3.2.2.1 Messages Common to Bicycles and Pedestrians

Messages handled in common by bicycles and pedestrians are specified as set forth below.

Structure DF/DE	Size	Remarks
DF_IndividualAppData(CommonToBicyclesAnd Pedestrians)		
DE_TargetLevelInformation	3 bits	
DE_SystemDelayTime	5 bits	
DE_MonitoringData	32 bits	

(1) DE_TargetLevelInformation

Data name	DE_TargetLevelInformation
Definition	Indicates the stored target information level (see 2.5.2)
Data size	3 bits
Data type	Unsigned integer
Expression range	1 to 5
Resolution	1

(2) DE_SystemDelayTime

Data name	DE_SystemDelayTime
Definition	Indicates the delay time occurring from the generation of data by the bicycle or pedestrian device to transmission. The longest delay time occurring within the device is stored.
Data size	5 bits
Data type	Unsigned integer
Expression range	0 ms to 310 ms
Resolution	10 ms

(3) DE_Monitoring Data

Data name	DE_MonitoringData
Definition	A field used for monitoring applications. Used according to the monitoring service application used. When used, measures to protect personal information should be taken. If this DE is not used, 0 is stored.
Data size	32 bits

Data type	Complies with the monitoring service application
Expression range	Complies with the monitoring service application
Resolution	Complies with the monitoring service application

3.2.2.2 Messages Exclusive to Bicycles

Messages handled exclusively by bicycles are specified as set forth below.

3.2.2.2.1 DF_IndividualAppData(BicycleBasicApplications)

Structure DF/DE	Size	Remarks
DF_IndividualAppData(BicycleBasicApplications)		
DE_AssistType	4 bits	
DE_BicycleType	4 bits	
DE_AssistStatus	2 bits	
DE_PedalingStatus	2 bits	
DE_BicycleDriveForce	8 bits	
DE_Collision/FallDetection	4 bits	

(1) DE_AssistType

Data name	DE_AssistType
Definition	Indicates the bicycle power assist type.
Data size	4 bits
Data type	Enumerated
Allocation	0: Undefined 1: Non-electric power assist bicycle 2: Electric-power assist bicycle (up to 24 km/h) 3 to 15: Reserved (for legal amendment, overseas use, etc.)

(2) DE_BicycleType

Data name	DE_BicycleType
Definition	Indicates the type of bicycle.
Data size	4 bits
Data type	Enumerated
Allocation	0: Undefined 1 to 15: TBD (Up to 15 categories such as city, cross, road, MTB, child carrier,

	child use, three-wheel, etc.)

(3) DE_AssistStatus

Data name	DE_AssistStatus
Definition	Indicates the assist status of the bicycle.
Data size	2 bits
Data type	Enumerated
Allocation	0: Undefined 1: Assist OFF 2: Assist ON 3: Self-driving function ON

(4) DE_PedalingStatus

Data name	DE_PedalingStatus
Definition	Indicates the pedaling status of the bicyclist.
Data size	2 bits
Data type	Enumerated
Allocation	0: Undefined 1: No pedaling 2: Currently pedaling 3: Reserved

(5) DE_BicycleDriveForce

Data name	DE_BicycleDriveForce
Definition	Indicates the drive force of the bicycle. In the case of 2,540 W or more, set as 254 (0xFE), and if unclear because of a lack of a sensor or otherwise, set as 255 (0xFF).
Data size	8 bits
Data type	Unsigned integer
Expression range	0 W – 2,540 W
Resolution	10 W

(6) DE_Collision/FallDetection

Data name	DE_Collision/FallDetection
Definition	Indicates the collision or fall status of the bicycle (TBD).
Data size	4 bits

Data type	Enumerated
Allocation	0: Undefined 1 to 15: TBD

3.2.2.2.2 DF_IndividualAppData(BicycleExtendedApplications)

Structure DF/DE	Size	Remarks
DF_IndividualAppData(BicycleExtendedApplications)		Since the system is expanding functions as an accident prevention support system, data that can be expected to be used in the future is defined as individual application data. The system may be used in use cases other than the accident prevention support described in Section 2.3.
DE_ShiftStagesNumber(Main)	5 bits	
DE_ShiftStagesNumber(MainMaximum)	5 bits	
DE_ShiftStagesNumber(Sub)	5 bits	
DE_ShiftStagesNumber(SubMaximum)	5 bits	
DE_TireCircumference	8 bits	
DE_Cadence	8 bits	
DE_GearRatio	10 bits	
DE_DriverTorque	8 bits	
DE_MotorTorque	8 bits	
DE_AssistPowerLimit	8 bits	
DE_AssistPower	8 bits	
DE_Power(HumanPower)	8 bits	
DE_RemainingBatteryLimit	8 bits	
DE_RemainingBattery	8 bits	
DE_RearLight	2 bits	
DE_DUStatus	2 bits	
DE_MaintenanceAlert	2 bits	
Reserved	4 bits	

(1) DE_ShiftStagesNumber(Main)

Data name	DE_ShiftStagesNumber(Main)
Definition	Indicates the number of stages of the main gear of the bicycle. This item is used for bicycles that have only one gear. If unspecified, set to zero (0x00).
Data size	5 bits
Data type	Unsigned integer
Expression range	1 speed (low end) to 31 speeds (top end)
Resolution	1 speed

(2) DE_ShiftStagesNumber(MainMaximum)

Data name	DE_ShiftStagesNumber(MainMaximum)
Definition	Indicates the maximum number of stages of the main gear of the bicycle. This item is used for bicycles that have only one gear. If unspecified, set to zero (0x00).
Data size	5 bits
Data type	Unsigned integer
Expression range	1 speed (low end) to 31 speeds (top end)
Resolution	1 speed

(3) DE_ShiftStagesNumber(Sub)

Data name	DE_ShiftStagesNumber(Sub)
Definition	Indicates the number of stages of the sub gear of the bicycle. Unspecified for bicycles that have only one gear. (If unspecified, set to zero (0x00)).
Data size	5 bits
Data type	Unsigned integer
Expression range	1 speed (low end) to 31 speeds (top end)
Resolution	1 speed

(4) DE_ShiftStagesNumber(SubMaximum)

Data name	DE_ShiftStagesNumber(SubMaximum)
Definition	Indicates the maximum number of stages of the sub gear of the bicycle. Unspecified for bicycles that have only one gear. (If unspecified, set to 0(0x00)).
Data size	5 bits
Data type	Unsigned integer
Expression range	1 speed (low end) to 31 speeds (top end)
Resolution	1 speed

(5) DE_TireCircumference

Data name	DE_TireCircumference
Definition	Indicates the tire circumference of the bicycle. If 2,550 mm or more, set to 255 (0xFF), if unspecified, set to 0 (0x00).
Data size	8 bits
Data type	Unsigned integer
Expression range	10 mm to 2,550 mm
Resolution	10 mm

(6) DE_Cadence

Data name	DE_Cadence
Definition	Indicates the cadence of the bicycle. If 254 rpm or higher, set to 254 (0xFE), if unspecified, set to 255 (0xFF).
Data size	8 bits
Data type	Unsigned integer
Expression range	0 rpm to 254 rpm
Resolution	10 rpm

(7) DE_GearRatio

Data name	DE_GearRatio
Definition	Indicates the gear ratio of the bicycle. The gear ratio is expressed as the number of rotations of the rear wheel/number of rotations of the crank. If 1,023% or higher, set to 1023 (0x3FF), if unspecified, set to 0 (0x00).
Data size	10 bits
Data type	Unsigned integer
Expression range	1% to 1,023%
Resolution	1%

(8) DE_DriverTorque

Data name	DE_DriverTorque
Definition	Indicates the driver torque of the bicycle. If 254 Nm or higher, set to 254 (0xFE), if unspecified, set to 255 (0xFF).
Data size	8 bits
Data type	Unsigned integer
Expression range	0 Nm to 254 Nm
Resolution	1 Nm

(9) DE_MotorTorque

Data name	DE_MotorTorque
Definition	Indicates the motor torque of the bicycle. If 254 Nm or higher, set to 254 (0xFE), if unspecified, set to 255 (0xFF).
Data size	8 bits
Data type	Unsigned integer
Expression range	0 Nm to 254 Nm
Resolution	1 Nm

(10) DE_AssistPowerLimit

Data name	DE_AssistPowerLimit
Definition	Indicates the upper limit of power assist of the bicycle. If 2,540 W or higher, set to 254 (0xFE), if unspecified, set to 255 (0xFF).
Data size	8 bits
Data type	Unsigned integer
Expression range	0 W to 2,540 W
Resolution	10 W

(11) DE_AssistPower

Data name	DE_AssistPower
Definition	Indicates the power assist of the bicycle. If 2,540 W or higher, set to 254 (0xFE), if unspecified, set to 255 (0xFF).
Data size	8 bits
Data type	Unsigned integer
Expression range	0 W to 2,540 W
Resolution	10 W

(12) DE_Power(HumanPower)

Data name	DE_Power(HumanPower)
Definition	Indicates the power of the driver. If 1,270 W or higher, set to 254 (0xFE), if unspecified, set to 255 (0xFF).
Data size	8 bits
Data type	Unsigned integer
Expression range	0 W to 1,270 W
Resolution	5 W

(13) DE_RemainingBatteryLimit

Data name	DE_RemainingBatteryLimit
Definition	Indicates the upper limit of the remaining battery power of the bicycle. If 2,540 Wh or higher, set to 254 (0xFE), if unspecified, set to 255 (0xFF).
Data size	8 bits
Data type	Unsigned integer
Expression range	0 Wh to 2,540 Wh
Resolution	10 Wh

(14) DE_RemainingBattery

Data name	DE_RemainingBattery
Definition	Indicates the remaining battery power of the bicycle. If 2,540 Wh or higher, set to 254 (0xFE), if unspecified, set to 255 (0xFF).
Data size	8 bits
Data type	Unsigned integer
Expression range	0 Wh to 2,540 Wh
Resolution	10 Wh

(15) DE_RearLight

Data name	DE_RearLight
Definition	Indicates the status of the bicycle's rear light.
Data size	2 bits
Data type	Enumerated
Allocation	0: Unspecified 1: OFF 2: ON 3: Reserved

(16) DE_DUStatus

Data name	DE_DUStatus
Definition	Indicates the status of the bicycle's drive unit.
Data size	2 bits
Data type	Enumerated
Allocation	0: Unspecified 1: Normal 2: Abnormal 3: Reserved

(17) DE_MaintenanceAlert

Data name	DE_MaintenanceAlert
Definition	Indicates whether the bicycle needs maintenance.
Data size	2 bits
Data type	Enumerated
Allocation	0: Unspecified

	1: Normal 2: Abnormal 3: Reserved

3.2.2.3 Messages Exclusive to Pedestrians

Messages handled exclusively by pedestrians are specified as set forth below.

Structure DF/DE	Size	Remarks
DF_IndividualAppData(PedestrianApplications)		
DE_AttributeInformation	6 bits	
DE_StepsNumber	14 bits	
DE_ActivityStatus(NumberOfStepsPerUnitOfTime)	2 bits	
Reserved	18 bits	

(1) DE_AttributeInformation

Data name	DE_AttributeInformation
Definition	Indicates the type of shoes.
Data size	6 bits
Data type	Enumerated
Allocation	1: Children's shoes 2: Shoes for seniors 3: Other general 0, 4 to 63: TBD

(2) DE_StepsNumber

Data name	DE_StepsNumber
Definition	Indicates the number of steps taken by the pedestrian. If 16,383 or more, set to 16383 (0x3FFF).
Data size	14 bits
Data type	Unsigned integer
Expression range	0 steps to 16,383 steps
Resolution	1 step

(3) DE_ActivityStatus

Data name	DE_ActivityStatus

Definition	Indicates the number of steps taken by the pedestrian per unit of time.
Data size	2 bits
Data type	Enumerated
Allocation	0: Stationary (20 steps or fewer) 1: Walking (100 steps or Fewer) 2: Running (300 steps or fewer) 3: Unspecified

Chapter 4. RSU Transmission Message Specifications

This chapter specifies the experimental message specifications for transmissions from RSUs to vehicles. Two types of RSU are anticipated: conventional RSUs and CSMA RSUs. CSMA RSUs are used for short-term experiments utilizing onboard radio equipment as a RSU. Radio stations are mobile stations, and inter-vehicle communications are used for communications.

When conducting experiments, the need to coordinate with related organizations from the perspective of the effects on operational stations should be kept in mind. Also, with regard to the radio equipment of CSMA RSUs, it is necessary to satisfy the technical conditions of the land mobile stations for 700 MHz band ITS and to keep in mind that it is necessary to confirm with the Ministry of Internal Affairs and Communications in advance regarding the fixed use of mobile stations (It may be necessary to acquire an experimental station).

4.1 Radio Communications Method

These experimental Guideline anticipate that radio communications will be conducted in accordance with ARIB STD-T109 (Reference Material [1]) and ITS Forum RC-010 (Reference Material [2]).

4.2 Message Specifications Defined in These Guideline

These Guideline describe the following two methods as experimental message specifications.

(1) Guideline method: A new message specifications suitable for the use cases envisioned in Chapter 2 for conventional RSUs. For the communications protocol, the roadside-to-vehicle communications methods described in Reference Materials [1] and [2] are anticipated. It is expected that investigation for practical application of the system will be conducted through demonstration experiments using this method.

(2) Guideline method (for CSMA RSUs): A new message specification for CSMA RSUs. For the communications protocol, the inter-vehicle communications methods described in Reference Materials [1] and [2] are anticipated.

For both communications methods, measures should be taken during experiments to prevent any effects on the on-board units (OBUs) of existing applications.

The layer structures for both methods are shown in Figure 4-1. The main differences between the methods are indicated in Table 4-1.

4.3 Transmission Cycle

Both methods described above are based on transmitting the necessary target information in a cycle of 100 ms. However, the speeds of bicycles and pedestrians are low compared to vehicles, and therefore, there is a need to investigate the use of a longer cycle from the perspectives of reducing communications volumes and

power consumption on the terminal side. The transmission cycles of target information for bicycles and pedestrians can be set arbitrarily so that this can be verified through experiments.

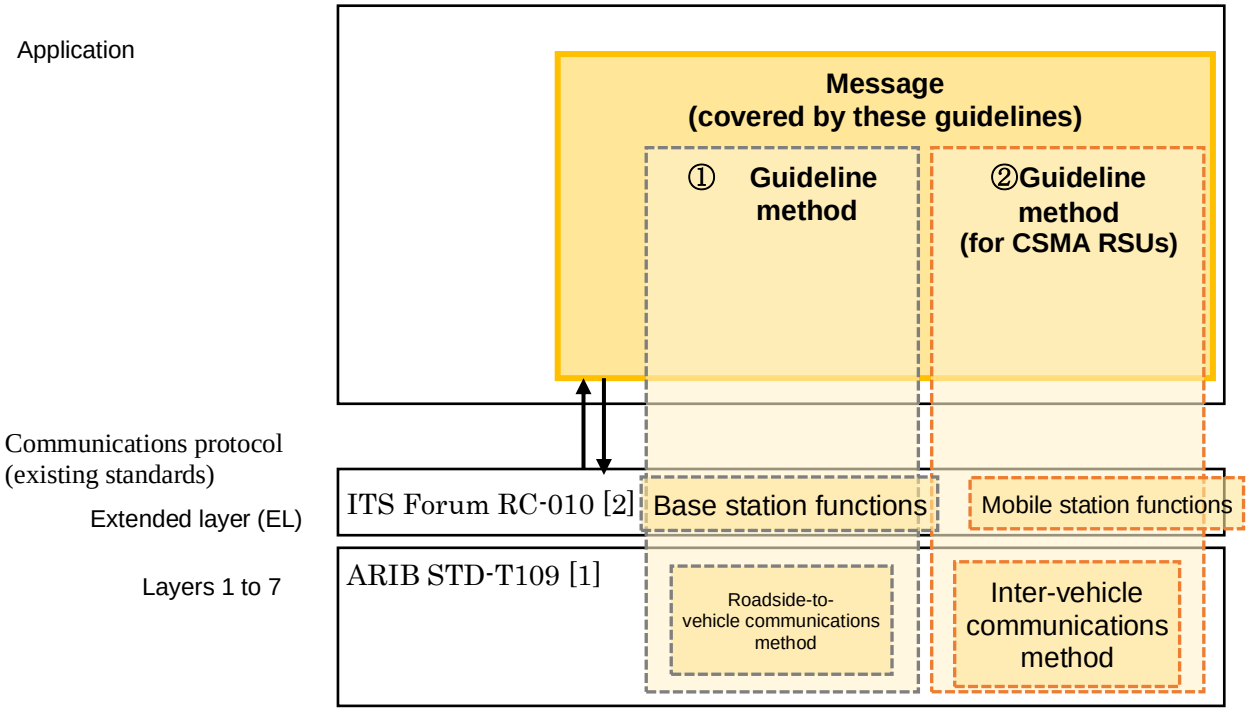


Figure 4-1. Layer Structure Relating to RSU Messages in These Guideline

Table 4-1. Overview of the Two Types of RSU Message Specifications Provided in These Guideline

		① Guideline method	② Guideline method (for CSMA RSUs)
Message specifications overview	Message specifications	Newly established for conventional RSUs	Newly established for CSMA RSUs
	Target status expression method	Longitude/latitude, speed, direction of travel, etc.	
	Number of targets per message	All communications targets	5 maximum
	In case of target non-detection	Transmit 0 as the number of targets	Transmit header only
Transmission period under T109		Roadside-to-vehicle transmission period	Period other than roadside-to-vehicle/roadside-to-roadside transmission

Handling of method in these Guideline	Specifications for experiments for achieving practical application	Provisional specifications for short-term verification tests

4.4 Transmission Message Specifications under These Guideline

Transmission message specifications in accordance with the T109 roadside-to-vehicle communications method are established as set forth below.

4.4.1 Message Structure

In cases where there are multiple targets within a single transmission cycle of a RSU, a consolidated message is transmitted one time within this structure. Broadly divided, messages comprise the RSU header field, the target information shared field, and the target information individual field. The basic message structure is shown in Table 4-2.

Table 4-2. Basic Structure of RSU Transmission Messages

Structural element	Overview
RSU header field	Shared information of roadside-to-vehicle communications not dependent on the application
Target information shared field	Shared attribute information in the relevant message not dependent on the individual target
Target common optional information	Attribute information that depends on the application (use case), roadside sensors, and so on but not on individual targets is optionally selected and stored as necessary.
Target information individual field	Individual information for each target (position, speed, etc.).
Target individual information (loop structure of the number of targets)	

Data elements or data frames are stored in each field. The structures of each field are described below.

4.4.1.1 RSU Header Field

Shared information in roadside-to-vehicle communications not dependent on the application. The structure is shown in Table 4-3.

Table 4-3. RSU Header Field Message Structure

Structure DF/DE	Size	Remarks
DF_RoadsideUnitHeaderInformation		
DE_CommonServiceStandardID	3 bits	
DE_OperatingCategoryCode	1 bit	
DE_RoadsideMessageVersion	4 bits	
DE_IncrementCounter	8 bits	
DE_RoadsideMessageID	16 bits	
DE_RoadsideUnitID	32 bits	
DF_TransmissionTimeInformation		
DE_LeapSecondCorrectionInformation	1 bit	
DE_Time(Hours)	7 bits	
DE_Time(Minutes)	8 bits	
DE_Time(Seconds)	16 bits	Millisecond units
DE_MessageSize	16 bits	
DE_Reserved(16 bits)	16 bits	

4.4.1.2 Target Information Shared Field

Stores shared attribute information in the relevant messages not dependent on the individual target. The structure is shown in Table 4-4.

Table 4-4. Target Information Shared Field Message Structure

Structure DF/DE	Size	Remarks
DF_TargetSharedManagementInformation		
DE_SystemStatus	8 bits	If the system status is invalid, the structure up to this item is used.
DE_TargetSharedOptionFlag	8 bits	The number of valid options (zero or more) is described below as (I)
DF_TargetSharedOptionField: 1		In the case where I=0, DF is not stored
DE_TargetSharedOptionSize	8 bits	
DF_TargetSharedOptionalInformation	Variable	
・・・		
DF_TargetSharedOptionField: 1		

In these Guideline, sensor related information is defined as one type of target common optional

information, and other options can be added arbitrarily according to the particulars of the experiment.

The structure of sensor related information is shown in Table 4-5.

Table 4-5. Sensor Related Information Message Structure

Structure DF/DE	Size	Remarks
DE_SensorsNumber	8 bits	The number of sensors (one or more) is described below as (J)
DF_SensorSpecificAttributeInformationField: 1		In the case where J=0, DF is not stored
DE_SensorSpecificAttributeInformationSize	8 bits	
DF_SensorSpecificAttributeInformation	Variable	
・・・		
DF_SensorSpecificTargetInformationField: J		

4.4.1.3 Target Information Individual Field

This field stores individual information (position, speed, etc.) for each target. A loop structure that stores information for just the number of targets is adopted. The structure is shown in Table 4-6.

Table 4-6. Target Information Individual Field Message Structure

Structure DF/DE	Size	Remarks
DE_TargetsNumber	8 bits	The number of targets (zero or more) is described below as (K)
DF_TargetIndividualInformation: 1		In the case where K=0, DF is not stored
・・・		
DF_TargetIndividualInformation: K		

The structure of target individual information is shown in Table 4-7. This structure follows the message specifications for bicycles and pedestrians described in Chapter 3, that is, the structure of RC-013, and some items are edited by RSUs.

Table 4-7. DF_TargetIndividualInformation Message Structure

Structure DF/DE	Size	Remarks
DF_TargetIndividualManagementInformation		
DE_CommonServiceStandardID	3 bits	
DE_TargetMessageID	2 bits	
DE_TargetIndividualVersionInformation	3 bits	
DE_TargetID	32 bits	
DE_TargetIndividualIncrementCounter	8 bits	
DE_DataLength	8 bits	
DE_IndividualOptionFlag	8 bits	
DF_GenerationTimeInformation		
DE_LeapSecondCorrectionInformation	1 bit	
DE_Time(Hours)	7 bits	
DE_Time(Minutes)	8 bits	
DE_Time(Seconds)	16 bits	
DF_TargetLocationInformation		
DE_Latitude	32 bits	
DE_Longitude	32 bits	
DE_Elevation	16 bits	
DE_PositionConfidence	4 bits	
DE_ElevationConfidence	4 bits	
DF_TargetStatusInformation		
DE_Speed	16 bits	
DE_Heading	16 bits	
DE_Acceleration	16 bits	
DE_SpeedConfidence	3 bits	
DE_HeadingConfidence	3 bits	
DE_Forward/RearAccelerationConfidence	3 bits	
DE_TransmissionState	3 bits	
DE_SteeringWheelAngle	12 bits	
DF_TargetAttributeInformation		
DE_SizeClassification	4 bits	
DE_RoleClassification	4 bits	
DE_VehicleWidth	10 bits	
DE_VehicleLength	14 bits	

(Continued on next page)

Structure DF/DE	Size	Remarks
(Target Individual Extended Field)		Corresponds to the free field under the bicycle/pedestrian message specifications (RC-013)
DF_IndividualExtendedFieldManagementInformation		
DE_IndividualExtendedFieldHeaderLength	5 bits	
DE_IndividualExtendedDataQuantity	3 bits	The number of data (1 or more) is described as L below
DF_IndividualExtendedDataManagementInformationSet		
DF_IndividualExtendedDataManagementInformation: 1		
DE_IndividualServiceStandardID	8 bits	
DE_IndividualExtendedDataHeaderAddress	8 bits	
DE_IndividualExtendedDataLength	8 bits	
・・・		
DF_IndividualExtendedDataManagementInformation: L		
(Individual Extended Data Field)		
Individual extended data: 1	Variable	In the case where L=0, DF is not stored
・・・		
Individual extended data: L	Variable	

4.4.2 Data Frames/Data Elements

Descriptions of the data frames and the data elements that they are made up of.

Items whose value assignment is TBD in the message definitions set forth below are optional under these Guideline for experiments.

4.4.2.1 DF_RoadsideUnitHeaderField

4.4.2.1.1 DF_RoadsideUnitHeaderInformation

Stores information common to application-independent roadside-to-vehicle communications. Each data element is described below.

(1) DE_CommonServiceStandardID

Data name	DE_CommonServiceStandardID
Definition	ID information that identifies the common service standard (the standard to which the message conforms). It is assumed that this will be the same for conventional RSUs and CSMA RSUs. However, the specific values can be set for each experiment and are not specified in these Guideline.

Data size	3 bits
Data type	Enumerated
Allocation	Optional under these Guideline.

(2) DE_OperatingCategoryCode

Data name	DE_OperatingCategoryCode
Definition	Indicates the experiment operation status category.
Data size	1 bit
Data type	Enumerated
Allocation	0: Being adjusted 1: In operation Set to “0” when equipment is being adjusted. In this case, the content and consistency of the provided data are not guaranteed.

(3) DE_MessageVersion

Data name	DE_RoadsideMessageVersion
Definition	The version of the message identified by DE_RoadsideMessageID.
Data size	1 bit
Data type	Unsigned integer
Allocation	Under these Guideline, set to “1.”

(4) DE_IncrementCounter

Data name	DE_IncrementCounter
Definition	Number information indicating the data transmission order. For each DE_RoadsideMessageID, the counter increments by one each time a transmission is sent.
Data size	8 bits
Data type	Unsigned integer
Expression range	0 – 255
Resolution	1

(5) DE_RoadsideMessageID

Data name	DE_RoadsideMessageID
Definition	ID information that identifies a message.
Data size	16 bits
Data type	Enumerated

Allocation	Optional under these Guideline.

(6) DE_RoadsideUnitID

Data name	DE RoadsideUnitID
Definition	ID information that identifies a radio device.
Data size	32 bits
Data type	Unsigned integer
Allocation	Optional under these Guideline.

(7) DE_MessageSize

Data name	DE MessageSize
Definition	Indicates the total number of bytes of the target information common field and the target information individual field, minus the common header field.
Data size	16 bits
Data type	Unsigned integer
Expression range	0 to 65,535
Resolution	1

(8) DE_Reserved

Data name	DE Reserved (16 bits)
Definition	A reserved field for experiment extension or future use.
Data size	16 bits
Allocation	Optional under these Guideline.

4.4.2.1.2 DF_TransmissionTimeInformation

Indicates the message generation time (hours, minutes, and seconds in units of milliseconds) in the application layer of the RSU. Delay time and so on occurring in lower layers are not taken into consideration. Each data element is described below.

(1) DE_LeapSecondCorrectionInformation

Data name	DE_LeapSecondCorrectionInformation
Definition	Information indicating whether there is a time leap second correction function.
Data size	1 bit
Data type	Boolean

Allocation	0: No correction function 1: Correction function present

(2) DE_Time(Hours)

Data name	DE_Time(Hours)
Definition	Time (hours) information expressed as UTC hours + 9. If unspecified, set 127 (0x7F).
Data size	7 bits
Data type	Unsigned integer
Expression range	0 to 23 hours
Resolution	1 hour

(3) DE_Time(Minutes)

Data name	DE_Time(Minutes)
Definition	Time (minutes) information. If unspecified, set to 255 (0xFF).
Data size	8 bits
Data type	Unsigned integer
Expression range	0 to 59 minutes
Resolution	1 minute

(4) DE_Time(Seconds)

Data name	DE_Time(Seconds)
Definition	Time (seconds) information expressed in millisecond units. If unspecified, set to 65535 (0xFFFF).
Data size	16 bits
Data type	Unsigned integer
Expression range	0 to 60.999 seconds
Resolution	0.001 seconds

4.4.2.2 Target Information Common Field

4.4.2.2.1 DF_TargetCommonManagementInformation

Stores attribute information common to the relevant message, independent of individual targets.

(1) DE_SystemStatus

Data name	DE_SystemStatus
Definition	Indicates the status of the relevant message. If radio transmission is possible but information cannot be sent due to a system error or other reason, the data is sent as invalid. In the case of invalid data, the configuration up to this data item is applied.
Data size	8 bits
Data type	Enumerated
Allocation	0: Valid 1: Invalid

(2) DE_TargetCommonOptionFlag

Data name	DE_TargetCommonOptionFlag
Definition	In the case where there is attribute information dependent on the application (use case), set the relevant option flag bit to 1 and store the relevant information in the DF_TargetCommonOptionField in the order in which it was validated. In these Guideline, only sensor attribute information is defined, and other options can be added arbitrarily according to the particulars of the experiment. Also, the extended option flag is set to 0 under these Guideline.
Data size	8 bits
Data type	Bit string
Allocation	[0]: Sensor attribute information [1] to [6]: Undefined [7]: Whether there is an extended option flag

4.4.2.2.2 DF_TargetCommonOption Field/DF_TargetCommonOptionInformation

Assuming that the required data length is different for each option, the data length is stored in DE_TargetCommonOptionSize and the relevant information Is stored in DF_TargetCommonOptionInformation. Since the required information depends on the application (use case) and system configuration of the experiment target, in these Guideline, sensor attribute information is defined as one of the target common option information items, and the other optional information can be added arbitrarily according to the particulars of the experiment.

(1) DE_TargetCommonOptionSize

Data name	DE_TargetCommonOptionSize
Definition	This item indicates the size of the following

	DF_TargetCommonOptionInformation in number of bytes.
Data size	8 bits
Data type	Unsigned integer
Expression range	1 to 255
Resolution	1

4.4.2.2.3 Sensor-Related Information/DF_SensorIndividualAttributeInformationField

(1) DE_SensorsNumber

Data name	DE_SensorsNumber
Definition	If it is desirable to transmit target information separately for each sensor, such as when the target detection results from multiple sensors are integrated and some of the attribute information differs for each sensor, this item should be set to a value of 2 or more. If it is not necessary to distinguish among the sensors, this item may be set to 1 regardless of the actual device configuration.
Data size	8 bits
Data type	Unsigned integer
Expression range	1 to 7
Resolution	1

(2) DE_SensorIndividualAttributeInformationSize

Data name	DE_ SensorIndividualAttributeInformationSize
Definition	This item indicates the size of the following DF_SensorIndividualAttributeInformation in number of bytes.
Data size	8 bits
Data type	Unsigned integer
Expression range	1 – TBD
Resolution	1

4.4.2.2.4 DF_SensorIndividualAttributeInformation

Information relating to sensors is stored, but since it depends on the use case and system configuration of the subject of the experiment, it is assumed to be defined as necessary at the time of the experiment. Here, an example of optional information assuming the configuration in which roadside sensors are used to detect targets is indicated.

(1) DE_SensorIdentificationID

Data name	DE_SensorIdentificationID
Definition	An ID identifying roadside sensors. Optional under these Guideline.
Data size	24 bits
Data type	Unsigned integer
Expression range	1 to
Resolution	1

(2) DE_SensorOperatingCategoryCode

Data name	DE_SensorOperatingCategoryCode
Definition	The operating status of a roadside sensor. Set to “0” when equipment is being adjusted. In this case, the content and consistency of the provided data are not guaranteed.
Data size	1 bit
Data type	Enumerated
Allocation	0: Being adjusted 1: In operation

(3) DE_SensorOperatingStatus

Data name	DE_SensorOperatingStatus
Definition	Indicates whether a roadside sensor is operating normally. If targets cannot be detected due to an abnormality, the sensor attribute information items, number of targets, and target individual information described below do not exist.
Data size	15 bits
Data type	Enumerated
Allocation	0: Normal Other than 0: Abnormal

4.4.2.3 Target Information Individual Field

A field for storing individual information (position, speed, etc.) for each target.

(1) DE_TargetsNumber

Data name	DE_TargetsNumber
Definition	The number of targets included in the target information field for each sensor.
Data size	8 bits
Data type	Unsigned integer
Expression range	0 – TBD

Resolution	1

4.4.2.4 Target Individual Information

4.4.2.4.1 DF_TargetIndividualManagementInformation

Basic management information relating to target individual information. This corresponds to common field management information under RC-013, but in the case of this message, some data elements are reserved or have independent defined values.

(1) DE_CommonServiceStandardID(TargetIndividualField)

Data name	DE_CommonServiceStandardID(TargetIndividualField)
Definition	Corresponds to DE_CommonServiceStandardID under RC-013, but it is not anticipated that receivers will use it for any type of processing. In cases where roadside sensors are also present, set this item to 0 and then transmit to RSUs.
Data size	3 bits
Data type	Enumerated
Allocation	See RC-013 However, in the case of a target detected only by roadside sensors, set to 0.

(2) DE_TargetMessageID

Data name	DE_TargetMessageID
Definition	Corresponds to DE_MessageID under RC-013.
Data size	2 bits
Data type	Enumerated
Allocation	0: Reserved 1: Basic message 2 to 3: Reserved

(3) DE_TargetIndividualVersionInformation

Data name	DE_TargetIndividualVersionInformation
Definition	Corresponds to DE_Version under RC-013.
Data size	3 bits
Data type	Enumerated
Allocation	0: Reserved 1: Version 1 2 to 7: Reserved

(4) DE_TargetID

Data name	DE_TargetID
Definition	ID information assigned by a RSU to identify whether the target is the same target as at the time of the previous transmission. The details of the ID assignment method during supplementary and integration processing are optional under these experimental Guideline, and it is assumed that they will be determined as necessary for each experiment.
Data size	32 bits
Data type	Unsigned integer
Expression range	0 to 4,294,967,295
Resolution	1

(5) DE_IndividualIncrementCounter

Data name	DE_IndividualIncrementCounter
Definition	A number indicating the data transmission order. The counter increments by one each time a transmission is sent to the same target ID. After reaching 255, the counter returns to 0. The details of the assignment method during supplementary and integration processing are optional under these experimental Guideline, and it is assumed that they will be determined along with DE-TargetID as necessary for each experiment.
Data size	8 bits
Data type	Unsigned integer
Expression range	0 to 255
Resolution	1

(6) DE_DataLength

Data name	DE_DataLength
Definition	The size of the target individual information excluding the target individual extended field expressed in bytes.
Data size	8 bits
Data type	Unsigned integer
Expression range	0 to 255
Resolution	1

(7) DE_IndividualOptionFlag

Data name	DE_IndividualOptionFlag

Definition	Corresponds to DE_OptionFlag under RC-013, but in these Guideline, “free field” is replaced by “target individual extended field.”
Data size	8 bits
Data type	Bit string
Allocation	[0] to [6]: Same as RC-013 [7]: Whether there is a target individual extended field

4.4.2.4.2 DF_GenerationTimeInformation

Indicates the time (in hours, minutes, and seconds in units of milliseconds) that the relevant target was present. In cases where the RSU performs supplementary processing, the assumed time delay during that period is qualitatively taken into account. If a roadside sensor detects a target, time information is added in consideration of the delay time qualitatively assumed for the detection process.

The constituent data elements are the same as those described in 4.4.2.1.2 DF_TransmissionTimeInformation.

4.4.2.4.3 DF_TargetPositionInformation

Target location information and its confidence. The information has the same structure and definition as the position information under RC-013. In the case of data elements for which such information cannot be obtained or that the RSU cannot supplement, an indefinite value is stored. Refer to RC-013 for the definitions of the data elements.

4.4.2.4.4 DF_TargetStatusInformation

Information on target status such as speed and heading. The information has the same structure and definition as the vehicle status information under RC-013. In the case of data elements for which such information is not present or cannot be obtained or that the RSU cannot supplement, an indefinite value is stored. Refer to RC-013 for the definitions of the data elements.

4.4.2.4.5 DF_TargetAttributeInformation

Information on target type and size. The information has the same structure and definition as the vehicle attribute information under RC-013. In the case of data elements for which such information is not present or cannot be obtained or that the RSU cannot supplement, an indefinite value is stored. Refer to RC-013 for the definitions of the data elements.

4.4.2.4.6 DF_IndividualExtendedFieldManagementInformation

Corresponds to the free field management information under RC-013. Basic management information is stored for the individual extended data of bicycles, pedestrians, and so on.

(1) DE_IndividualExtendedFieldHeaderLength

Data name	DE_IndividualExtendedFieldHeaderLength
Definition	The data size of the individual extended field excluding the individual extended data expressed in bytes. Corresponds to DE_IndividualAppHeaderLength under RC-013.
Data size	5 bits
Data type	Unsigned integer
Expression range	4 to 22 bytes
Resolution	1 byte

(2) DE_IndividualExtendedDataNumber

Data name	DE_IndividualExtendedDataNumber
Definition	The number of individual extended data stored in the individual extended data field. Corresponds to DE_NumberOfIndividualAppData under RC-013.
Data size	3 bits
Data type	Unsigned integer
Expression range	1 to 7
Resolution	1

4.4.2.4.7 DF_IndividualExtendedDataManagementInformation

Corresponds to the individual app data management information set under RC-013. Consolidates DF_IndividualExntendedDataManagementInformation.

(1) DE_IndividualServiceStandardID

Data name	DE_IndividualServiceStandardID(TargetIndividualField)
Definition	Corresponds to IndividualServiceStandardID under RC-013. Optional under these Guideline.
Data size	8 bits

(2) DE_IndividualExtendedDataHeaderAddress

Data name	DE_IndividualExtendedDataHeaderAddress

Definition	Indicates in bytes the starting storage location of the individual extended data with the individual extended data field header set to 0. Corresponds to DE_IndividualAppDataAddress under RC-013.
Data size	8 bits
Data type	Unsigned integer
Expression range	0 to 59th byte
Resolution	1 byte

(3) DE_IndividualExtendedDataLength

Data name	DE_IndividualExtendedDataLength
Definition	Indicates in bytes the data size of the individual extended data. Corresponds to DE_IndividualAppDataLength under RC-013.
Data size	8 bits
Data type	Unsigned integer
Expression range	1 to 60 bytes
Resolution	1 byte

4.4.2.5 Individual Extended Data

Corresponds to individual app data to under RC-013. After storing the message in the free field of the message specification for bicycles and pedestrians specified in Chapter 3 some items are edited by the RSU. However, in Chapter 3 only the data elements common to bicycles and pedestrians are required, and the presence or absence of other data elements may be arbitrarily determined for each experiment.

4.4.2.5.1 Bicycle and Pedestrian Individual Extended Data Message Structure

The message structure is indicated in Table 4-8.

Table 4-8. Individual Extended Data Message Structure (in the Case of Bicycle and Pedestrian Use)

Structure DF/DE	Size	Remarks
DF_TargetIndividualExtendedData(TargetCommon)		
DE_TargetLevelInformation	3 bits	
DE_Supplementation/IntegrationExistence Information	2 bits	A field for storing system delay times for bicycle and pedestrian messages, but these items are edited by the RSU.
DE_IntegrationSupplementationInformation	3 bits	
DF_IndividualAppData(BicycleBasicApplications)		Arbitrarily stored in cases where information received from a bicycle is transmitted by a RSU. If the information is not stored, it is not included in the message structure.
DE_AssistType	4 bits	
DE_BicycleType	4 bits	
DE_AssistStatus	2 bits	
DE_PedalingStatus	2 bits	
DE_BicycleDriveForce	8 bits	
DE_Collision/FallDetection	4 bits	

4.4.2.5.2 Data Elements

Refer to Chapter 3 for data elements not described here.

(1) DE_TargetLevelInformation

Data name	DE_TargetLevelInformation
Definition	Indicates the stored target information level (see 2.5.2).
Data size	3 bits
Data type	Unsigned integer
Expression range	1 to 5
Resolution	1

(2) DE_Supplementation/IntegrationExistenceInformation

Data name	DE_Supplementation /IntegrationExistenceInformation
Definition	Indicates whether the RSU performed supplementation or integration processing.
Data size	2 bits
Data type	Enumerated
Allocation	00: No supplementation or integration processing 01: Supplementation processing 10: Integration processing 11: Unspecified

(3) DE_IntegrationSupplementationInformation

Data name	DE_IntegrationSupplementationInformation
Definition	Indicates the source of the original target information when a RSU performs integration processing. If integration is not performed, all of this information is set to 0.
Data size	3 bits
Data type	Bit string
Allocation	[0]: Information received from the target was integrated [1]: Information received from multiple roadside sensors was integrated [2]: Reserved

4.5 Transmission Message Specifications under These Guideline (CSMA RSUs)

4.5.1 Message Structure

The CSMA RSU transmission message structure is shown in Table 4-9. The message structure comprises the CSMA RSU header field at the beginning and the CSMA RSU target field. The CSMA RSU header field stores information for identifying the service standard and the message. The CSMA RSU target field stores target information detected by the RSU, and the fields are increased from 1 to a maximum of five in order according to the number of targets detected. If the RSU does not detect a target, only the CSMA RSU header field is transmitted, without the CSMA RSU target field.

Table 4-9. CSMA RSU Transmission Message Structure

Data Structure	Stored DF	Size	Remarks
CSMA RSU Header Field	DF_CSMARoadsideUnitHeaderInformation	20 bytes	
CSMA RSU Target Field 1	DF_CSMARoadsideUnitTargetInformation	0 or 16 bytes	Add up to a maximum of five fields according to the number of targets detected.
CSMA RSU Target Field 2	DF_CSMARoadsideUnitTargetInformation	0 or 16 bytes	
CSMA RSU Target Field 3	DF_CSMARoadsideUnitTargetInformation	0 or 16 bytes	
CSMA RSU Target Field 4	DF_CSMARoadsideUnitTargetInformation	0 or 16 bytes	
CSMA RSU Target Field 5	DF_CSMARoadsideUnitTargetInformation	0 or 16 bytes	
		Total 20 to 100 bytes	

4.5.2 Data Frames

4.5.2.1 DF_CSMARoadsideUnitHeaderInformation

The structure of DF_CSMARoadsideUnitHeaderInformation is shown in Table 4-10.

Table 4-10. DF_CSMARoadsideUnitHeaderInformation Structure

Data Frame/Data Element		Size	Remarks
DF_CSMARoadsideUnitHeaderInformation		160 bits	
	DE_CommonServiceStandardID	3 bits	
	DE_OperatingCategoryCode	1 bit	
	DE_RoadsideMessageVersion	4 bits	
	DE_IncrementCounter	8 bits	
	DE_RoadsideMessageID	16 bits	
	DE_RoadsideUnitID	32 bits	
	DE_IntersectionID	32 bits	
	DF_TransmissionTimeInformation	32 bits	
	DE_MessageSize	16 bits	
	DE_Reserved(16 bits)	16 bits	

4.5.2.2 DF_TransmissionTimeInformation

The structure of DF_TransmissionTimeInformation is shown in Table 4-11.

Table 4-11. DF_TransmissionTimeInformation Structure

Data Frame/Data Element		Size	Remarks
DF_TransmissionTimeInformation		32 bits	
	DE_LeapSecondCorrectionInformation	1 bit	
	DE_Time(Hours)	7 bits	UTC “hours” + 9
	DE_Time(Minutes)	8 bits	UTC “minutes”
	DE_Time(Seconds)	16 bits	UTC “milliseconds”

4.5.2.3 DF_CSMARoadsideUnitTargetInformation

The structure of DF_CSMARoadsideUnitTargetInformation is shown in Table 4-12.

Table 4-12. DF_CSMARoadsideUnitTargetInformation Structure

Data Frame/Data Element		Size	Remarks
DF_CSMARoadsideUnitTargetInformation		128 bits	
	DE_TargetID_light	8 bits	
	DF_PositionInformation_light	64 bits	
	DF_StatusInformation_light	48 bits	
	DF_TragetAttributeInformation_light	8 bits	

4.5.2.4 DF_PositionInformation_light

The structure of DF_PositionInformation_light is shown in Table 4-13.

Table 4-13. DF_PositionInformation_light Structure

Data Frame/Data Element		Size	Remarks
DF_PositionInformation_light		64 bits	
	DE_Latitude	32 bits	
	DE_Longitude	32 bits	

4.5.2.5 DF_StatusInformation_light

The structure of DF_StatusInformation_light is shown in Table 4-14.

Table 4-14. DF_StatusInformation_light Structure

Data Frame/Data Element		Size	Remarks
DF_StatusInformation_light		48 bits	
	DE_Speed	16 bits	
	DE_Heading	16 bits	
	DE_Acceleration	16 bits	

4.5.2.6 DF_TargetAttributeInformation_light

The structure of DF_TargetAttributeInformation_light is shown in Table 4-15.

Table 4-15. DF_TargetAttributeInformation_light Structure

Data Frame/Data Element		Size	Remarks
DF_TargetAttributeInformation_light		8 bits	
	DE_TargetType	4 bits	
	DE_TargetSize	4 bits	

4.5.3 Data Elements

See 4.4.2 for information on data elements defined in common with the standard RSU header field in DF-CSMARoadsideUnitHeaderInformation.

(1) DE_IntersectionID

Data name	DE_IntersectionID
Definition	ID information for identifying an intersection within the target detection range of a RSU.
Data size	32 bits
Data type	Unsigned integer
Expression range	0 to 4,294,967,295
Resolution	1

(2) DE_TargetID_light

Data name	DE_TargetID_light
Definition	ID information for identifying a target.
Data size	8 bits
Data type	Unsigned integer
Expression range	0 to 255
Resolution	1

(3) DE_Latitude

Data name	DE_Latitude
Definition	Location latitude information. The geodetic system is WGS84 (or equivalent). Positive values indicate north latitude and negative values indicate south latitude. If unspecified, set to -2147483648 (0x80000000).
Data size	32 bits
Data type	Integer
Expression range	-90 to 90 deg.
Resolution	0.0000001 deg.

(4) DE_Longitude

Data name	DE_Longitude
Definition	Location longitude information. The geodetic system is WGS84 (or equivalent). Positive values indicate east longitude and negative values indicate west longitude. If unspecified, set to -2147483648 (0x80000000).
Data size	32 bits
Data type	Integer
Expression range	-180 to 180 deg.
Resolution	0.0000001 deg.

(5) DE_Speed

Data name	DE_Speed
Definition	Speed information for the target. If unspecified, set to 65535 (0xFFFF).
Data size	16 bits
Data type	Unsigned integer
Expression range	0 to 163.83 m/s
Resolution	0.01 m/s

(5) DE_Heading

Data name	DE_Heading
Definition	Heading information for the target. North is 0 degrees, and angles values are set in a clockwise direction. If unspecified, set to 65535 (0xFFFF).
Data size	16 bits
Data type	Unsigned integer
Expression range	0 to 359.9875 deg.
Resolution	0.0125 deg.

(6) DE_Acceleration

Data name	DE_Acceleration
Definition	Acceleration information for the target. If unspecified, set to -32768 (0x8000).
Data size	16 bits
Data type	Integer
Expression range	-20 to 20 m/s^2
Resolution	0.01 m/s^2

(7) DE_TargetType

Data name	DE_TargetType
Definition	Type information for the target
Data size	4 bits
Data type	Enumerated
Allocation	0: Large vehicle (including large specialized vehicles) 1: Medium vehicle 2: Ordinary vehicle (including small specialized vehicles and mini-vehicles (four-wheeled)) 3: Motorcycle (including large motorcycles and motorized bicycles) 4: Bicycle 5: Light vehicle other than bicycle (cart, rickshaw, etc.) 6: Pedestrian (including wheelchairs, scooters, etc.) 7: Street car 8 to 14: Reserved 15: Other, unknown

(8) DE_TargetSize

Data name	DE_TargetSize
Definition	Width information for the target. If less than 0.5 m set to 0 (0x0), if 7 m or more set to 14 (0xE), and if unspecified, set to 15 (0xF).
Data size	4 bits
Data type	Unsigned integer
Expression range	0 to 7 m
Resolution	0.5 m

Appendix 1. System Time Delay Definition

As discussed in Section 2.5, in cases where bicycle or pedestrian transmission information is level 4 or lower, the message does not contain the information generation time. For this reason, the RSU estimates and assigns the information generation time based on the system delay time received from the bicycle or pedestrian (message supplementation).

System delay time is defined as the steady-state delay time required from data generation by the bicycle or pedestrian device to transmission.

The RSU estimates the time of information generation by subtracting the total system delay and RSU processing delay from the time it receives the bicycle or pedestrian transmission information. However, the RSU processing delay may be ignored if it is sufficiently small compared to the total delay. Figure A1-1 shows a conceptual diagram.

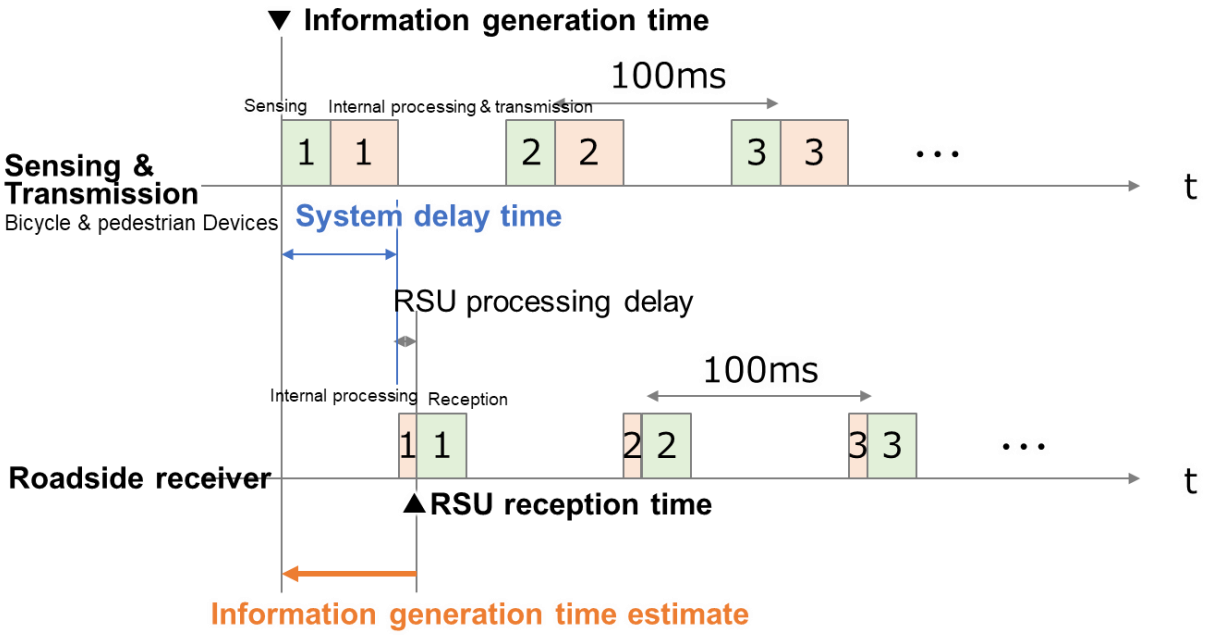


Figure A1-1. Conceptual Diagram of System Delay Time and Information Generation Time Estimation

Appendix 2. Additional Explanation concerning Supplementary and Integration Processing

1 Supplementary Processing

Table A2-1 and A2-2 show the details of supplementary processing by RSUs organized by the level of a bicycle or pedestrian transmission information. DF_GenerationTimeInformation is estimated and provided based on the internal time and system delay of the RSU at level 4 or below. At level 1, the system delay time is not included in the bicycle or pedestrian transmission information, and therefore, the RSU estimates the delay time based on the specified value for the system delay time that it has. DF_TargetPositionInformation and DF_TargetStatusInformation are given when the wireless positioning technology is implemented on the RSU at level 3 or lower. Target level information is updated according to the supplemented items. If all items are supplemented, the level is 5.

Table A2-1. Supplementary Processing (When the RSU Is Equipped with Wireless Positioning Technology)

			Bicycle/Pedestrian Transmission Information					Information Held by RSU	After Supplementation Processing				
	Data Frame	Data Element	Level 1	Level 2	Level 3	Level 4	Level 5		Former Level 1	Former Level 2	Former Level 3	Former Level 4	Former Level 5
Target Individual Information	DF_TargetIndividualManagementInformation	Common Service Standard ID	○	○	○	○	○	-	○	○	○	○	○
		Target Message ID	○	○	○	○	○	-	○	○	○	○	○
		Target Individual Version Information	○	○	○	○	○	-	○	○	○	○	○
		Target ID	○	○	○	○	○	-	○	○	○	○	○
		Increment Counter	○	○	○	○	○	-	○	○	○	○	○
		Data Length	○	○	○	○	○	-	○	○	○	○	○
		Individual Option Flag	○	○	○	○	○	-	○	○	○	○	○
	DF_GenerationTimeInformation		-	-	-	-	Generation Time Information	RSU Internal Time	Estimated Default Value	Estimated System Delay Time	Estimated System Delay Time	Estimated System Delay Time	Generation Time Information
	DF_TargetPositionInformation	Latitude	-	-	-	○	○	○	○	○	○	○	○
		Longitude	-	-	-	○	○	○	○	○	○	○	○
		Elevation	-	-	-	Optional	Optional	Optional	Optional	Optional	Optional	Optional	Optional
		Position Confidence	-	-	-	○	○	○	○	○	○	○	○
		Elevation Confidence	-	-	-	Optional	Optional	Optional	Optional	Optional	Optional	Optional	Optional
	DF_TargetStatus Information	Speed	-	○	○	○	○	○	○	○	○	○	○
		Heading	-	-	○	○	○	○	○	○	○	○	○
		Acceleration	-	○	○	○	○	○	○	○	○	○	○
		Vehicle Speed Confidence	-	○	○	○	○	○	○	○	○	○	○
		Vehicle Heading Confidence	-	-	○	○	○	○	○	○	○	○	○
		Acceleration Confidence	-	○	○	○	○	○	○	○	○	○	○
		Transmission State	-	-	Optional	Optional	Optional	-	Optional	Optional	Optional	Optional	Optional
		Steering Wheel Angle	-	-	Optional	Optional	Optional	-	Optional	Optional	Optional	Optional	Optional
	DF_TargetAttribute Information	Size Classification	○	○	○	○	○	-	○	○	○	○	○
		Role Classification	○	○	○	○	○	-	○	○	○	○	○
		Vehicle Width	Optional	Optional	Optional	Optional	Optional	-	Optional	Optional	Optional	Optional	Optional
		Vehicle Length	Optional	Optional	Optional	Optional	Optional	-	Optional	Optional	Optional	Optional	Optional
Target Individual Extended Field	DF_TargetIndividualExtendedData(CommonToBicyclesAndPedestrians)	Target Level Information	1	2	3	4	5	Level Assessment	5	5	5	5	5
		System Delay Time	-	○	○	○	Unnecessary	Specified Value	-	○	○	○	○
		Monitoring Data	Optional	Optional	Optional	Optional	Optional	-	Optional	Optional	Optional	Optional	Optional

Table A2-2. Supplementary Processing (When the RSU Is Not Equipped with Wireless Positioning Technology)

			Bicycle/Pedestrian Transmission Information					Information Held by RSU	After Supplementation Processing				
	Data Frame	Data Element	Level 1	Level 2	Level 3	Level 4	Level 5		Former Level 1	Former Level 2	Former Level 3	Former Level 4	Former Level 5
Target Individual Information	DF_TargetIndividualManagementInformation	Common Service Standard ID	○	○	○	○	○	-	○	○	○	○	○
		Target Message ID	○	○	○	○	○	-	○	○	○	○	○
		Target Individual Version Information	○	○	○	○	○	-	○	○	○	○	○
		Target ID	○	○	○	○	○	-	○	○	○	○	○
		Increment Counter	○	○	○	○	○	-	○	○	○	○	○
		Data Length	○	○	○	○	○	-	○	○	○	○	○
		Individual Option Flag	○	○	○	○	○	-	○	○	○	○	○
	DF_GenerationTimeInformation		-	-	-	-	Generation Time Information	RSU Internal Time	Estimated Default Value	Estimated System Delay Time	Estimated System Delay Time	Estimated System Delay Time	Generation Time Information
	DF_TargetPositionInformation	Latitude	-	-	-	○	○	-	-	-	-	○	○
		Longitude	-	-	-	○	○	-	-	-	-	○	○
		Elevation	-	-	-	Optional	Optional	-	-	-	-	Optional	Optional
		Position Confidence	-	-	-	○	○	-	-	-	-	○	○
		Elevation Confidence	-	-	-	Optional	Optional	-	-	-	-	Optional	Optional
	DF_TargetStatus Information	Speed	-	○	○	○	○	-	-	○	○	○	○
		Heading	-	-	○	○	○	-	-	-	○	○	○
		Acceleration	-	○	○	○	○	-	-	○	○	○	○
		Vehicle Speed Confidence	-	○	○	○	○	-	-	○	○	○	○
		Vehicle Heading Confidence	-	-	○	○	○	-	-	-	○	○	○
		Acceleration Confidence	-	○	○	○	○	-	-	○	○	○	○
		Transmission State	-	-	Optional	Optional	Optional	-	Optional	Optional	Optional	Optional	Optional
		Steering Wheel Angle	-	-	Optional	Optional	Optional	-	Optional	Optional	Optional	Optional	Optional
	DF_TargetAttribute Information	Size Classification	○	○	○	○	○	-	○	○	○	○	○
		Role Classification	○	○	○	○	○	-	○	○	○	○	○
		Vehicle Width	Optional	Optional	Optional	Optional	Optional	-	Optional	Optional	Optional	Optional	Optional
		Vehicle Length	Optional	Optional	Optional	Optional	Optional	-	Optional	Optional	Optional	Optional	Optional
Target Individual Extended Field	DF_TargetIndividual ExtendedData(CommonToBicyclesAndPedestrians)	Target Level Information	1	2	3	4	5	Level Assessment	1	2	3	5	5
		System Delay Time	-	○	○	○	Unnecessary	Specified Value	-	○	○	○	○
		Monitoring Data	Optional	Optional	Optional	Optional	Optional	-	Optional	Optional	Optional	Optional	Optional

2 Integration Processing

Table A2-3 shows that the data elements and integration policies that are subject to integration processing by RSUs. As described in Section 2.5.4, because the integration process for target information involves identification processing, it targets bicycle and pedestrian transmission information at level 4 and higher, which includes location information and so on necessary for target identification. However, because level for bicycle and pedestrian transmission information becomes level 5 through the supplementation process discussed above, only level 5 information is actually targeted.

The integration process selects and discards information from bicycles, pedestrians, or vehicles (omitted in Table A2-3) and sensors so that more valid information remains for each data element. The respective integration policies are as follows.

- Target individual management information

  Parent information sources are selected according to the purposes of the experiment.

- Generation time information, target position information, target status information (excluding transmission state and steering wheel angle)

  It is desirable to select the most accurate information based on the accuracy information of the target

position information and target status information (e.g., target position confidence).

- Bicycle or pedestrian-specific data such as transmission state, steering wheel angle, and target attribute information

  It is desirable to select information transmitted by bicycles and pedestrians.

Table A2-3 Integration Processing

	Data Frame	Data Element	Bicycle/Pedestrian After Supplementation Processing	Sensor	After Integration Processing	
					Content	Integration Policy
Target Individual Information	DF_TargetIndividualManagementInformation	Common Service Standard ID	○	○	○	Select parent information sources according to the purposes of the experiment
		Target Message ID	○	○	○	
		Target Individual Version Information	○	○	○	
		Target ID	○	○	○	
		Increment Counter	○	○	○	
		Data Length	○	○	○	
		Individual Option Flag	○	○	○	
	DF_GenerationTimeInformation		○	○	○	It is desirable to select the most accurate information
	DF_TargetPositionInformation	Latitude	○	○	○	
		Longitude	○	○	○	
		Elevation	Optional	Optional	○	
		Position Confidence	○	○	○	
		Elevation Confidence	Optional	Optional	○	
	DF_TargetStatusInformation	Speed	○	○	○	
		Heading	○	○	○	
		Acceleration	○	○	○	
		Vehicle Speed Confidence	○	○	○	
		Vehicle Heading Confidence	○	○	○	
		Acceleration Confidence	○	○	○	
		Transmission State	Optional	-	Optional	Bicycle
		Steering Wheel Angle	Optional	-	Optional	
	DF_TargetAttributeInformation	Size Classification	○	Optional	○	Bicycle/Pedestrian
		Role Classification	○	Optional	○	
		Vehicle Width	Optional	Optional	Optional	
		Vehicle Length	Optional	Optional	Optional	
Target Individual Extended Field	DF_TargetIndividualExtendedData(CommonToBicyclesAndPedestrians)	Target Level Information	5	-	5	-
		Supplementation/Integration Information	01/00	-	10	-
		Integrated Supplementary Information	0	-	1	-