ENGLISH TRANSLATION

700 MHz BAND INTELLIGENT TRANSPORT SYSTEMS — TEST ITEMS AND CONDITIONS FOR MOBILE STATION INTEROPERABILITY VERIFICATION

GUIDELINE

ITS FORUM RC-011 Ver. 1.0

Established on May 31, 2012

ITS Info-communications Forum

of Japan

General Notes to the English Translation of ITS Info-communications Forum Guidelines

1. Notes on Copyright

- The copyright of this document is ascribed to the ITS Info-communications Forum of Japan.

2. Notes on English Translation

- ITS Info-communications Forum Guidelines are usually written in Japanese. This document is a translation into English of the original document for the purpose of convenience of users. If there are any discrepancies in the content, expressions, etc. between the original document and this translated document, the original document shall prevail.

- ITS Info-communications Forum Guidelines, in the original language, are made publicly available through web posting. The original document of this translation may have been further revised and therefore users are encouraged to check the latest version at an appropriate page under the following URL:
http://www.itsforum.gr.jp/Public/Eguideline/index.html.

700 MHz BAND INTELLIGENT TRANSPORT SYSTEMS — TEST ITEMS AND CONDITIONS FOR MOBILE STATION INTEROPERABILITY VERIFICATION

GUIDELINE

ITS FORUM RC-011 Ver. 1.0

Established on May 31, 2012

ITS Info-communications Forum

of Japan

Revision History

Ver.	Date	Chapter/Section	Reason	Revised Content
1.0	May 31, 2012	Establishment	Newly established	

[Blank]

Introduction

This Guideline applies to the "700 MHz Band Intelligent Transport Systems Standard ARIB STD-T109" (hereinafter referred to as "the Standard"). It describes how to verify the connectivity, security, and interoperability of land mobile stations for systems using the Standard. The Guideline covers test items, procedures, and specifications of testing equipment. The Guideline is intended to ensure interoperability of land mobile radio stations (hereinafter referred to as "mobile stations") implementing the Standard, and to promote the spread of 700 MHz band intelligent transport systems.

(1) Background

Since 2009, the Committee for the Realization of Driver Assistance Communications Systems has been placing a major focus on the 700 MHz band for the implementation of a driver assistance communications system, and has been exploring topics such as interoperability, operations management, and security.

(2) Purpose

This Guideline is intended to prevent a situation where different manufacturers of mobile stations interpret the Standard differently, leading to a failure to connect. For this purpose, the Guideline describes how to check the basic communication characteristics of mobile stations to verify connectivity between mobile stations from different manufacturers, and to make sure that a given level of performance is provided.

[Blank]

Interoperability Verification Guideline

Contents

[Blank]

Chapter 1 General Descriptions

1.1 Overview

Comfirming connectivity to land mobile station compliant with "700 MHz Band Intelligent Transport Systems Standard ARIB STD-T109" (hereinafter referred to as the "Standard") can be checked by testing the items listed in the ARIB Technical Report "700 MHz Band Intelligent Transport Systems Test Items and Conditions for Mobile Station Compatibility Confirmation ARIB TR-T20" (hereinafter referred to as "Technical Report"). However, it is important to check not only for connectivity to testing equipment but also for interoperability between mobile stations from different manufacturers.

Chapter 2 of this Guideline deals with test items that are not listed in the Technical Report but for which is desirable to perform practical testing. The chapter describes the connectivity verification items along with suitable test procedures. Chapter 3 describes security related test items and procedures, which are outside the scope covered by the Standard and the Technical Report. Chapter 4 describes test items and procedures for verifying interoperability between mobile stations from different manufacturers. Chapter 5 describes the specifications of a simulator designed to be used as connectivity testing equipment.

1.2 Test implementation

This Guideline assumes that all operation testing based on the Standard has been performed by the mobile station manufacturer at the development or manufacturing stage.

The testing procedures described in this Guideline are designed to be able to be performed in a general testing environment, so that no special demands are placed on the testing entity or the manufacturer with regard to environmental conditions or special functions for the mobile station.

1.3 Normative references

Items not specifically described in this Guideline are to be dealt with in accordance with the following standards. The version to use unless otherwise specified is the latest version.

ARIB STD-T109	700 MHz Band Intelligent Transport Systems Standard
ARIB TR-T20	700 MHz Band Intelligent Transport Systems Test Items and

1.4 Items not covered in the Guideline

Numeric values or parameters not given in this Guideline are to be decided by the body responsible for system operation (hereinafter referred to as "operation management organization"). Specifics are provided in Annex A.

1.5 Notation for numerals

This Guideline uses an appended "h" to denote hexadecimal numbers (i.e. "00h"), "b" to denote binary numbers (i.e. "00b"), and no indication for decimal numbers (i.e. "0").

Chapter 2 Connectivity Verification Test

2.1 Purpose of connectivity verification test

The purpose of testing the connectivity of mobile stations is to verify that the manufacturer of the mobile station is meeting the specification requirements for mobile stations given in the Standard. To fulfill this purpose, two types of tests are required. 1: Using a connectivity measurement setup (measuring equipment and simulator), the mobile station is to be tested to establish that it meets the requirements laid down in the above Standard. 2: Interoperability with mobile stations from other manufacturers is to be tested.

This chapter describes the procedures for item 1. Item 2 is dealt with in Chapter 4 "Interoperability Verification Test".

2.2 Preconditions

The connectivity verification test is to be implemented by the manufacturer of the mobile station on its own initiative. The test procedure, items, and test content are to be based on the Technical Report which is to be used as reference.

The current chapter provides supplementary information to the Technical Report.

2.3 Configuration for connectivity verification test

2.3.1 Test configuration of technical condition for radio equipment

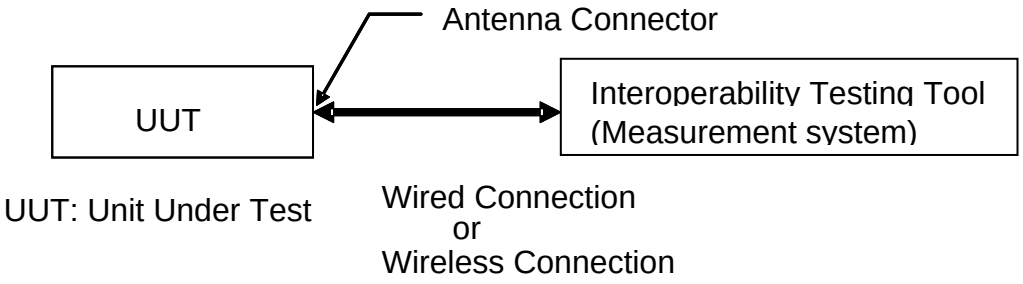


Fig. 2-1 Test Configuration of Technical Condition for Radio Equipment

2.3.2 Test configuration of physical layer

Identical to test configuration of technical condition for radio equipment described in section 2.3.1.

2.3.3 Test configuration of communication control system

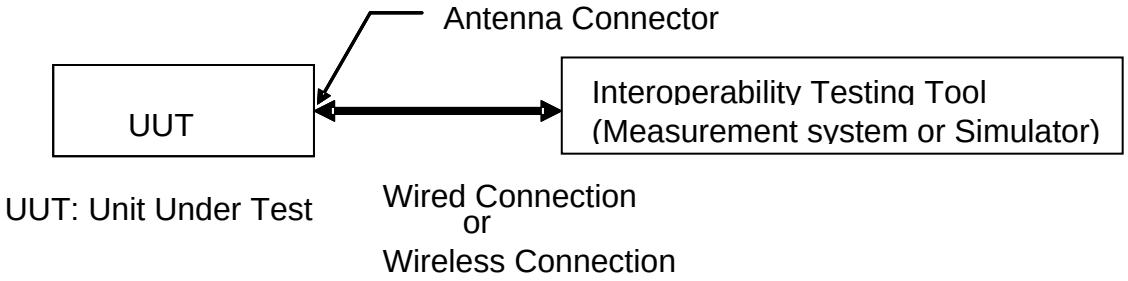


Fig. 2-2 Test Configuration of Communication Control System

2.4 Test items for connectivity verification test

Test items in this chapter are numbered using the following format: TR X-X-X.

2.4.1 Test items of technical condition for radio equipment

Table 2-1 Test Items of Technical Condition for Radio Equipment

Test No.	Item
TR 1-1	Transmitter
TR 1-1-1	Frequency deviation
TR 1-1-2	Occupied bandwidth
TR 1-1-3	Antenna power tolerance
TR 1-1-4	Unwanted emission intensity
TR 1-1-5	Transmission data rate
TR 1-2	Receiver
TR 1-2-1	Limits of incidentally produced radiation
TR 1-3	Controller
TR 1-3-1	Interference prevention function
TR 1-3-2	Carrier sense function
TR 1-3-3	Timestamp control function

2.4.2 Test items of physical layer

Table 2-2 Test Items of Physical Layer

Test No.	Item
TR 2-1-1	Modulation accuracy
TR 2-1-2	Reception sensitivity
TR 2-1-3	Maximum input power for reception
TR 2-1-4	Blocking characteristics
TR 2-1-5	CCA sensitivity (preamble detection)
TR 2-1-6	CCA sensitivity (power detection)

2.4.3 Test items of communication control system

Table 2-3 Test Items of Communication Control System

Test No.	Item
TR 2-2	Operation principle test
TR 2-2-1	Mobile station signal reception
TR 2-2-2	CSMA send check (data rate change)
TR 2-2-3	CSMA send check (frame length change)
TR 2-2-4	CSMA send check (distributed space)
TR 2-2-5	CSMA send test (random waiting period)
TR 2-2-6	CSMA send test (latest MSDU send)
TR 2-2-7	Base station signal reception
TR 2-2-8	Synchronization information update by base station signal
TR 2-2-9	Timestamp update by base station signal
TR 2-2-10	Roadside-to-vehicle communication period information update by base station signal
TR 2-2-11	Synchronization information update by mobile station signal
TR 2-2-12	Timestamp update by mobile station signal
TR 2-2-13	Roadside-to-vehicle communication period information update by mobile station signal
TR 2-2-14	Synchronization information check by elapsed time
TR 2-2-15	Roadside-to-vehicle communication period information update by elapsed time
TR 2-2-16	Inter-vehicle and roadside-to-vehicle communication layer check
TR 2-3	Applied operation test

TR 2-3-1	Synchronization information update by base station and mobile station signal
TR 2-3-2	Timestamp update by base station and mobile station signal
TR 2-3-3	Synchronization information update by multiple mobile station signals
TR 2-3-4	Timestamp update by multiple mobile station signals
TR 2-3-5	Roadside-to-vehicle communication period information update by multiple mobile station signals

2.5 Test description for connectivity verification test

2.5.1 Test description of technical condition for radio equipment

See section 2.4.1 of Technical Report. No additions.

2.5.2 Test description of physical layer

See section 2.4.2 of Technical Report. Additional information is given for each test number below.

Test No. TR 2-1-3

Item Maximum input power for reception

Additions

[Test procedure]

4. Adjust step attenuator so that signal from vector signal generator is x dBm (power exceeding -20 dBm) at antenna terminal of UUT (Unit Under Test). (Note 1)
5. Then adjust step attenuator so that signal from vector signal generator is -20 dBm at antenna terminal of UUT, and measure packet error rate [%] with packet error rate counter.

Note 1: Value of x to be specified by operation management organization.

Test No. TR 2-1-4

Item Blocking characteristics

Additions

[Test procedure]

11. Output a modulated signal corresponding to a 12 Mbps data rate from vector signal generator 1.
12. Perform test steps 2 to 10.

Test No. TR 2-1-5

Item CCA sensitivity (preamble detection)

Additions

[Test procedure]

7. Output a modulated signal corresponding to a 12 Mbps data rate from the vector signal generator.
8. Perform test steps 2 to 6.

Test No. TR 2-1-6
Item CCA sensitivity (power detection)
Additions
[Check items]
・Verify that power checked with signal analyzer in test step 4 is not observed in test step 6.

2.5.3 Test description of communication control system

See section 2.4.3 of Technical Report. Additional information is given for each test number below.

Test No. TR 2-2-1
Item Mobile station signal reception
Additions
[Check items]
・Verify that content of simulator transmission ASDU and UUT reception ASDU matches.

Test No. TR 2-2-2
Item CSMA send check (data rate change)
Additions
[Check items]
・Verify that content of UUT transmission ASDU and simulator reception ASDU matches.

Test No. TR 2-2-6
Item CSMA send test (latest MSDU send)
Additions
[Check items]
・Verify that content of second UUT transmission ASDU and simulator reception ASDU matches.

Test No. TR 2-2-7
Item Base station signal reception
Additions
[Test conditions]
・When connectivity testing equipment is transmitting for multiple roadside-to-vehicle

communication periods, ensure that transmission is not performed outside of roadside-to-vehicle communication period.

Data rate	ASDU data length	Transmission count
12 Mbps	1500 octets (Note 3)	9 (Note 3)

Note 3: To be specified by operation management organization if secure communication is used.

[Check items]

- Verify that number of frames transmitted by connectivity testing equipment and number of frames received by the UUT matches.
- Verify that content of connectivity testing equipment transmission ASDU and UUT reception ASDU matches.

[Blank]

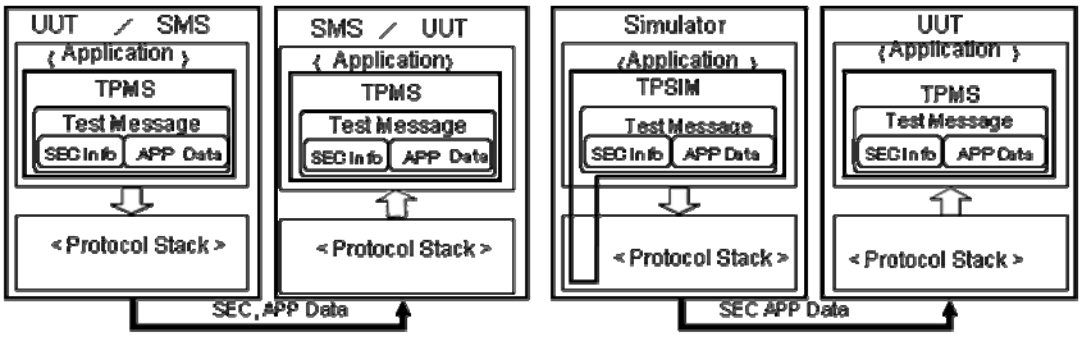
Chapter 3 Security Testing

3.1 Purpose of security testing

The security testing procedures described in this Guideline are intended to verify that the mobile station is manufactured in such a way as to allow implementation of features based on security policy specified for the 700 MHz band intelligent transport system. Detailed testing of the actual security implementation is therefore outside the scope of this Guideline.

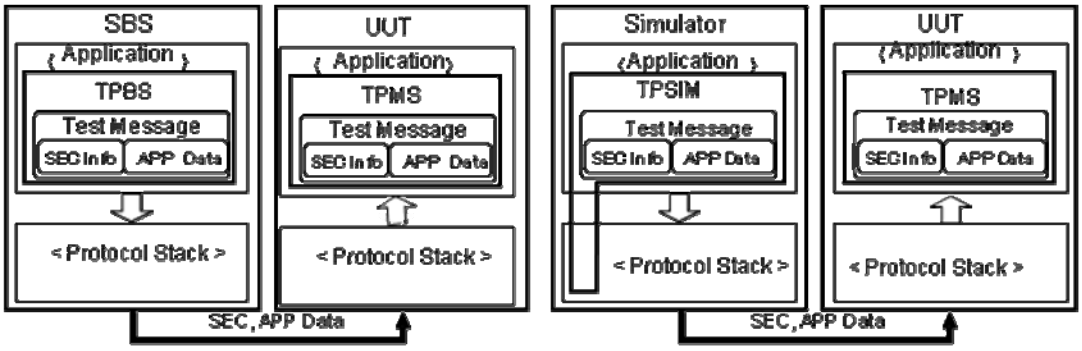
3.2 Configuration for security testing

The physical configuration for security testing is the same as the configuration described in Chapters 2 and 4. The logical configuration for security testing consists of the security test scheme for inter-vehicle communication shown in Fig. 3-1 and the security test scheme for roadside-to-vehicle communication shown in Fig. 3-2. The test program is to be installed on the UUT, standard mobile station, standard base station, and simulator, and/or any additional external equipment. "Test program" refers to a program that is able create test messages, issue instructions for transmitting and acquiring such messages, display the test results and perform result evaluation as required. Test messages consist of security parameter information, application data, and other elements necessary for performing security testing. The standard mobile station is to be produced by each respective manufacturer and must be certified by the operation management organization. The standard base station is assumed to be a licensed station for which connectivity standards have been established by the operation management organization.



SEC Info : Security Parameter Information
APP Data : Application Data
SMS : Standard Mobile Station
TPMS : Test Program for Mobile Station
TPSIM : Test Program for Simulator

Fig. 3-1 Security Test Scheme for Inter-Vehicle Communication



SEC Info : Security Parameter Information
APP Data : Application Data
TPBS : Test Program for Base Station
TPSIM : Test Program for Simulator
SBS : Standard Base Station

Fig. 3-2 Security Test Scheme for Roadside-to-Vehicle Communication

3.3 Security testing items

(1) Proposed test items for UUT

No.	Target	Tested section	Item	Details	NOTE
1	Mobile station	MS (UUT) → SMS	Inter-vehicle communication message transmission	Send short data frame (no encryption)	
				Send short data frame (with encryption)	
				Check input/output encryption function	
2	Mobile station	SMS→MS (UUT)	Inter-vehicle communication message reception	Receive short data frame (no encryption)	
				Receive short data frame (with encryption)	
				Check input/output encryption function	
3	Mobile station	SBS→ MS (UUT)	Roadside-to-vehicle communication message reception	Receive short data frame (no encryption)	
				Receive short data frame (with encryption)	
				Receive long data frame (no encryption)	
				Receive long data frame (with encryption)	
				Check input/output encryption function	
4	Mobile station	MS (UUT) → SMS	Inter-vehicle communication invalid message transmission	Check security function with input of short data outside security parameter range (no encryption)	
				Check security function with input of short data outside security parameter range (with encryption)	
5	Mobile station	MS (Sim.) → MS (UUT)	Inter-vehicle communication invalid message reception	Check security function with reception of short data with invalid frame (no encryption)	
				Check security function with reception of short data with invalid frame (with encryption)	
6	Mobile station	BS (Sim.) → MS (UUT)	Roadside-to-vehicle communication invalid message reception	Check security function with reception of short data with invalid frame (no encryption)	
				Check security function with reception of short data with invalid frame (with encryption)	
				Check security function with reception of long data with invalid frame (no encryption)	
				Check security function with reception of long data with invalid frame (with encryption)	

Note: "Short data" refers for example to a message with an ASDU length of 100 octets.
"Long data" refers for example to a message with an ASDU length of 1500 octets.

Legend

・SMS: Standard mobile station

・SBS: Standard base station

・MS (UUT): Mobile station under test

・MS (Sim.): Mobile station simulated by simulator

・BS (Sim.): Base station simulated by simulator

3.4 Security testing description

<table>
<tr><td>No.</td><td>1</td><td>Item</td><td>Inter-vehicle communication message transmission</td></tr>
<tr><td>Test outline</td><td colspan="3">Check that inter-vehicle communication message transmission is possible.</td></tr>
<tr><td>Test conditions</td><td colspan="3">UUT → Standard mobile station
With encryption/Without encryption</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. Test program for mobile station issues instruction to UUT to transmit message frame.
2. Standard mobile station receives signal output by UUT and test program for mobile station extracts message from received frame.
Test value pattern
<table>
<tr><th>Item</th><th>Test value</th></tr>
<tr><td>ASDU length</td><td>100 octets</td></tr>
<tr><td>Security parameter</td><td>Value x determined by operation management organization</td></tr>
<tr><td>Encryption</td><td>Yes/No (Note 1) (Note 2)</td></tr>
</table>
Note 1: If the UUT implements several encryption methods, the test should be performed for each method.
Note 2: The test should be performed repeatedly using several different encryption keys.</td></tr>
<tr><td>Verification item</td><td colspan="3">・ Message input to UUT and message obtained by standard mobile station must match.</td></tr>
</table>

<table>
<tr><td>No.</td><td>2</td><td>Item</td><td>Inter-vehicle communication message reception</td></tr>
<tr><td>Test outline</td><td colspan="3">Check that inter-vehicle communication message reception is possible.</td></tr>
<tr><td>Test conditions</td><td colspan="3">Standard mobile station → UUT
With encryption/Without encryption</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. Test program for mobile station issues instruction to standard mobile station to transmit message frame.
2. UUT receives signal output by standard mobile station and test program for mobile station extracts message from received frame.
Test value pattern
<table>
<tr><th>Item</th><th>Test value</th></tr>
<tr><td>ASDU length</td><td>100 octets</td></tr>
<tr><td>Security parameter</td><td>Value x determined by operation management organization</td></tr>
<tr><td>Encryption</td><td>Yes/No (Note 1)</td></tr>
</table>
Note 1: If the UUT implements several encryption methods, the test should be performed for each method.</td></tr>
<tr><td>Verification item</td><td colspan="3">・ Message input to standard mobile station and message obtained by UUT must match.</td></tr>
</table>

<table>
<tr><td>No.</td><td>3</td><td>Item</td><td>Roadside-to-vehicle communication message reception</td></tr>
<tr><td>Test outline</td><td colspan="3">Check that roadside-to-vehicle communication message reception is possible.</td></tr>
<tr><td>Test conditions</td><td colspan="3">Standard base station → UUT
With encryption/Without encryption</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. Base station test program issues instruction to standard base station to transmit message frame.
2. UUT receives signal output by standard base station and test program for mobile station extracts message from received frame.
Test value pattern
<table>
<tr><th>Item</th><th>Test value</th></tr>
<tr><td>ASDU length</td><td>100 octets / 1500 octets</td></tr>
<tr><td>Security parameter</td><td>Value x determined by operation management organization</td></tr>
<tr><td>Encryption</td><td>Yes/No (Note 1)</td></tr>
</table>
Note 1: If the UUT implements several encryption methods, the test should be performed for each method.</td></tr>
<tr><td>Verification item</td><td colspan="3">・ Message input to standard base station and message obtained by UUT must match.</td></tr>
</table>

<table>
<tr><td>No.</td><td>4</td><td>Item</td><td>Inter-vehicle communication invalid message transmission</td></tr>
<tr><td>Test outline</td><td colspan="3">Check that mobile station performs suitable error processing and operation is not interrupted when an input outsize security parameter range occurs.</td></tr>
<tr><td>Test conditions</td><td colspan="3">UUT → Standard mobile station
With encryption/Without encryption</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. Test program for mobile station issues instruction to UUT to transmit message frame with out-of-range security parameter.
2. Standard mobile station receives signal output by UUT and test program for mobile station extracts message.
3. Test program for mobile station issues instruction to UUT to transmit message frame with in-range security parameter.
4. Standard mobile station receives signal output by UUT and test program for mobile station extracts message.
Test value pattern
<table>
<tr><th>Item</th><th>Test value</th></tr>
<tr><td>ASDU length</td><td>100 octets</td></tr>
<tr><td>Security parameter</td><td>Value x determined by operation management organization</td></tr>
<tr><td>Encryption</td><td>Yes/No (Note 1)</td></tr>
</table>
Note 1: If the UUT implements several encryption methods, the test should be performed for each method.</td></tr>
<tr><td>Verification items</td><td colspan="3">・ If transmission with out-of-range security parameter is performed, standard mobile station must not receive frame. (No signal output from UUT)
・ If transmission with in-range security parameter is performed, standard mobile station must receive frame, and message input to UUT and message obtained by standard mobile station must match.</td></tr>
</table>

<table>
<tr><td>No.</td><td>5</td><td>Item</td><td>Inter-vehicle communication invalid message reception</td></tr>
<tr><td>Test outline</td><td colspan="3">Check that mobile station performs suitable error processing and operation is not interrupted when invalid frame signal occurs.</td></tr>
<tr><td>Test conditions</td><td colspan="3">Simulator → UUT
With encryption/Without encryption
・Simulator must operate as mobile station.</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. Test program for simulator issues instruction to simulator to transmit invalid message frame (frame with out-of-range data structure or frame created with out-of-range security parameter setting).
2. UUT receives signal output by simulator and test program for mobile station extracts message from received frame.
3. Test program for simulator issues instruction to simulator to transmit normal message frame.
4. UUT receives signal output by simulator and test program for mobile station extracts message from received frame.
Test value pattern
<table>
<tr><th>Item</th><th>Test value</th></tr>
<tr><td>ASDU length</td><td>100 octets</td></tr>
<tr><td>Security parameter</td><td>Value x determined by operation management organization</td></tr>
<tr><td>Encryption</td><td>Yes/No (Note 1)</td></tr>
</table>
Note 1: If the UUT implements several encryption methods, the test should be performed for each method.</td></tr>
<tr><td>Verification items</td><td colspan="3">・ UUT must not output message when invalid frame is sent. Alternatively, UUT may output an indication that an invalid message frame is processed.
・ If transmission with normal message frame is performed, UUT must receive frame, and message input to simulator and message obtained by UUT must match.</td></tr>
</table>

<table>
<tr><td>No.</td><td>6</td><td>Item</td><td>Roadside-to-vehicle communication invalid message reception</td></tr>
<tr><td>Test outline</td><td colspan="3">Check that mobile station performs suitable error processing and operation is not interrupted when invalid frame signal occurs.</td></tr>
<tr><td>Test conditions</td><td colspan="3">Simulator → UUT
With encryption/Without encryption
・ Simulator must operate as base station.</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. Test program for simulator issues instruction to simulator to transmit invalid message frame (frame with out-of-range data structure or frame created with out-of-range security parameter setting).
2. UUT receives signal output by simulator and test program for mobile station extracts message from received frame.
3. Test program for simulator issues instruction to simulator to transmit normal message frame.
4. UUT receives signal output by simulator and test program for mobile station extracts message from received frame.
Test value pattern
<table>
<tr><th>Item</th><th>Test value</th></tr>
<tr><td>ASDU length</td><td>100 octets / 1500 octets</td></tr>
<tr><td>Security parameter</td><td>Value x determined by operation management organization</td></tr>
<tr><td>Encryption</td><td>Yes/No (Note 1)</td></tr>
</table>
Note 1: If the UUT implements several encryption methods, the test should be performed for each method.</td></tr>
<tr><td>Verification items</td><td colspan="3">・ UUT must not output message when invalid frame is sent. Alternatively, UUT may output an indication that an invalid message frame is processed.
・ If transmission with normal message frame is performed, UUT must receive frame, and message input to simulator and message obtained by UUT must match.</td></tr>
</table>

3.5 Security testing procedure

When performing security testing, the following items must be as determined by the operation management organization.

(1) Security related message configuration and format

(2) Security related encryption key handling and processing method

(3) Concrete values of security related parameters

[Blank]

Chapter 4 Interoperability Verification Test

4.1 Purpose of interoperability verification test

The test is intended to prevent a situation where different manufacturers of mobile stations interpret the Standard differently, leading to a failure to connect. For this purpose, the test checks the basic communication characteristics of mobile stations to verify connectivity between mobile stations from different manufacturers, and to verify that a given level of performance is provided. Basic communication connectivity is checked with the Interoperability test. Compliance with standards, performance, and exception handling capability are checked with the Conformance test, Performance test, and Exception test.

4.2 Configuration of interoperability verification test

There are two configurations for interconnectivity verification testing. One is used for the Interoperability test and the other for the Conformance, Performance, and Exception tests.

The Interoperability test configuration consists of the UUT and a standard mobile station produced by each manufacturer. The configuration for the Conformance test, Performance test, and Exception test consists of the UUT and a simulator that performs transmission and reception operation of a mobile station and base station. The simulator must incorporate an RF transmitter and receiver for both base station and mobile station operation and must be able to communicate with the UUT, but the concrete configuration and model type for simulator equipment are not covered by this Guideline. Specifications to ensure that the required functions are given in Chapter 5.

4.2.1 Configuration for Interoperability test

The Interoperability test configuration consists of the UUT and a standard mobile station. An example for a test configuration designed to verify interoperability by radio connection is shown Fig. 4-1.

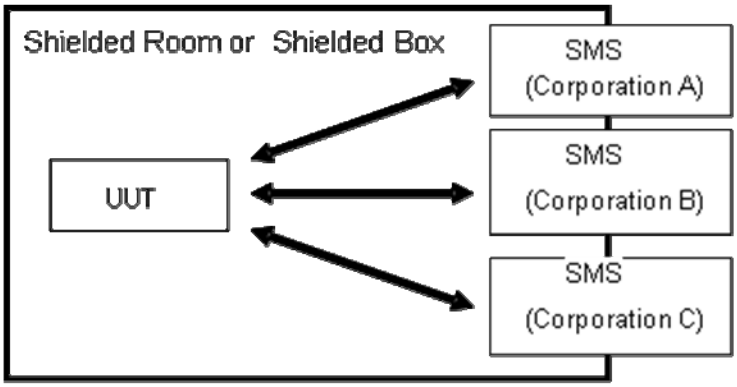


Fig. 4-1 Test Configuration for Interoperability by Radio Connection

4.2.2 Configuration for Conformance test, Performance test, and Exception test

The configuration for the Conformance test, Performance test, and Exception test consists of the UUT and connectivity testing equipment. The connectivity testing equipment is a simulator that can perform the transmission and reception functions of a mobile station and base station. For this purpose, it is equipped with an RF transmitter/receiver for both mobile station and base station operation, allowing two-way communication with the UUT. The UUT and connectivity testing equipment may be connected either by radio connection via antennas on both sides or by wired connection using coaxial cable or similar. The configuration is shown in Fig. 4-2.

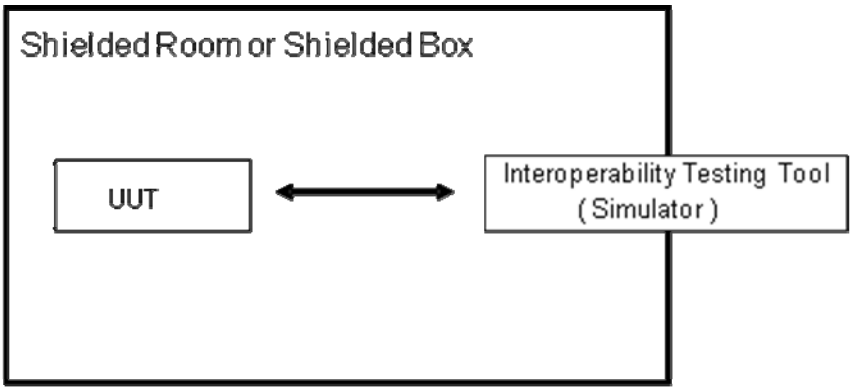


Fig. 4-2 Test Configuration for Conformance, Performance, and Exception by Radio Connection

4.2.3 Sample test bed configuration

When performing the interoperability verification test, it is desirable to use a

dedicated test bed that easily allows establishing the required test configuration. An example for such a test bed comprising the simulator, standard base station, standard mobile station, computer for performing analysis, etc. is shown in Fig. 4-3.

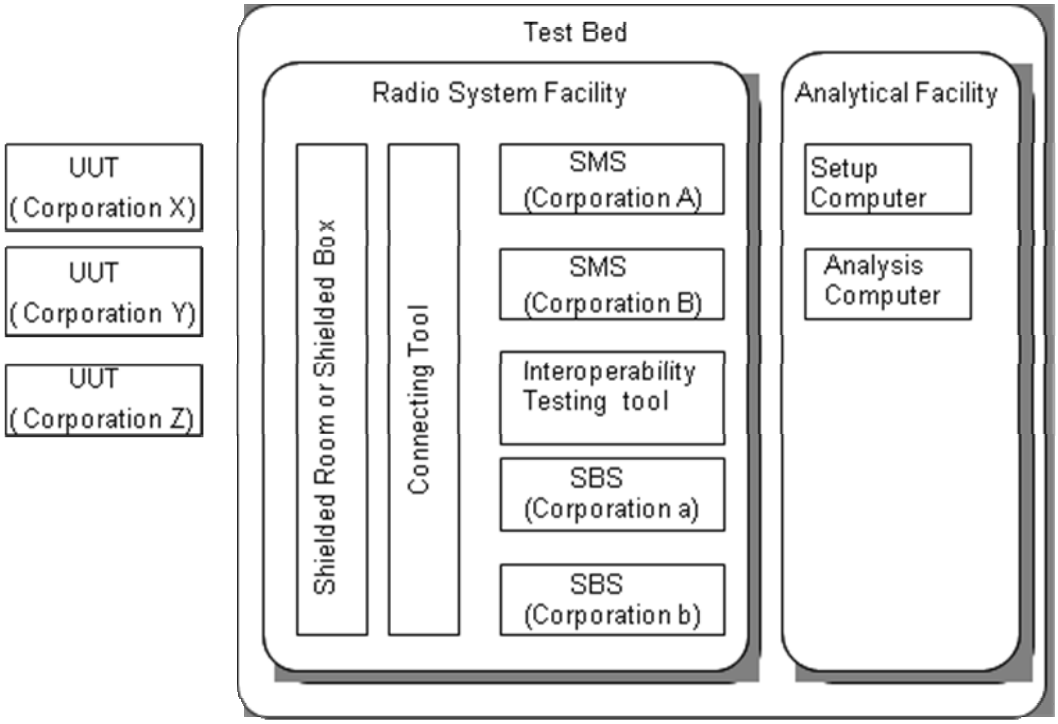


Fig.4-3 Sample Test Bed Configuration

4.3 Interoperability verification test items

4.3.1 Interoperability verification test items

The interoperability test items are listed in Table 4-1. A check mark (✓) is used to indicate to which test category (IN: Interoperability, CON: Conformance, PER: Performance, EX: Exception) the respective item belongs.

Table 4-1 Interoperability Verification Test Items

No.	Layer	Item	Applicable standard	NOTE	IN	CON	PER	EX
1-1	LLC transmission	Address field	4.3.5.6.1	=AAAAh		レ		
1-2		Control field	4.3.5.6.2	=03h		レ		
1-3		Protocol identifier	4.3.5.6.3	=03 0000 0001h		レ		
1-4	LLC reception	Address field	4.3.5.5.2	Operation other than AAAAh undefined				レ

1-5		Control field	4.3.5.5.3	Discarded or passed to higher layer with identifier code if non-number type information (UI) command (P bit) is 1 (13h)				✓
1-6		Protocol identifier	↑	Operation other than 03 0000 0001h undefined				✓
1-7		PDU with invalid LLC	4.3.5.3.2	Invalid for L1/MAC sublayer, PDU length not integer multiple of octets, PDU length less than 8 octets, no valid control field				✓
2-1	IR transmission	Protocol version number	4.4.3.1.2	=0000b		✓		
2-2		Type	↑	=0000b		✓		
2-3		Reserved	↑	=0b		✓		
2-4		Enhanced field	↑	=00h		✓		
2-5	IR reception	Protocol version number	4.4.3.3.2	Operation other than 0000b undefined				✓
2-6		Type	↑	Operation other than 0000b undefined				✓
2-7		Synchronization information	↑	Non-standard operation undefined				✓
2-8		Reserved	↑	Operation other than 0b undefined				✓
2-9		Timestamp	↑	Non-standard operation undefined				✓
2-10		Roadside-to-vehicle communication period length	↑	Non-standard operation undefined				✓
2-11		Enhanced field	↑	Operation other than 00h undefined				✓
3-1	L7 transmission	Link address	4.5.2.1.4	= MAC control field		✓		
			4.5.3.1.2	Destination address				
3-2		Version	↑	0		✓		
3-3		Security classification information	↑	Security Information		✓		
3-4		Reserved	↑	0		✓		
3-5		Application associated information	↑	Application Associated Information		✓		
3-6	L7 reception	Link address	4.5.2.1.4	Identification Code specified in MAC control field		✓		
			4.5.3.2.2					

3-7		Security classification information	↑			✓		
3-8		Application associated information	↑			✓		
3-9		Application data length	↑	0 - 1500 octets, out-of-range reception undefined				✓
4-1	Apps transmission	Application message	-	Application message transmission	✓			
4-2		High-load environment (inter-vehicle)	-				✓	
4-3		High-load environment (inter-vehicle + roadside-to-vehicle)	-				✓	
4-4	Apps reception	Application message	-	Application message reception	✓		✓	
4-5		Difficult reception environment	-				✓	

4.3.2 Interoperability verification test parameters

4.3.2.1 Layer 1

The test parameters for layer 1 are as follows.

Parameter	Value
Output power	At antenna terminal of UUT: -50 dBm
Data rate	Mobile station: 6 Mbps, Base station: 12 Mbps

4.3.2.2 Layer 2

The test parameters for layer 2 are as follows.

Parameter	Value
Destination address	FFFF FFFF FFFFh (default), FE00 0000 0000h
Transmission source address	[Arbitrary value]
Radio station identification code	[Equipment-specific value]
Transmission count value	[Arbitrary value]

4.3.2.3 LLC

The LLC related test parameters are as follows. (Underlined are exception values)

Parameter	Value
DSAP/SSAP field	AAAAh (default), 0000h
Control field	03h (default),13h, FFh
Protocol identifier	03 0000 0001h (default), 00 0000 0800h
PDU length	96 (default), 0

4.3.2.4 Inter-vehicle and roadside-to-vehicle communication control information layer

The parameters for the inter-vehicle and roadside-to-vehicle communication control information layer are as follows. (Underlined are exception values)

Parameter	Value
Version	0 (default), 1
Type	0 (mobile station default), 1 (base station default), 2
Synchronization information	000b (default), 011b
Reserved	0 (default), 1
Timestamp	0 (default), 1000000
Roadside-to-vehicle communication period information Transfer count	All periods: 00b (default) Period 1: 01b, Period 2: 02b, Other period: 00b
Roadside-to-vehicle communication period information Roadside-to-vehicle communication period length	All periods: 0 units (default), Period 1 to 15: 63 units, Period 16: 0 units, Period 1: 63 units, Period 2: 1 unit, Other periods: 0 units
Enhanced field	00h (default), FFh

4.3.2.5 Layer 7

The test parameters for layer 7 are as follows. (Underlined are exception values)

(1) MobileStationBroadcastData primitive

Parameter	Value
ControlInformation/DataRate	0
SecurityClassification	0, 1 (selected according to security)
ApplicationAssociatedInformation	0
ApplicationDataLength	100 (default), 0, 1500, 1501
ApplicationData	Value x *
LinkAddress	FFFF FFFF FFFFh (default), FE00 0000 0000h

(2)BaseStationBroadcastData primitive

Parameter	Value
ControlInformation/DataRate	4
SecurityClassification	0, 1 (selected according to security)
ApplicationAssociatedInformation	00h (default), FFh
ApplicationDataLength	1500 (default), 0, 1501
ApplicationData	Value x *
LinkAddress	FFFF FFFF FFFFh

*: Value of x to be specified by operation management organization.

4.3.3 Interoperability verification test description

4.3.3.1 Test description for Interoperability test

<table>
<tr><td>No.</td><td>4-1-IN</td><td>Item</td><td>Apps transmission: Application message</td></tr>
<tr><td>Test outline</td><td colspan="3">Verify that application message transmission is possible.</td></tr>
<tr><td>Test conditions</td><td colspan="3">UUT → Standard mobile station
Encryption key: value x. Value of x to be specified by operation management organization.</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. Test program for mobile station issues instruction to UUT to transmit frame with predetermined message.
2. Standard mobile station receives frame, and test program for mobile station extracts message.
Test value pattern
<table>
<tr><th>Item</th><th>Test value</th></tr>
<tr><td>ASDU length</td><td>100 octets</td></tr>
<tr><td>Security parameter</td><td>Value x determined by operation management organization</td></tr>
<tr><td>Encryption</td><td>Yes/No (Note 1) (Note 2)</td></tr>
</table>
Note 1: If the UUT implements several encryption methods, the test should be performed for each method.
Note 2: The test should be performed repeatedly using several different encryption keys.</td></tr>
<tr><td>Verification item</td><td colspan="3">・ Message input to UUT and message obtained by standard mobile station must match.</td></tr>
</table>

<table>
<tr><td>No.</td><td>4-4-IN</td><td>Item</td><td>Apps reception: Application message</td></tr>
<tr><td>Test outline</td><td colspan="3">Verify that application message reception is possible.</td></tr>
<tr><td>Test conditions</td><td colspan="3">Standard mobile station → UUT
Encryption key: value x. Value of x to be specified by operation management organization.</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. Test program for mobile station issues instruction to standard mobile station to transmit frame with predetermined message.
2. UUT receives frame, and test program for mobile station extracts message.
Test value pattern
<table>
<tr><th>Item</th><th>Test value</th></tr>
<tr><td>ASDU length</td><td>100 octets</td></tr>
<tr><td>Security parameter</td><td>Value x determined by operation management organization</td></tr>
<tr><td>Encryption</td><td>Yes/No (Note 1) (Note 2)</td></tr>
</table>
Note 1: If the UUT implements several encryption methods, the test should be performed for each method.
Note 2: The test should be performed repeatedly using several different encryption keys.</td></tr>
<tr><td>Verification item</td><td colspan="3">・ Message input to standard mobile station and message obtained by UUT must match.</td></tr>
</table>

4.3.3.2 Test description for Conformance test

<table>
<tr><td>No.</td><td>1-1-CON</td><td>Item</td><td>LLC transmission: Address field</td></tr>
<tr><td>Test outline</td><td colspan="3">Verify that transmission is performed with correct LLC header format.</td></tr>
<tr><td>Test conditions</td><td colspan="3">UUT → Simulator
・ Simulator must operate as mobile station.</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. UUT sends arbitrary frame.
2. Simulator receives frame.</td></tr>
<tr><td>Verification item</td><td colspan="3">・ Address field in LLC control field of received frame must match specified bit string.<table><tr><td>Verification item</td><td>Standard value</td></tr><tr><td>DSAP/SSAP address field</td><td>AAAAh</td></tr></table></td></tr>
</table>

<table>
<tr><td>No.</td><td>1-2-CON</td><td>Item</td><td>LLC transmission: Control field</td></tr>
<tr><td>Test outline</td><td colspan="3">Verify that transmission is performed with correct LLC header format.</td></tr>
<tr><td>Test conditions</td><td colspan="3">UUT → Simulator
・ Simulator must operate as mobile station.</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. UUT sends arbitrary frame.
2. Simulator receives frame.</td></tr>
<tr><td>Verification item</td><td colspan="3">・ Control field in LLC control field of received frame must match specified bit string.<table><tr><td>Verification item</td><td>Standard value</td></tr><tr><td>Control field</td><td>03h</td></tr></table></td></tr>
</table>

<table>
<tr><td>No.</td><td>1-3-CON</td><td>Item</td><td>LLC transmission: Protocol identifier</td></tr>
<tr><td>Test outline</td><td colspan="3">Verify that transmission is performed with correct LLC header format.</td></tr>
<tr><td>Test conditions</td><td colspan="3">UUT → Simulator
・ Simulator must operate as mobile station.</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. UUT sends arbitrary frame.
2. Simulator receives frame.</td></tr>
<tr><td>Verification item</td><td colspan="3">・ Protocol identifier in LLC control field of received frame must match specified bit string.<table><tr><td>Verification item</td><td>Standard value</td></tr><tr><td>Protocol identifier</td><td>03 0000 0001h</td></tr></table></td></tr>
</table>

No.	2-1-CON	Item	IR transmission: Protocol version number
Test outline	Verify that transmission is performed with correct IR control field format.		
Test conditions	UUT → Simulator ・ Simulator must operate as mobile station.		
Test procedure	1. UUT sends arbitrary frame. 2. Simulator receives frame.		
Verification item	・ Protocol version number in IR control field of received frame must match specified bit string.		

Verification item	Standard value
Protocol version number	0000b

No.	2-2-CON	Item	IR transmission: Type
Test outline	Verify that transmission is performed with correct IR control field format.		
Test conditions	UUT → Simulator ・ Simulator must operate as mobile station.		
Test procedure	1. UUT sends arbitrary frame. 2. Simulator receives frame.		
Verification item	・ Type in IR control field of received frame must match specified bit strings.		

Verification item	Standard value
Type	0000b

No.	2-3-CON	Item	IR transmission: Reserved
Test outline	Verify that transmission is performed with correct IR control field format.		
Test conditions	UUT → Simulator ・ Simulator must operate as mobile station.		
Test procedure	1. UUT sends arbitrary frame. 2. Simulator receives frame.		
Verification item	・ Reserved field in IR control field of received frame must match specified bit strings.		

Verification item	Standard value
Reserved	0b

<table>
<tr><td>No.</td><td>2-4-CON</td><td>Item</td><td>IR transmission: Enhanced field</td></tr>
<tr><td>Test outline</td><td colspan="3">Verify that transmission is performed with correct IR control field format.</td></tr>
<tr><td>Test conditions</td><td colspan="3">UUT → Simulator
・ Simulator must operate as mobile station.</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. UUT sends arbitrary frame.
2. Simulator receives frame.</td></tr>
<tr><td>Verification item</td><td colspan="3">・ Enhanced field in IR control field of received frame must match specified bit strings.
<table>
<tr><td>Verification item</td><td>Standard value</td></tr>
<tr><td>Enhanced field</td><td>00h</td></tr>
</table></td></tr>
</table>

<table>
<tr><td>No.</td><td>3-1-CON</td><td>Item</td><td>L7 transmission: Link Address</td></tr>
<tr><td>Test outline</td><td colspan="3">Verify that LinkAddress included in MobileStationBroadcastData.request which is a primitive between application and layer 7 can provide MAC control field destination address.</td></tr>
<tr><td>Test conditions</td><td colspan="3">UUT → Simulator
・ Simulator must operate as mobile station.</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. Test program for mobile station issues instruction to UUT to transmit a frame with test value assigned to LinkAddress.
2. Simulator receives frame.
Test value pattern
<table>
<tr><td>Item</td><td>Test value</td></tr>
<tr><td>LinkAddress</td><td>FFFF FFFF FFFFh/FE00 0000 0000h</td></tr>
</table></td></tr>
<tr><td>Verification item</td><td colspan="3">・ MAC control field destination address of received frame must match value assigned to LinkAddress.</td></tr>
</table>

<table>
<tr><th>No.</th><td>3-2-CON</td><td>Item</td><td>L7 transmission: Version</td></tr>
<tr><td>Test outline</td><td colspan="3">Verify that transmission is performed with correct layer 7 header format.</td></tr>
<tr><td>Test conditions</td><td colspan="3">UUT → Simulator
・ Simulator must operate as mobile station.</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. UUT sends arbitrary frame.
2. Simulator receives frame.</td></tr>
<tr><td>Verification item</td><td colspan="3">・ Layer 7 header version in received frame must match specified bit strings.
<table>
<tr><th>Verification item</th><th>Standard value</th></tr>
<tr><td>Version</td><td>0000b</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>No.</th><td>3-3-CON</td><td>Item</td><td>L7 transmission: Security classification information</td></tr>
<tr><td>Test outline</td><td colspan="3">Verify that SecurityClassification included in MobileStationBroadcastData.request which is a primitive between application and layer 7 can provide layer 7 header security classification information.</td></tr>
<tr><td>Test conditions</td><td colspan="3">UUT → Simulator
・ Simulator must operate as mobile station.</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. Test program for mobile station issues instruction to UUT to transmit a frame with test value assigned to SecurityClassification.
2. Simulator receives frame.
Test value pattern
<table>
<tr><th>Item</th><th>Test value</th></tr>
<tr><td>SecurityClassification</td><td>0/1</td></tr>
</table></td></tr>
<tr><td>Verification item</td><td colspan="3">・ Security classification information of layer 7 header in received frame must match value assigned to SecurityClassification.</td></tr>
</table>

<table>
<tr><td>No.</td><td>3-4-CON</td><td>Item</td><td>L7 transmission: Reserved</td></tr>
<tr><td>Test outline</td><td colspan="3">Verify that transmission is performed with correct layer 7 header format.</td></tr>
<tr><td>Test conditions</td><td colspan="3">UUT → Simulator
・ Simulator must operate as mobile station.</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. UUT sends arbitrary frame.
2. Simulator receives frame.</td></tr>
<tr><td>Verification item</td><td colspan="3">・ Layer 7 header reserved field in received frame must match specified bit strings.
<table>
<tr><td>Verification item</td><td>Standard value</td></tr>
<tr><td>Reserved</td><td>000b</td></tr>
</table></td></tr>
</table>

<table>
<tr><td>No.</td><td>3-5-CON</td><td>Item</td><td>L7 transmission: Application associated information</td></tr>
<tr><td>Test outline</td><td colspan="3">Verify that ApplicationAssociatedInformation included in MobileStationBroadcastData.request which is a primitive between application and layer 7 can provide layer 7 header application associated information.</td></tr>
<tr><td>Test conditions</td><td colspan="3">UUT → Simulator
・ Simulator must operate as mobile station.</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. Test program for mobile station issues instruction to UUT to transmit a frame with test value assigned to ApplicationAssociatedInformation.
2. Simulator receives frame.
Test value pattern
<table>
<tr><td>Item</td><td>Test value</td></tr>
<tr><td>ApplicationAssociatedInformation</td><td>00h/FFh</td></tr>
</table></td></tr>
<tr><td>Verification item</td><td colspan="3">・ Application associated information of layer 7 header in received frame must match value assigned to ApplicationAssociatedInformation.</td></tr>
</table>

<table>
<tr><td>No.</td><td>3-6-CON</td><td>Item</td><td>L7 reception: Link Address</td></tr>
<tr><td>Test outline</td><td colspan="3">Verify that LinkAddress included in MobileStationBroadcastData.indication which is a primitive between application and layer 7 allows obtaining MAC control field with radio station identification code.</td></tr>
<tr><td>Test conditions</td><td colspan="3">Simulator → UUT
・ Simulator must operate as mobile station.</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. Simulator transmits frame with test value assigned to radio station identification code in MAC control field.
2. UUT receives frame, and test program for mobile station obtains LinkAddress.
Test value pattern<table><tr><th>Item</th><th>Test value</th></tr><tr><td>Radio station identification code</td><td>[Equipment-specific value or arbitrary value]</td></tr></table></td></tr>
<tr><td>Verification item</td><td colspan="3">・ LinkAddress in obtained MobileStationBroadcastData.indication must match value assigned to radio station identification code in MAC control field.</td></tr>
</table>

<table>
<tr><td>No.</td><td>3-7-CON</td><td>Item</td><td>L7 reception: Security classification information</td></tr>
<tr><td>Test outline</td><td colspan="3">Verify that SecurityClassification included in MobileStationBroadcastData.indication which is a primitive between application and layer 7 can provide layer 7 header security classification information.</td></tr>
<tr><td>Test conditions</td><td colspan="3">Simulator → UUT
・ Simulator must operate as mobile station.</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. Simulator transmits frame with test value assigned to security classification information in layer 7 header.
2. UUT receives frame, and test program for mobile station obtains SecurityClassification.
Test value pattern<table><tr><th>Item</th><th>Test value</th></tr><tr><td>Security section information</td><td>0/1</td></tr></table></td></tr>
<tr><td>Verification item</td><td colspan="3">・ SecurityClassification in obtained MobileStationBroadcastData.indication must match value assigned to Layer 7 header security classification information.</td></tr>
</table>

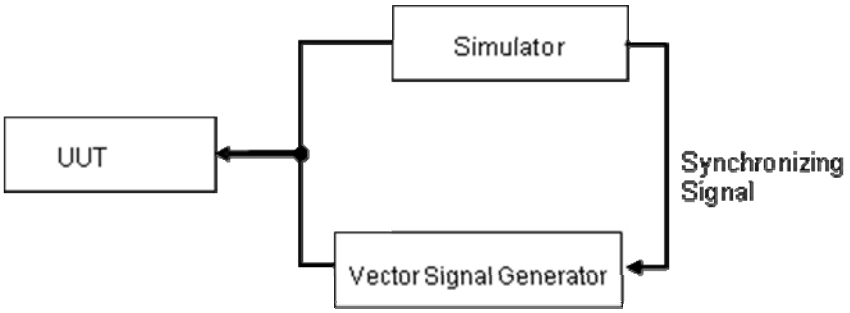
<table>
<tr><td>No.</td><td>3-8-CON</td><td>Item</td><td>L7 reception: Application associated information</td></tr>
<tr><td>Test outline</td><td colspan="3">Verify that ApplicationAssociatedInformation included in MobileStationBroadcastData.indication which is a primitive between application and layer 7 can provide layer 7 header application associated information.</td></tr>
<tr><td>Test conditions</td><td colspan="3">Simulator → UUT
・ Simulator must operate as mobile station.</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. Simulator transmits frame with test value assigned to application associated information in layer 7 header.
2. UUT receives frame, and test program for mobile station obtains ApplicationAssociatedInformation.
Test value pattern
<table>
<tr><th>Item</th><th>Test value</th></tr>
<tr><td>Application associated information</td><td>00h/FFh</td></tr>
</table></td></tr>
<tr><td>Verification item</td><td colspan="3">・ApplicationAssociatedInformation in obtained MobileStationBroadcastData.indication must match value assigned to layer 7 header application associated information.</td></tr>
</table>

4.3.3.3 Test description for Performance test

No.	4-2-PER	Item	Apps transmission: High-load environment (inter-vehicle)
Test outline	Verify that application message transmission is possible also under high reception load conditions.		
Test conditions	UUT ⇔ Simulator ・ Simulator must operate as mobile station.		
Test procedure	1. Simulator repeats the following steps from transmission 1 to reception 2 in 200 ms intervals. (1) Transmission 1: continuous send (from 0 to 92 ms) using [50 µs + x µs] frame interval (2) Reception 1: (from 92 to 94 ms) (3) Transmission 2: continuous send (from 94 to 198 ms) using [50 µs + x µs] frame interval (4) Reception 2: (from 198 to 200 ms) Value of x µs to be specified by operation management organization. 2. Test program for mobile station issues instruction to UUT to transmit one message frame every 100 ms. Repeat up to a count of 1000. 3. Simulator receives frames. Count number of received frames.		
Verification item	・ At least x frames must be normally received by simulator. Value of x to be specified by operation management organization.		

No.	4-3-PER	Item	Apps transmission: High-load environment (inter-vehicle + roadside-to-vehicle)
Test outline	Verify that application message transmission is possible also under high reception load conditions.		
Test conditions	UUT ⇔ Simulator ・ Simulator must operate as base station and mobile station.		
Test procedure	1. Simulator repeats the following steps from transmission 1 to reception 2 in 200 ms intervals. (1) Transmission 1: ・Roadside-to-vehicle communication message Send one frame with ASDU length of 1500 octets within each roadside-to-vehicle communication period (from 0 to 3.024 ms, 6.240 to 9.264 ms, 12.480 to 15.504 ms, 18.720 to 21.744 ms, 24.960 to 27.984 ms, 31.200 to 34.224 ms, 37.440 to 40.464 ms, 43.680 to 46.704 ms, 49.920 to 52.944 ms, 56.160 to 59.184 ms, 62.400 to 65.424 ms, 68.640 to 71.664 ms, 74.880 to 77.904 ms, 81.120 to 84.144 ms, 87.360 to 90.384 ms) ・Inter-vehicle communication message Using [50 μs + x μs] transmission frame interval, from 0 to 92 ms, except during roadside-to-vehicle communication period (2) Reception 1: (from 92 to 94 ms) (3) Transmission 2: ・Roadside-to-vehicle communication message Send one frame with ASDU length of 1500 octets within each roadside-to-vehicle communication period (from 100 to 103.024 ms, 106.240 to 109.264 ms, 112.480 to 115.504 ms, 118.720 to 121.744 ms, 124.960 to 127.984 ms, 131.200 to 134.224 ms, 137.440 to 140.464 ms, 143.680 to 146.704 ms, 149.920 to 152.944 ms, 156.160 to 159.184 ms, 162.400 to 165.424 ms, 168.640 to 171.664 ms, 174.880 to 177.904 ms, 181.120 to 184.144 ms, 187.360 to 190.384 ms) ・Inter-vehicle communication message Using [50 μs + x μs] transmission frame interval, from 94 to 198 ms, except during roadside-to-vehicle communication period. (4) Reception 2: (from 198 to 200 ms) Value of x μs to be specified by operation management organization. 2. Test program for mobile station issues instruction to UUT to transmit one message frame every 100 ms. Repeat up to a count of 1000. 3. Simulator receives frames. Count number of received frames.		
Verification item	・ At least x frames must be normally received by simulator. Value of x to be specified by operation management organization.		

No.	4-4-PER	Item	Apps reception: Application message
Test outline	Verify that application message reception is possible also under high reception load conditions.		
Test conditions	Simulator → UUT ・ Simulator must operate as mobile station.		
Test procedure	1. Simulator performs continuous send in 100 ms units, using [50 μs + x μs] transmission frame interval. Value of x μs to be specified by operation management organization. 2. UUT receives frames, and test program for mobile station extracts messages. Count number of received messages.		
Verification item	・ At least x messages must be extracted by test program for mobile station for every 100 ms. Value of x to be specified by operation management organization.		

No.	4-5-PER	Item	Apps reception: Difficult reception environment
Test outline	Verify that application message reception is possible also under high reception load conditions, when reception is temporarily difficult.		
Test conditions	Establish a configuration as shown below. ・ Simulator must operate as mobile station. ・ Vector signal generator must operate as mobile station. ・ Simulator and vector signal generator must be synchronized by synchronizing signal. ・ Input levels to UUT from simulator and vector signal generator must be identical. 		
Test procedure	1. Simulator performs continuous send, using [50 µs + x µs] transmission frame interval. Value of x µs to be specified by operation management organization. 2. Vector signal generator performs continuous send, using 2 ms transmission frame interval. 3. UUT sends frames, and test program for mobile station extracts messages. Number of messages for an arbitrary 100 ms period are counted. 4. Repeat steps 1 to 3 x times, changing transmission start timing for vector signal generator every time. Average of message count for x times is determined. Value of x to be specified by operation management organization.		
Verification item	・ At least x messages must be extracted by test program for mobile station for every 100 ms. Value of x to be specified by operation management organization.		

4.3.3.4 Test description for Exception test

<table>
<tr><td>No.</td><td>1-4-EX</td><td>Item</td><td>LLC reception: Invalid address field</td></tr>
<tr><td>Test outline</td><td colspan="3">Verify that no malfunction occurs when a frame with a non-standard address field in LLC control field is received.</td></tr>
<tr><td>Test conditions</td><td colspan="3">Simulator → UUT
・ Simulator must operate as mobile station.</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. Simulator sends frames with test values assigned to address field in LLC control field, in the order (1), (2).
2. UUT receives frames, and test program for mobile station is used to check messages.
Test value pattern
<table>
<tr><th>Item</th><th>Test value</th></tr>
<tr><td rowspan="2">DSAP/SSAP address field</td><td>(1) 0000h (non-standard value)</td></tr>
<tr><td>(2) AAAAh (standard value)</td></tr>
</table></td></tr>
<tr><td>Verification item</td><td colspan="3">・ Verify that frames with standard values are received normally and messages can be extracted.</td></tr>
</table>

<table>
<tr><td>No.</td><td>1-5-EX</td><td>Item</td><td>LLC reception: Invalid control field</td></tr>
<tr><td>Test outline</td><td colspan="3">Verify that no malfunction occurs when a frame with a non-standard control field in LLC control field is received.</td></tr>
<tr><td>Test conditions</td><td colspan="3">Simulator → UUT
・ Simulator must operate as mobile station.</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. Simulator sends frames with test values assigned to control field in LLC control field, in the order (1), (2), (3).
2. UUT receives frames, and test program for mobile station is used to check messages.
Test value pattern
<table>
<tr><th>Item</th><th>Test value</th></tr>
<tr><td rowspan="3">Control field</td><td>(1) FFh (non-standard value)</td></tr>
<tr><td>(2) 13h (non-standard value)</td></tr>
<tr><td>(3) 03h (standard value)</td></tr>
</table></td></tr>
<tr><td>Verification item</td><td colspan="3">・ Verify that frames with standard values are received normally and messages can be extracted.</td></tr>
</table>

<table>
<tr><td>No.</td><td>1-6-EX</td><td>Item</td><td>LLC reception: Invalid protocol identifier</td></tr>
<tr><td>Test outline</td><td colspan="3">Verify that no malfunction occurs when a frame with a non-standard protocol identifier in LLC control field is received.</td></tr>
<tr><td>Test conditions</td><td colspan="3">Simulator → UUT
・ Simulator must operate as mobile station.</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. Simulator sends frames with test values assigned to protocol identifiers in LLC control field, in the order (1), (2).
2. UUT receives frames, and test program for mobile station is used to check messages.
Test value pattern
<table>
<tr><th>Item</th><th>Test value</th></tr>
<tr><td rowspan="2">Protocol identifier</td><td>(1) 00 0000 0800h (non-standard value)</td></tr>
<tr><td>(2) 03 0000 0001h (standard value)</td></tr>
</table></td></tr>
<tr><td>Verification item</td><td colspan="3">・ Verify that frames with standard values are received normally and messages can be extracted.</td></tr>
</table>

<table>
<tr><td>No.</td><td>1-7-EX</td><td>Item</td><td>LLC reception: PDU with invalid LLC</td></tr>
<tr><td>Test outline</td><td colspan="3">Verify that received frames with non-standard LLC Protocol Data Unit (LPDU) are discarded properly.</td></tr>
<tr><td>Test conditions</td><td colspan="3">Simulator → UUT
・ Simulator must operate as mobile station.</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. Simulator sends frames with test values set as PDU length of LLC, in the order (1), (2).
2. UUT receives frames, and test program for mobile station is used to check messages.
Test value pattern
<table>
<tr><th>Item</th><th>Test value</th></tr>
<tr><td rowspan="2">PDU length</td><td>(1) 0 octets (out-of-range value)</td></tr>
<tr><td>(2) 96 octets (in-range value)</td></tr>
</table></td></tr>
<tr><td>Verification item</td><td colspan="3">・ Verify that frames with out-of-range values are not received, and frames with in-range values are received normally and messages can be extracted.</td></tr>
</table>

<table>
<tr><td>No.</td><td>2-5-EX</td><td>Item</td><td>IR reception: Invalid protocol version number</td></tr>
<tr><td>Test outline</td><td colspan="3">Verify that no malfunction occurs when a frame with a non-standard protocol version number in IR control field is received.</td></tr>
<tr><td>Test conditions</td><td colspan="3">Simulator → UUT
・ Simulator must operate as mobile station.</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. Simulator sends frames with test values assigned to protocol version numbers in IR control field, in the order (1), (2).
2. UUT receives frames, and test program for mobile station is used to check messages.
Test value pattern
<table>
<tr><th>Item</th><th>Test value</th></tr>
<tr><td rowspan="2">Protocol version number</td><td>(1) 0001b (non-standard value)</td></tr>
<tr><td>(2) 0000b (standard value)</td></tr>
</table></td></tr>
<tr><td>Verification item</td><td colspan="3">・ Verify that frames with standard values are received normally and messages can be extracted.</td></tr>
</table>

<table>
<tr><td>No.</td><td>2-6-EX</td><td>Item</td><td>IR reception: Invalid type</td></tr>
<tr><td>Test outline</td><td colspan="3">Verify that no malfunction occurs when a frame with non-standard type in IR control field is received.</td></tr>
<tr><td>Test conditions</td><td colspan="3">Simulator → UUT
・ Simulator must operate as mobile station.</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. Simulator sends frames with test values assigned to type in IR control field, in the order (1), (2).
2. UUT receives frames, and test program for mobile station is used to check messages.
Test value pattern
<table>
<tr><th>Item</th><th>Test value</th></tr>
<tr><td rowspan="2">Type</td><td>(1) 0011b (non-standard value)</td></tr>
<tr><td>(2) 0000b (standard value)</td></tr>
</table></td></tr>
<tr><td>Verification item</td><td colspan="3">・ Verify that frames with standard values are received normally and messages can be extracted.</td></tr>
</table>

<table>
<tr><td>No.</td><td>2-7-EX</td><td>Item</td><td>IR reception: Invalid synchronization information</td></tr>
<tr><td>Test outline</td><td colspan="3">Verify that no malfunction occurs when a frame with non-standard synchronization information in IR control field is received.</td></tr>
<tr><td>Test conditions</td><td colspan="3">Simulator → UUT
・ Simulator must operate as mobile station.</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. Simulator sends frames with test values assigned to synchronization information in IR control field, in the order (1), (2).
2. UUT receives frames, and test program for mobile station is used to check messages.
Test value pattern
<table>
<tr><th>Item</th><th>Test value</th></tr>
<tr><td rowspan="2">Synchronization information</td><td>(1) 011b (non-standard value)</td></tr>
<tr><td>(2) 000b (standard value)</td></tr>
</table></td></tr>
<tr><td>Verification item</td><td colspan="3">・ Verify that frames with standard values are received normally and messages can be extracted.</td></tr>
</table>

<table>
<tr><td>No.</td><td>2-8-EX</td><td>Item</td><td>IR reception: Invalid reserved</td></tr>
<tr><td>Test outline</td><td colspan="3">Verify that no malfunction occurs when a frame with non-standard reserved field in IR control field is received.</td></tr>
<tr><td>Test conditions</td><td colspan="3">Simulator → UUT
・ Simulator must operate as mobile station.</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. Simulator sends frames with test values assigned to reserved field in IR control field, in the order (1), (2).
2. UUT receives frames, and test program for mobile station is used to check messages.
Test value pattern
<table>
<tr><th>Item</th><th>Test value</th></tr>
<tr><td rowspan="2">Reserved</td><td>(1) 1b (non-standard value)</td></tr>
<tr><td>(2) 0b (standard value)</td></tr>
</table></td></tr>
<tr><td>Verification item</td><td colspan="3">・ Verify that frames with standard values are received normally and messages can be extracted.</td></tr>
</table>

<table>
<tr><td>No.</td><td>2-9-EX</td><td>Item</td><td>IR reception: Invalid timestamp</td></tr>
<tr><td>Test outline</td><td colspan="3">Verify that no malfunction occurs when a frame with non-standard timestamp in IR control field is received.</td></tr>
<tr><td>Test conditions</td><td colspan="3">Simulator → UUT
・ Simulator must operate as mobile station.</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. Simulator sends frames with test values assigned to timestamp in IR control field, in the order (1), (2).
2. UUT receives frames, and test program for mobile station is used to check messages.
Test value pattern
<table>
<tr><th>Item</th><th>Test value</th></tr>
<tr><td rowspan="2">Timestamp</td><td>(1) 1000000 (out-of-range value)</td></tr>
<tr><td>(2) 0 (in-range value)</td></tr>
</table></td></tr>
<tr><td>Verification item</td><td colspan="3">・ Verify that frames with in-range values are received normally and messages can be extracted.</td></tr>
</table>

<table>
<tr><td>No.</td><td>2-10-EX</td><td>Item</td><td>IR reception: Invalid roadside-to-vehicle communication period length</td></tr>
<tr><td>Test outline</td><td colspan="3">Verify that no malfunction occurs when a frame with non-standard roadside-to-vehicle communication period information (roadside-to-vehicle communication period length) in IR control field is received.</td></tr>
<tr><td>Test conditions</td><td colspan="3">Simulator → UUT
・ Simulator must operate as mobile station.</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. Simulator sends frames with test values assigned to roadside-to-vehicle communication period information (roadside-to-vehicle communication period length) in IR control field, in the order (1), (2).
2. UUT receives frames, and test program for mobile station is used to check messages.
Test value pattern
<table>
<tr><th>Item</th><th>Test value</th></tr>
<tr><td>Transfer count</td><td>Period 1: 01b, Period 2: 02b, Others: 00b</td></tr>
<tr><td rowspan="2">Roadside-to-vehicle communication period length</td><td>(1) All periods: 0 units (out-of-range value)</td></tr>
<tr><td>(2) Period 1: 63 units, Period 2: 1 unit, Others: 0 units (in-range value)</td></tr>
</table></td></tr>
<tr><td>Verification item</td><td colspan="3">・ Verify that frames with in-range values are received normally and messages can be extracted.</td></tr>
</table>

<table>
<tr><td>No.</td><td>2-11-EX</td><td>Item</td><td>IR reception: Invalid enhanced field</td></tr>
<tr><td>Test outline</td><td colspan="3">Verify that no malfunction occurs when a frame with non-standard enhanced field in IR control field is received.</td></tr>
<tr><td>Test conditions</td><td colspan="3">Simulator → UUT
・ Simulator must operate as mobile station.</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. Simulator sends frames with test values assigned to enhanced field in IR control field, in the order (1), (2).
2. UUT receives frames, and test program for mobile station is used to check messages.
Test value pattern<table><tr><th>Item</th><th>Test value</th></tr><tr><td rowspan="2">Enhanced field</td><td>(1) FFh (non-standard value)</td></tr><tr><td>(2) 00h (standard value)</td></tr></table></td></tr>
<tr><td>Verification item</td><td colspan="3">・ Verify that frames with standard values are received normally and messages can be extracted.</td></tr>
</table>

<table>
<tr><td>No.</td><td>3-9-EX</td><td>Item</td><td>L7 reception: Invalid ApplicationDataLength</td></tr>
<tr><td>Test outline</td><td colspan="3">Verify that a received ASDU with non-standard ApplicationDataLength is properly discarded.</td></tr>
<tr><td>Test conditions</td><td colspan="3">Simulator → UUT
・ Simulator must operate as mobile station.</td></tr>
<tr><td>Test procedure</td><td colspan="3">1. Simulator sends frames with test values set as ASDU length, in the order (1), (2), (3).
2. UUT receives frames, and test program for mobile station is used to check messages.
Test value pattern<table><tr><th>Item</th><th>Test value</th></tr><tr><td rowspan="3">ASDU length</td><td>(1) 1501 octets (out-of-range value)</td></tr><tr><td>(2) 0 octets (in-range value)</td></tr><tr><td>(3) 1500 octets (in-range value)</td></tr></table></td></tr>
<tr><td>Verification item</td><td colspan="3">・ Verify that frames with out-of-range values are not received, and frames with standard values are received normally and messages can be extracted.</td></tr>
</table>

Chapter 5 Simulator Specifications

Testing Systems include measuring instrument and a simulator. The basic functionality of the simulator is to provide the capability for two-way communication with mobile stations.

The simulator also is to incorporate a test program that makes use of the test program for mobile stations to perform connectivity tests.

The connection format between the simulator and the UUT (Unit Under Test) is to be based on the content of the ARIB Technical Report TR-T20 (700 MHz Band Intelligent Transport Systems Test Items and Conditions for Mobile Station Compatibility Confirmation).

5.1 General items

The specifications in this chapter are intended as reference to be used when designing and manufacturing a simulator for testing the connectivity of land mobile radio stations for use in 700 MHz band intelligent transport systems.

5.1.1 Standard to follow

Regarding points not explicitly covered in this chapter, the following standard is to be followed:

Association of Radio Industries and Businesses (hereinafter referred to as "ARIB") STD-T109 "700 MHz Band Intelligent Transport Systems"

5.1.2 Reference standards

(1) Radio Law (Ordinance Regulating Radio Equipment, etc.)

(2) Telecommunications Business Law (Ordinance Regulating Business Equipment, etc.)

(3) Japan Industrial Standards (JIS)

(4) ITS Info-communications Forum Guidelines

(5) The Telecommunication Technology Committee Standards

(6) Guide Book of Electrical Equipment

(7) Technical reference material from Nippon Telegraph and Telephone Corporation (NTT)

(8) Japan Approvals Institute for Telecommunications Equipment (JATE) Standards

5.1.3 Compliance certifications to obtain (recommended)

The simulator constructed according to the specifications in this chapter should obtain all required technical compliance certifications as specified by the Radio Law. The required technical compliance certifications will depend on the testing environment.

5.1.4 Items not explicitly stated

Items not explicitly stated in this chapter may be dealt with at the discretion and the responsibility of the operator constructing the simulator.

5.2 System configuration

5.2.1 Test system configuration and simulator positioning

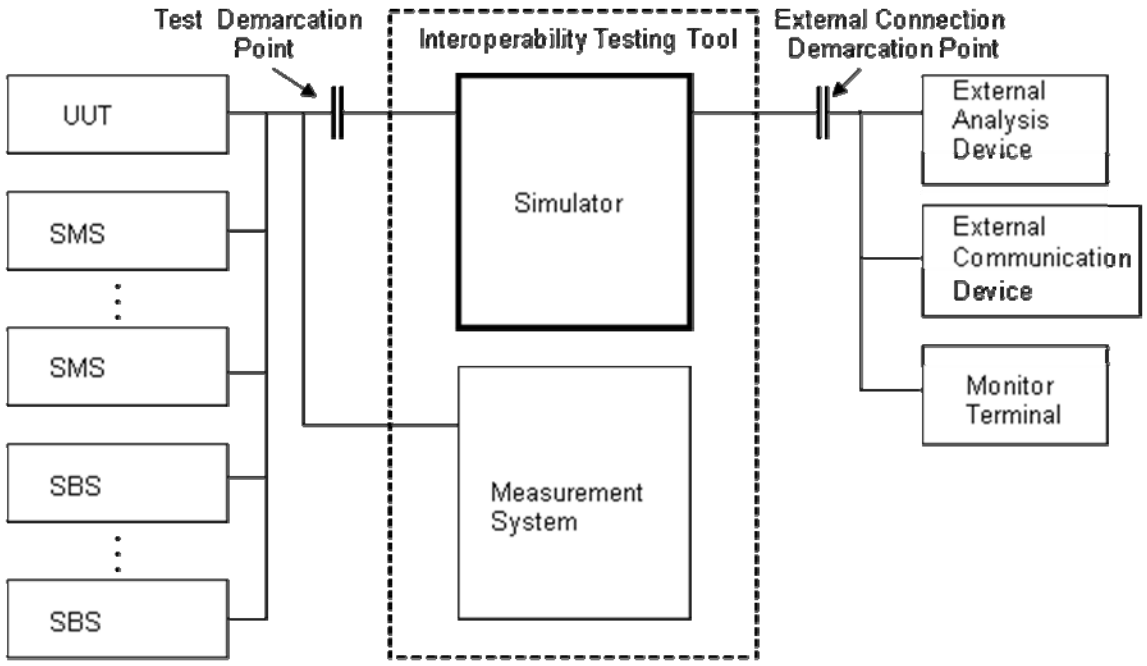


Fig.5-1 Test System Configuration and Simulator

The simulator specified in this chapter is to be connected by wired and wireless connection and incorporated into the overall system. It is denoted by the bold frame in Fig. 5-1. The simulator serves as the testing system within the test bed as described in section 4.2.3.

5.2.2 Interface points

The simulator has two interface points. The wireless interface point is called the test

demarcation point. The wired interface point is called the external connection demarcation point.

5.2.3 Interface types

The test demarcation point, which represents the wireless interface, is to be connected either by coaxial cable or by antenna. For details, see the Technical Report.

The external connection demarcation point, which represents the wired interface, is to use a standard Ethernet connection compliant with 10BASE-T or higher.

5.3 Equipment configuration and structure

5.3.1 Equipment configuration

As shown in Fig. 5-2, the simulator configuration includes the interface section, communication control section, RF section, information processing section, and sensor signal section. The antenna part in the RF section must be a standard antenna with specifications as determined by the operation management organization.

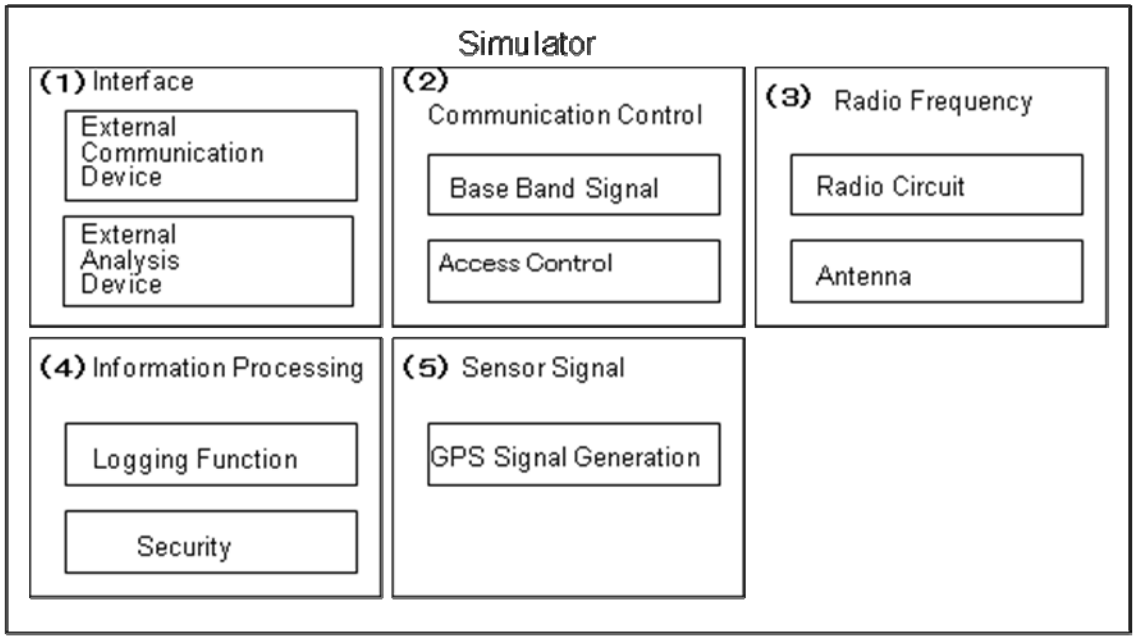


Fig.5-2 Equipment Configuration

5.3.2 General items

The simulator described in this chapter should be solid and sturdy, both in mechanical and electrical terms.

5.3.3 Description of equipment

The simulator described in this chapter shall provide the functional equivalent of multiple mobile stations and multiple base stations in a 700 MHz band intelligent transport system and shall be capable of testing the connectivity of UUT. It also shall implement a test program for efficiently carrying out such tests.

CSMA/CA access control is not mandatory.

5.3.4 Operation environment (recommended)

Ambient ratings

Temperature range for guaranteed performance: 0°C to +45°C

Relative humidity: 10% to 90%

Electromagnetic environment: Normal urban environment noise level

Spurious radiation: Compliant with Radio regulation and ARIB standards as well as VCCI Class A

Grounding: Type III grounding desirable

5.3.5 Power supply specifications (recommended)

The main equipment should satisfy the following requirements.

Power supply voltage: 100 to 240 V AC, ±10%, 50 – 60 Hz

Power supply voltage fluctuations: Performance guaranteed over a range of ±10% from rated voltage.

Momentary power interruption handling: At a temperature of 24°C ±4°C, operation should be maintained for up to 40 ms with a 100% drop

Power consumption: Max. 100 VA with maximum load

Protection equipment: Surge protection should be implemented.

Insulation resistance/strength: Insulation resistance 10 megohms or better at DC 500V Megger

Insulation strength 2000 V AC for 1 minute

Insulation resistance value applies to condition with protection devices in place. Insulation strength value applies to condition without protection devices.

Power switch: Construction should incorporate an externally operated power switch.

Power indicator lamp: An indicator lamp showing when the system is powered should be installed at an easy to see location.

5.3.6 RF input

The simulator shall be configured to allow a cable connection to the UUT for test purposes, so that it can receive 10 mW/MHz which is the transmission output power of the UUT.

5.3.7 Reference signal

The simulator may have to operate in conjunction with other systems (including other simulators if multiple simulators are used) and the vector signal generator. Synchronization in such a case should be based on a reference signal such as defined below. However, with regard to the vector signal generator, the operation management organization shall determine the concrete values.

- Frequency: 10 MHz
- Output level: ≧10 dBm
- Output impedance: 50 ohms
- Input level: 0 to 20 dBm
- Input impedance: 50 ohms

5.3.8 Trigger signal

The simulator shall incorporate a profile function (see Fig. 5-3) that enables a trigger signal whose High and Low timing can be set in 1 μs units for frames transmitted within a period of 104 ms or higher (settable in 1 ms units).

The output specifications of the trigger signal should be as follows.

- Output level: TTL and CMOS compatible level signals can be output.

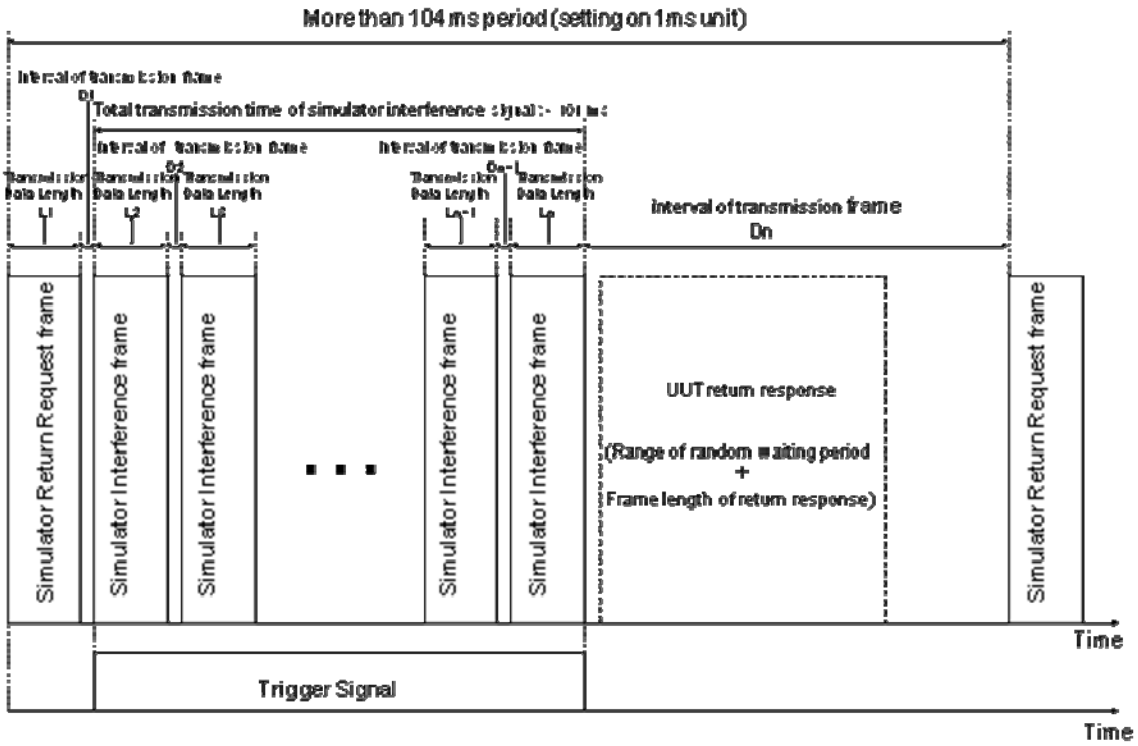


Fig.5-3 Frame Transmission Concept for Profile Function (Example) (TR2-2-5)

5.4 Major functions

The major functions of the simulator are shown in Table 5-1 as operation modes. Besides the operation modes where the simulator functions as one mobile station or one base station, there are also modes that simulate simultaneous operation of base station and mobile station (switched as required within a 100 ms transmission period) and operation as multiple mobile stations or multiple base stations.

Table 5-1 Operation Modes

No.	Operation mode	Operation outline	NOTE
1	Mobile station (single) mode	Operate as 1 mobile station.	
2	Base station (single) mode	Operate as 1 base station.	
3	Base station (single)/ mobile station (single) mode	Operate as 1 base station and 1 mobile station and enable separate frame transmission for each. IR control field (synchronization information, timestamp) for each frame must be settable to arbitrary values.	
4	Mobile station (multiple) mode	Operate as multiple mobile stations and enable separate frame transmission for each. IR control field (synchronization information, timestamp) for each frame must be settable to arbitrary values.	
5	Base station (single)/ mobile station (multiple) mode	Operate as 1 base station and multiple mobile stations and enable separate frame transmission for each. IR control field (roadside-to-vehicle communication period information) for each frame must be settable to arbitrary values.	
6	Base station (multiple) mode	Operate as multiple base stations and enable separate frame transmission for each. IR control field (roadside-to-vehicle communication period) for each frame must be settable to arbitrary values.	

5.4.1 Mobile station functions

The mobile station functions to be implemented by the simulator are listed in Table 5-2. Other functions are to follow the Standard.

Table 5-2 Mobile Station Functions

No.	Function	Applicable layer					NOTE
		PMD/PLCP	MAC	LLC	IVC-RVC	L7	
1	Set transmission data rate	○	−	−	−	○	See Standard
2	Set transmission data length	−	−	−	−	○	See section 5.4.1.1
3	Set variable attenuation	○	−	−	−	−	See section 5.4.1.2
4	Set transmission frame interval	−	−	−	−	○	See section 5.4.1.3
5	Set transmission frame count	−	−	−	−	○	See section 5.4.1.4
6	Set MAC control field (radio station identification code)	−	○	−	−	−	See section 5.4.1.5
7	Set LLC control field (address field)	−	−	○	−	−	See section 5.4.1.6
8	Set LLC control field (control field)	−	−	○	−	−	See section 5.4.1.7
9	Set LLC control field (protocol identifier)	−	−	○	−	−	See section 5.4.1.8
10	Set IR control field (protocol version number)	−	−	−	○	−	See section 5.4.1.9
11	Set IR control field (type)	−	−	−	○	−	See section 5.4.1.10
12	Set IR control field (synchronization information)	−	−	−	○	−	See section 5.4.1.11
13	Set IR control field (reserved)	−	−	−	○	−	See section 5.4.1.12
14	Set IR control field (timestamp)	−	○	−	○	−	See section 5.4.1.13
15	Set IR control field (roadside-to-vehicle communication period	−	−	−	○	−	See section 5.4.1.14

	information)						
16	Set IR control field (enhanced field)	–	–	–	○	–	See section 5.4.1.15
17	Set L7 header (security classification information)	–	–	–	–	○	See section 5.4.1.16
18	Set L7 header (application associated information)	–	–	–	–	○	See section 5.4.1.17
19	Set invalid frame transmission (security)	–	–	–	–	○	See section 5.4.1.18
20	Indicate reception data rate	○	–	–	–	○	See section 5.4.1.19
21	Indicate reception data (ASDU) length	–	–	–	–	○	See Standard
22	Indicate reception data (ASDU) content	–	–	–	–	○	See Standard
23	Indicate reception frame count	–	–	–	–	○	See section 5.4.1.20
24	Indicate frame reception timestamp	–	○	–	–	–	See section 5.4.1.21
25	Indicate MAC control field (destination address) information (reception)	–	○	–	–	○	See section 5.4.1.22
26	Indicate LLC control field (address field) information (reception)	–	–	○	–	–	See section 5.4.1.23
27	Indicate LLC control field (control field) information (reception)	–	–	○	–	–	See section 5.4.1.24
28	Indicate LLC control field (Protocol identifier) information (reception)	–	–	○	–	–	See section 5.4.1.25
29	Indicate IR control field (synchronization information) (reception)	–	–	–	○	–	See section 5.4.1.26

30	Indicate IR control field (timestamp) information (reception)	–	–	–	○	–	See section 5.4.1.27
31	Indicate IR control field (roadside-to-vehicle communication period information) (reception)	–	–	–	○	–	See section 5.4.1.28
32	Indicate IR control field (protocol version number) information (reception)	–	–	–	○	–	See section 5.4.1.29
33	Indicate IR control field (type) information (reception)	–	–	–	○	–	See section 5.4.1.30
34	Indicate IR control field (reserved) information (reception)	–	–	–	○	–	See section 5.4.1.31
35	Indicate IR control field (enhanced field) information (reception)	–	–	–	○	–	See section 5.4.1.32
36	Indicate L7 header (version) information (reception)	–	–	–	–	○	See section 5.4.1.33
37	Indicate L7 header (security classification information) (reception)	–	–	–	–	○	See section 5.4.1.34
38	Indicate L7 header (reserved) information (reception)	–	–	–	–	○	See section 5.4.1.35
39	Indicate L7 header (application associated information) (reception)	–	–	–	–	○	See section 5.4.1.36

5.4.1.1 Set transmission data length

The function must allow setting the transmission data length (ASDU) to 0/32/100/1500/1501 octets.

The function must allow setting the LPDU length to 0/96 octets.

5.4.1.2 Set variable attenuation

The function must allow varying the output power of the simulator to achieve an output of -50 dBm and -17 dBm or higher.

Taking also the antenna characteristics into account, it must be possible to set values so that tests 2-2-4 and 2-2-5 in the Technical Report can be performed.

The reason why a simulator output of -17 dBm or higher is required is explained in Annex B "Simulator Output Levels for Tests TR 2-2-4/TR 2-2-5."

5.4.1.3 Set transmission frame interval

The function must allow setting the transmission frame interval at the antenna terminal of the simulator to 2 ms and 50 μs.

5.4.1.4 Set transmission frame count

The function must enable frame transmission by the following two methods.

· Set transmission frame count to 1, 2, 3

When simulating multiple mobile stations, the transmission frame count for each mobile station must be settable to 1.

· Transmit frames until transmission is stopped (continuous transmission)

In this case, transmission frames must be counted and it must be possible to display the count.

A profile function that enables free setting of transmission frames (transmission data length) and transmission frame interval (in 1 μs units) for a period of 100 ms and 104 ms or higher (settable in 1 ms units) and 200 ms must be provided.

Furthermore, the number of repetitions for the period set with the profile function must be settable to 500 and 1000.

5.4.1.5 Set MAC control field (radio station identification code)

The function must allow setting the radio station identification code in the MAC control field to an arbitrary value for each transmitted frame.

5.4.1.6 Set LLC control field (address field)

The function must allow setting the address field in the LLC control field to an arbitrary value for each transmitted frame.

5.4.1.7 Set LLC control field (control field)

The function must allow setting the control field in the LLC control field to an arbitrary value for each transmitted frame.

5.4.1.8 Set LLC control field (protocol identifier)

The function must allow setting the protocol identifier field in the LLC control field to an arbitrary value for each transmitted frame.

5.4.1.9 Set IR control field (protocol version number)

The function must allow setting the protocol version number in the IR control field to an arbitrary value for each transmitted frame.

5.4.1.10 Set IR control field (type)

The function must allow setting the type in the IR control field to an arbitrary value for each transmitted frame.

5.4.1.11 Set IR control field (synchronization information)

The function must allow setting the synchronization information in the IR control field to an arbitrary value for each transmitted frame, as shown below.

(b2, b1, b0) = (1, 0, 0), (1, 0, 1), (1, 1, 0), (1, 1, 1), (0, 0, 0), (0, 1, 1)

5.4.1.12 Set IR control field (reserved)

The function must allow setting the reserved field in the IR control field to an arbitrary value for each transmitted frame.

5.4.1.13 Set IR control field (timestamp)

The function must allow setting the timestamp field in the IR control field to an arbitrary value in the range from 0 to 1000000 for each transmitted frame. It must also be possible to independently set the timer of the base station and mobile station to separate values.

5.4.1.14 Set IR control field (roadside-to-vehicle communication period information)

The function must allow setting arbitrary values for roadside-to-vehicle communication period information (b7, b6: transfer count, b5 to b0: roadside-to-vehicle communication period duration) for the roadside-to-vehicle communication period 1 to 16 (length of all fields 16 octets) for each transmitted frame.

5.4.1.15 Set IR control field (enhanced field)

The function must allow setting the enhanced field in the IR control field to an arbitrary value for each transmitted frame.

5.4.1.16 Set L7 header (security classification information)

The function must allow setting the security classification information in the L7 header to an arbitrary value for each transmitted frame.

5.4.1.17 Set L7 header (application associated information)

The function must allow setting the application associated information in the L7 header to an arbitrary value for each transmitted frame.

5.4.1.18 Set invalid frame transmission (security)

The function must allow sending a signal corresponding to an invalid message frame (frame with out-of-range data structure or frame created with out-of-range security parameter setting) for security processing by the UUT.

5.4.1.19 Indicate reception data rate

The function must indicate the data rate of a normally received frame.

5.4.1.20 Indicate reception frame count

The function must allow indicating the count of normally received frames.

5.4.1.21 Indicate frame reception timestamp

The function must allow indicating the time (rxtime) when a frame was received.

When the simulator functions as a base station and mobile station, or multiple mobile stations, a non-synchronized condition will exist between the base station and mobile station, or multiple mobile stations, and it is necessary to know the time at the base station and each mobile station at the point of frame reception. The simulated base station and mobile stations therefore must have a timer.

5.4.1.22 Indicate MAC control field (destination address) information (reception)

The function must allow indicating the destination address in the MAC control field of the normally received MPDU.

5.4.1.23 Indicate LLC control field (address field) information (reception)

The function must allow indicating the address field in the LLC control field of the normally received LPDU.

5.4.1.24 Indicate LLC control field (control field) information (reception)

The function must allow indicating the control field in the LLC control field of the normally received LPDU.

5.4.1.25 Indicate LLC control field (protocol identifier) information (reception)

The function must allow indicating the protocol identifier field in the LLC control field of the normally received LPDU.

5.4.1.26 Indicate IR control field (synchronization information) (reception)

The function must allow indicating the synchronization information in the IR control field of the normally received IPDU.

5.4.1.27 Indicate IR control field (timestamp) information (reception)

The function must allow indicating the timestamp in the IR control field of the normally received IPDU.

5.4.1.28 Indicate IR control field (roadside-to-vehicle communication period information) (reception)

The function must allow indicating the roadside-to-vehicle communication period information (transfer count, roadside-to-vehicle communication period duration) in the IR control field of the normally received IPDU.

5.4.1.29 Indicate IR control field (protocol version number) information (reception)

The function must allow indicating the protocol version number in the IR control field of the normally received IPDU.

5.4.1.30 Indicate IR control field (type) (reception)

The function must allow indicating the identification information in the IR control field of the normally received IPDU.

5.4.1.31 Indicate IR control field (reserved) information (reception)

The function must allow indicating the reserved field in the IR control field of the normally received IPDU.

5.4.1.32 Indicate IR control field (enhanced field) information (reception)

The function must allow indicating the enhanced field in the IR control field of the normally received IPDU.

5.4.1.33 Indicate L7 header (version) information (reception)

The function must allow indicating the version information in the L7 header of the normally received APDU.

5.4.1.34 Indicate L7 header (security classification information) (reception)

The function must allow indicating the security classification information in the L7 header of the normally received APDU.

5.4.1.35 Indicate L7 header (reserved) information (reception)

The function must allow indicating the reserved information in the L7 header of the normally received APDU.

5.4.1.36 Indicate L7 header (application associated information) (reception)

The function must allow indicating the application associated information in the L7 header of the normally received APDU.

5.4.1.37 Others

The first octet of the ASDU in a frame sent by the simulator must be as follows.

Response request frame: "E0h"

Other than above: "00h"

For the TR 2-2-4 and TR 2-2-5 tests, the frame transmission described below must be repeated 1000 times.

1. Simulator sends response request frame.

2. Starting from 50 μs after sending the response request frame, simulator sends interference frames by repeating transmission/stop pattern with a 50 μs frame interval until the total transmission time exceeds 101 ms.

3. At least 1 ms after receiving a response frame from the UUT, the simulator returns to step 1 and repeats the procedure.

For steps 1 to 3 above, a profile function that enables free setting of transmission frames (transmission data length) and transmission frame interval (in 1 μs units) for a

period of 104 ms or higher (settable in 1 ms units) must be provided. The concept of frame transmission with the profile function is shown in Fig. 5-3.

The number of response frames received from the UUT must be counted and it must be possible to display the count.

5.4.2 Base station functions

The base station functions to be implemented by the simulator are listed in Table 5-3. Other functions are to follow the Standard.

Table 5-3 Base Station Functions

No.	Function	Applicable layer					NOTE
		PMD/ PLCP	MAC	LLC	IVC-RVC	L7	
1	Set transmission data rate	○	−	−	−	○	See section 5.4.2.1
2	Set transmission data (ASDU) length	−	−	−	−	○	See section 5.4.2.2
3	Set transmission frame count	−	−	−	−	○	See section 5.4.2.3
4	Set transmission frame interval	−	−	−	−	○	See section 5.4.2.4
5	Set variable attenuation	○	−	−	−	−	See section 5.4.2.5
6	Set IR control field (synchronization information)	−	−	−	○	−	See section 5.4.2.6
7	Set IR control field (timestamp)	−	−	−	○	−	See section 5.4.2.7
8	Set IR control field (roadside-to-vehicle communication period information)	−	−	−	○	−	See section 5.4.2.8
9	Set invalid frame transmission (security)	−	−	−	−	○	See section 5.4.2.9
10	Indicate frame reception timestamp	−	○	−	−	−	See section 5.4.2.10

11	Indicate IR control field (synchronization information) (reception)	−	−	−	○	−	See section 5.4.2.11
12	Indicate IR control field (timestamp) information (reception)	−	−	−	○	−	See section 5.4.2.12
13	Indicate IR control field (roadside-to-vehicle communication period information) (reception)	−	−	−	○	−	See section 5.4.2.13

5.4.2.1 Set transmission data rate

This function must be compliant with the Standard. Available transmission data rates are listed in Table 5-4.

Table 5-4 Base Station Transmission Data Rates

Data rate	Subcarrier modulation	Encoding ratio
3 Mbps	BPSK	1/2
4.5 Mbps	BPSK	3/4
6 Mbps	QPSK	1/2
9 Mbps	QPSK	3/4
12 Mbps	16QAM	1/2
18 Mbps	16QAM	3/4

5.4.2.2 Set transmission data (ASDU) length

The function must allow setting the length to an arbitrary value (0 to 1500 octets) suitable for transmission data rates (see section 5.4.2.1).

5.4.2.3 Set transmission frame count

The function must allow setting the frame count to an arbitrary value (1 to x) suitable for the transmission data rate and data length.

When simulating multiple base stations, the transmission frame count for each base station must be settable to 1.

The value of x is determined by the operation management organization.

A profile function that enables free setting of transmission frames (transmission data length) and transmission frame interval (in 1 μs units) for a control period of 100 ms and 200 ms must be provided. Furthermore, the number of repetitions for the period set with the profile function must be settable to 500 and 1000.

5.4.2.4 Set transmission frame interval

The function must allow setting the transmission frame interval at the antenna terminal of the simulator to the shortest space.

5.4.2.5 Set variable attenuation

The function must allow setting the transmission power of the simulator to -50 dBm.

Taking also the antenna characteristics into account, it must be possible to set values so that the tests can be performed.

5.4.2.6 Set IR control field (synchronization information)

The function must allow setting the synchronization information in the IR control field to an arbitrary value for each transmitted frame, as shown below.

(b2, b1, b0) = (1, 0, 0), (0, 0, 0)

5.4.2.7 Set IR control field (timestamp)

The function must allow setting the timestamp field in the IR control field to an arbitrary value in the range from 0 to 999999 for each transmitted frame. It must also be possible to independently set the timer of the base station and mobile station to separate values.

5.4.2.8 Set IR control field (roadside-to-vehicle communication period information)

The function must allow setting arbitrary values for roadside-to-vehicle communication period information (b7, b6: transfer count, b5 to b0: roadside-to-vehicle communication period duration) for the roadside-to-vehicle communication period 1 to 16 (length of all fields 16 octets) for each transmitted frame.

5.4.2.9 Set invalid frame transmission (security)

The function must allow sending a signal corresponding to an invalid message frame (frame with out-of-range data structure or frame created with out-of-range security parameter setting) for security processing by the UUT.

5.4.2.10 Indicate frame reception timestamp

The function must allow indicating the time (rxtime) when a frame was received.

When the simulator functions as a base station and mobile station, or multiple mobile stations, a non-synchronized condition will exist between the base station and mobile station, or multiple mobile stations, and it is necessary to know the time at the base station and each mobile station at the point of frame reception. The simulated base station and mobile stations therefore must have a timer.

5.4.2.11 Indicate IR control field (synchronization information) (reception)

The function must allow indicating the synchronization information in the IR control field of the normally received IPDU.

5.4.2.12 Indicate IR control field (timestamp) information (reception)

The function must allow indicating the timestamp in the IR control field of the normally received IPDU.

5.4.2.13 Indicate IR control field (roadside-to-vehicle communication period information) (reception)

The function must allow indicating the roadside-to-vehicle communication period information (transfer count, roadside-to-vehicle communication period duration) in the IR control field of the normally received IPDU.

5.4.3 Test programs

5.4.3.1 Definition of test program for simulator

The simulator must implement a test program that facilitates the conducting of connectivity testing with the UUT. However, procedural programs intended to completely automate the test process are outside the scope of the current specifications.

5.4.3.2 Implementation of test program for simulator

Fig. 5-4 shows the test program structure for the simulator.

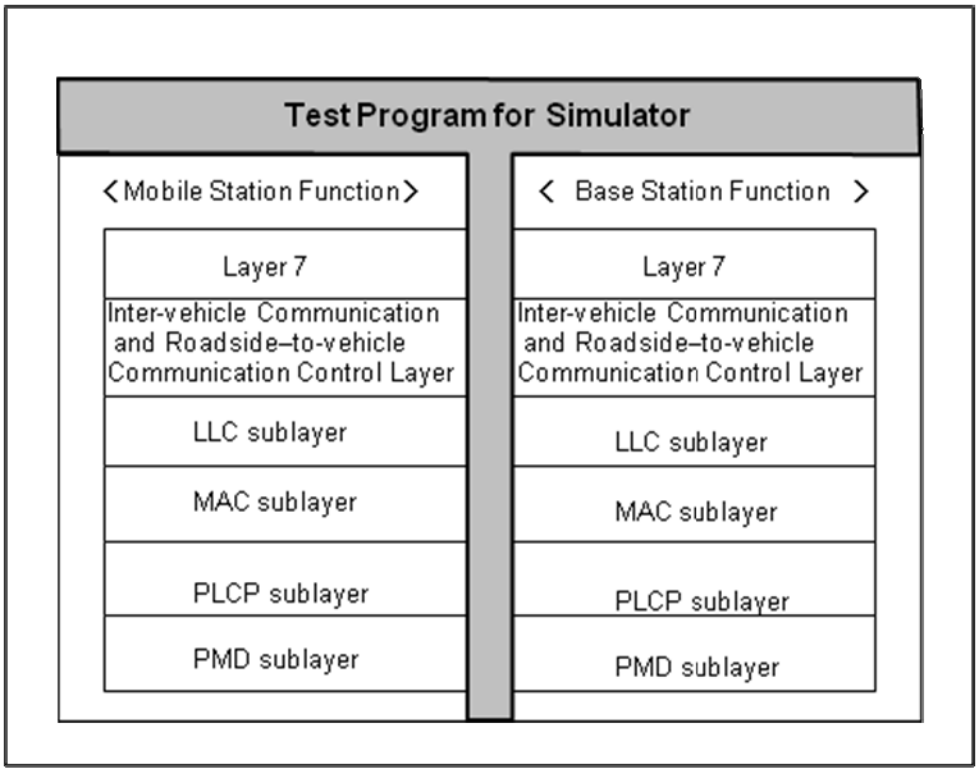


Fig. 5-4 Test Program Structure for Simulator

The test program for simulator covers the six operation modes to be realized by the simulator, as listed in Table 5-1, and starts the mobile station functions and base station functions as required. The implementation method and startup method are not specified. The test program for simulator must incorporate the setting and reading of the parameter of the simulator used for testing the UUT, and also must incorporates the logging function of the measured data. Furthermore, functions for testing error handling and for maintenance management are also required.

5.4.4 Error handling function

The simulator shall incorporate a function for transmitting a signal that is suitable for checking the error handling performance of the UUT. An error in the context of this document envisions a condition as defined in the SDL diagram, but until the SDL diagram has been finalized, the capability for checking the exception handling performance of the UUT is desirable.

"Exception handling" in this document is as defined in the section on Exception test in Chapter 4.

The specifications required of the simulator with regard to exception handling must be such as to allow performing the tests of Chapter 4. In concrete terms, this means the ability to transmit the basic parameters for a specific Interoperability Verification Test.

5.5 Maintenance management function

5.5.1 Self-diagnosis function

The simulator specified in this chapter shall have a self-diagnosis function that can detect defects and error conditions and can provide notification of such conditions to external equipment. Some examples of defects and error conditions are listed below.

- Internal temperature problem
- Fan stop
- Frequency synthesizer out-of-lock condition
- RAM/ROM checksum error
- Transmission data rate / data length / frame count / data content error

With regard to defects and error conditions that cannot be detected by the self-diagnosis function, a provision must be made to evaluate these by using test bed facilities such as the standard mobile station, etc.

5.5.2 Monitor terminal

The simulator specified in this chapter shall be equipped with a connection for a terminal (monitor terminal) or similar equipment that allows monitoring the internal condition of the simulator. The monitor terminal must allow making parameter settings and issuing commands to the UUT. The monitor terminal shall possess an interface (GUI, etc.) that facilitates operation by the user.

5.5.3 Log data storage function

The simulator specified in this chapter shall be equipped with a storage device for storing log data obtained during testing. Storage can be implemented either in the simulator itself or in the monitor terminal.

Chapter 6 Definitions and Abbreviations

6.1 Glossary

The following definitions are used in the glossary of this Guideline.

[IR control field]

A field included in the IPDU, comprising the protocol version, type, synchronization information, reserved field, timestamp, roadside-to-vehicle communication period information, and enhanced field.

[IVC-RVC Protocol Data Unit (IPDU)]

Data unit exchanged between the inter-vehicle and roadside-to-vehicle communication (IVC-RVC) control information layers.

[Application Service Data Unit (ASDU)]

Data unit exchanged between application and layer 7.

[Mobile station]

A radio station installed in a vehicle or similar. Same meaning as "land mobile station".

[MAC Service Data Unit (MSDU)]

Data unit exchanged between LLC sublayer and MAC sublayer of layer 2.

[MAC sublayer]

Part where telecommunications management of the transmission channel of layer 1 is conducted.

[LLC sublayer]

To conduct packet transmission between entities in a high-ranking layer, this layer provides a non-confirmation connectionless type service.

[LLC Protocol Data Unit (LPDU)]

Data unit exchanged between the LLC sublayers of layer 2.

[Octet]

Element composed of a binary array of 8 bits.

[Step attenuator]

A device providing attenuation in adjustable steps of 10 dB and 1 dB.

[Base station]

A radio station set up at the roadside.

[Antenna connector]

Also called antenna port, this is a coaxial connector for connecting the antenna of the UUT. It may be mounted directly on the chassia of the radio station or employ a pigtail configuration with a cable protruding from the chassia and having a connector at the end.

[Cable connection]

A configuration where the antenna terminal (coaxial connector) of the radio station is connected directly to the connectivity testing equipment via a coaxial cable.

[Shielded room / shielded box]

A larger (room) or smaller (box) device that uses metal plating or other means to prevent or attenuate electromagnetic radiation passing from the inside to the outside and vice versa.

[Signal analyzer]

A measuring equipment, usually called a vector signal analyzer, that is used for measurement and allows various types of analysis and evaluation of modulated signals. By implementing signal analysis software for wireless LAN, it allows analysis and evaluation of OFDM signals. The equipment enables measurement of the three elements determining modulation accuracy, namely transmitter center frequency leakage, transmitter spectral flatness, and transmitter constellation error. The packet error rate (PER) can also be measured.

[Testing program]

A test program is a program either implemented in the UUT, standard mobile station, standard base station, and simulator, or implemented in external equipment, serving to perform input and output of test data, transmission and reception of test messages. According to requirements, the program also comprises functions that allow the display and evaluation of test results.

[Simulator]

A equipment comprising the communication interface functions of both base station and mobile station, and capable of two-way communication with the UUT via RF signals. The specifications are described in Chapter 5 of this Guideline.

[Connectivity testing equipment]

Test equipment to which the UUT can be connected, with the aim of measuring the functions and performance of the UUT. The connectivity testing equipment category includes measuring equipment and the simulator.

[Data rate]

A quantity expressing the data transfer speed. Same meaning as "RATE" in the SIGNAL field.

[Packet Error Rate (PER)]

A ratio calculated from the number of successfully received packets vs. the number of transmitted packets.

[Packet error rate counter]

A measuring equipment for determining the packet error rate. Commonly consists of a bit error counter and a computer running dedicated software for calculating the packet error rate.

[Unit Under Test (UUT)]

The land mobile radio station whose radio equipment is being tested.

[Standard]

A document by the Association of Radio Industries and Businesses (ARIB) specifying standard requirements for consumer equipment utilizing radio waves.

[Standard base station]

A reference base station produced by each respective manufacturer and certified by the operation management organization.

[Standard mobile station]

A reference mobile station produced by each respective manufacturer and certified by the operation management organization.

[Protocol Data Unit (PDU)]

Data unit exchanged between same-level protocols.

[Preamble]

Refers to the PLCP preamble, which is first part of the transmitted/received signal serving to enable signal detection and synchronization.

[Primitive]

A basic instruction used for requesting and providing services between layers.

[Vector signal generator]

A signal generator allowing vector modulation, able to produce various kinds of modulated signals, non-modulated waves, etc. Through the use of functional options, a vector signal generator can also produce OFDM signals.

[Wireless connection]

A configuration where the radio station with integrated antenna is connected to the connectivity testing equipment via a radio wave link.

[Land mobile station]

A radio station installed in a vehicle or similar. Same meaning as "mobile station".

[Layer 1]

A conceptual hierarchy indicating the physical medium in which signal transmission occurs. (Also called the physical layer, providing the interface for layer 2.)

[Layer 2]

A conceptual hierarchy indicating the medium in which data link control occurs. (Also called the data link layer, providing the interface for the inter-vehicle and roadside-to-vehicle communication control information layer.)

[Layer 7]

A conceptual hierarchy indicating the medium in which general processing functions for various applications are performed. (Provides the interface for applications.)

[Roadside-to-vehicle communication period information]

Information included in the IR control field of the IPDU, consisting of the transfer count and roadside-to-vehicle communication period duration.

6.2 Abbreviations

[A]

AC:	Alternate Current
ALME:	Application Layer Management Entity
ARIB:	Association of Radio Industries and Businesses
ASDU:	Application Service Data Unit

[B]

BPSK:	Binary Phase Shift Keying

[C]

CCA:	Clear Channel Assessment
CSMA:	Carrier Sense Multiple Access

[D]

DC: Direct Current

DSAP: Destination Service Access Point

[E]

[F]

FI: Frame Information

[G]

GPS: Global Positioning System

GUI: Graphical User Interface

[H]

[I]

IPDU: IVC-RVC Protocol Data Unit

ITS: Intelligent Transport Systems

IVC-RVC: Inter-Vehicle Communication - Roadside-to-Vehicle Communication

[J]

JATE: Japan Approvals Institute for Telecommunications Equipment

JIS: Japanese Industrial Standards

[K]

[L]

L1: Layer 1 (Physical Layer)

L2: Layer 2 (Data Link Layer)

L7: Layer 7 (Application Layer)

LLC: Logical Link Control

LPDU: LLC Protocol Data Unit

[M]

MAC: Medium Access Control

MSDU: MAC Service Data Unit

[N]

[O]

[P]
PDU: Protocol Data Unit
PLCP: Physical Layer Convergence Protocol
PMD: Physical Medium Dependent

[Q]
QAM: Quadrature Amplitude Modulation
QPSK: Quadrature Phase Shift Keying

[R]
RAM: Random Access Memory
RF: Radio Frequency
ROM: Read Only Memory

[S]
SDL: Specification and Description Language
SSAP: Source Service Access Point

[T]
TTC: Telecommunication Technology Committee

[U]

[V]
VCCI: Voluntary Control Council for Information Technology Equipment

[W]

[X]

[Y]

[Z]

[Blank]

Annex A: Values Determined by Operation Management Organization

When performing the Interoperability Verification Test, specific numerical values must be used. However, actual values that cannot be specified as part of this Guideline are denoted here by the letter "x". Such values are to be set and specified by the operation management organization, i.e. the public or business entity that is responsible for services and/or operation of the 700 MHz band system, or an entity to which this task has been officially assigned.

This Guideline is based on the assumption that it will be used by the operation management organization, and therefore makes explicit use of "x" wherever necessary.

Table Annex-A lists all locations where "x" is used.

Table Annex-A List of Locations Where "x" Is Used

No.	Section number	Item	Notation	NOTE
1	2.5.2 Test description of physical layer	Test number TR 2-1-3	x dBm	Power value
2	3.4 Security test description	Test number 1, 2, 3, 4, 5, 6	Value x	Security parameter
3	4.3.2 Interoperability verification test parameters	Layer 7	Value x	ApplicationData
4	4.3.3.1 Test description for Interoperability test	Test number 4-1-IN	Value x	Security parameter
5	As above	As above	Value x	Encryption key
6	As above	Test number 4-4-IN	Value x	Security parameter
7	As above	As above	Value x	Encryption key
8	4.3.3.3 Test description for Performance test	Test number 4-2-PER	x μs	Setting value
9	As above	As above	Value x	Verification item
10	As above	Test number 4-3-PER	x μs	Setting value
11	As above	As above	Value x	Verification item
12	As above	Test number 4-4-PER	x μs	Setting value
13	As above	As above	Value x	Verification item
14	As above	Test number 4-5-PER	x μs	Setting value
15	As above	As above	x times	Test procedure
16	As above	As above	Value x	Verification item

Annex B: Simulator Output Levels for Tests TR 2-2-4/TR 2-2-5

The spectrum analyzer conditions required for calculating the simulator output level for the TR 2-2-4 and TR 2-2-5 tests are given in B.1.

B.1 Reason why a UUT signal of -30 dBm or more is required at the spectrum analyzer input for TR 2-2-4/TR 2-2-5

The reason why the test conditions for TR 2-2-4 and TR 2-2-5 in the Technical Report are given as "UUT signal of -30 dBm or more required at spectrum analyzer input" is as follows.

The display noise level of a spectrum analyzer is commonly on the order of -150 dBm/Hz to -140 dBm/Hz.

In the TR 2-2-4/TR 2-2-5 test, the spectrum analyzer setting RBW = 10 MHz is used. Taking the bandwidth of 10 MHz (10log(10 MHz) = 70 dB) into account, the display noise level is -80 dBm to -70 dBm. In order to ensure that the level of the invalid signal packet occurring once every 1000 times (-30 dB with an Ave setting of 1000) is higher than the internal noise level of the spectrum analyzer (-70 dBm), i.e. to ensure that it is at least -60 dBm, the signal P2 at the spectrum analyzer input must be at least -30 dBm.

From the above, it follows that the display noise level of the spectrum analyzer must be -140 dBm/Hz or lower.

B.2 Calculating the simulator output level

Assuming that spectrum analysis for TR tests is done with measuring equipment that supports physical layer tests and also implements spectrum analyzer functions, the display noise level of the measuring equipment should be on the order of about -150 dBm/Hz.

In section B.1, the display noise level of the spectrum analyzer is assumed to be at least -140 dBm/Hz. The -150 dBm/Hz requirement therefore can be met by inserting a 10 dB attenuator at the input of the spectrum analyzer. The internal mixer input level of the spectrum analyzer is about -10 dBm maximum. When the PAPR (Peak to Average Power Ratio) of the OFDM signal is 13 dB, the level that can be input to the spectrum analyzer is (-10 dBm + 10 dB (SA_ATT[*1]) -13 dB (PAPR) =) -13 dBm or lower.

To keep the P2 signal from the UUT at the spectrum analyzer input to -13 dBm or lower, the suitable values in the test configuration diagram for TR-2-2-4/TR 2-2-5 are as follows. UUT output level: +20 dBm, power divider insertion loss: 6 dB, cable loss:

disregarded, attenuation setting of step attenuator 2: 27 dB or higher.

The required condition for obtaining a level of -50 dBm for the signal from the simulator at the antenna terminal of the UUT is as follows. Simulator output: (-50 dBm + 27 dB (ATT2[*2]) + 6 dB + 0 dB (ATT1[*3]) =) -17 dBm or higher

*1: Attenuator at spectrum analyzer input

*2: Step attenuator 2 in test configuration diagram for TR 2-2-4/TR 2-2-5

*3: Step attenuator 1 in test configuration diagram for TR 2-2-4/TR 2-2-5

Simulator output level ≧-17 dBm

The following diagram illustrates the conditions described above.

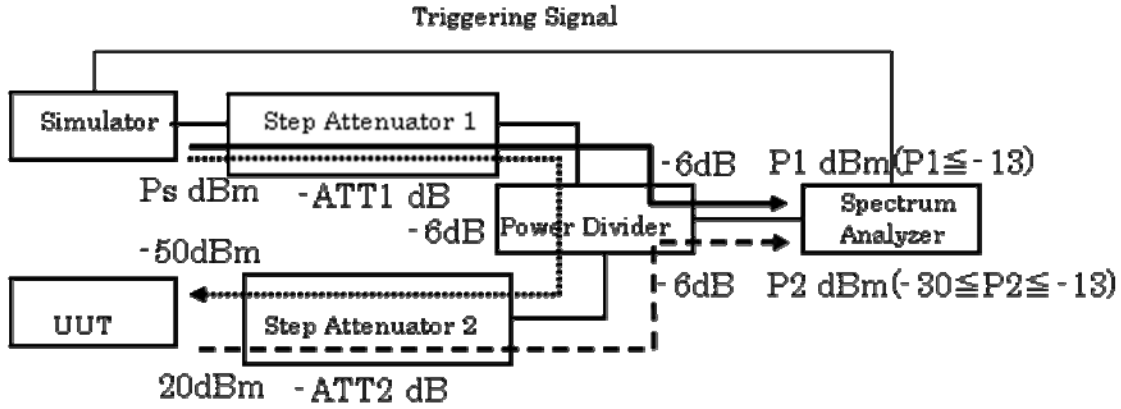


Fig.B-1 Test Configuration and Signal Level

Table B-1 Test Requirements

Parameter	Setting value	NOTE
UUT output level	20 dBm	
Power divider loss	6 dB	
Cable loss	0 dB	
Spectrum analyzer maximum input level (OFDM signal input)	-13 dBm	
Spectrum analyzer display noise level	-70 dBm/10 MHz	
Input level of simulator signal at UUT	-50 dBm	from Technical Documentation
Minimum spectrum analyzer input level of UUT signal	-30 dBm	from Technical Documentation

P1 - ATT1 - 6 - ATT2 = -50 (1)

P1 - ATT1 - 6 = P2 ≦ -13 (2)

-30 ≦ (20 - ATT2 - 6) ≦ -13 (3)

From equation (3), 27 ≦ ATT2 ≦ 44 (4)

From equation (2), P1 - ATT1 ≦ -7 (5)

From equation (1), P1 - ATT1 + 44 = ATT2 (6)

From equation (6) and equation (4) 27 ≦ (P1 - ATT1 + 44) ≦ 44

-17 ≦ (P1 - ATT1) ≦ 0 (7)

Relational expression to fulfill both equation (7) and equation (5)

-17 ≦ (P1 - ATT1) ≦ -7

When ATT1 = 0dB

-17 ≦ P1≦ -7

When P1 is -7 dBm or higher, attenuated with ATT1*, P1 must be made at least

P1 ≧ -17 [dBm]

* Setting range of ATT1 must be chosen so that UUT signal can be received by simulator.