Specification of Diagnostic Communication
(Diagnostic on CAN - Network Layer)

<CONTENTS>

1. Scope

This specification prescribes about Network Layer utilized for data communication between the electronic control unit (ECU) and a diagnostic tool on CAN bus.
Contents without this specification refer to ISO 15765-2 (Network layer service).

2. Application

This specification applies to ECUs and a diagnosis tester to execute data communication on CAN bus.

3. Definition of Terms

The key terms used in this specification are defined as follows:

(1) $
The values following to the symbol $ are the number of hexadecimal.
(Store appropriate numerical value in "$XX").

4.Network Layer Definitions

4.1 CAN message format

CAN message consists of following information.

(1) Address Information (N_AI)
It contains the priority and the address information.

(2) Network Protocol Control Information (N_PCI)
It contains the frame type, the number of frame, and the data length.

(3) Network Data (N_Data)
It contains the Message Data to transmit.

Table4.1 CAN message format (Normal fixed addressing)

N_PDU type	CAN ID	CAN frame data field							
		Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
Single Frame	N_AI	N_PCI	N_Data						
First Frame	N_AI	N_PCI		N_Data					
Consecutive Frame	N_AI	N_PCI	N_Data						
Flow Control Frame	N_AI	N_PCI			N/A				

The Functional addressing is applied only to the Single Frame.

4.2 N_AI (CAN-ID) format

N_AI (CAN-ID) uses Physical / Functional CAN ID of CAN2.0B frame format.

Table4.2 29 bit CAN identifers

CAN ID Type	CAN Identifier (29bit)			
Physical CAN ID	$18	$DA	Target Address ($XX)	Source Address ($XX)
Functional CAN ID	$18	$DB	Target Address ($XX)	Source Address ($XX)

Table4.3 Physical / Functional Addressing Definition

Addressing	Description
Physical	Using a Diagnostic Address ID assigned to specific ECU, the request message is transmitted. By this way, the diagnostic tool can designate one ECU.
Functional	Using a global Diagnostic Address ID, the request message is transmitted. By this way, the diagnostic tool can designate multiple ECUs (e.g. all ECU on a vehicle).

4.2.1 Target / Source Address

The address used to identify each ECU is defined separately. Basically, the address for diagnostic tool shall be "$FA". However if an ECU cannot use it, inquire of Mitsubishi FUSO Design Department.

4.3 Single Frame Transmission

In case that the length of data transmitted by the sender are 7 bytes or less, the Single Frame shall be used.

(1) Transmission flow

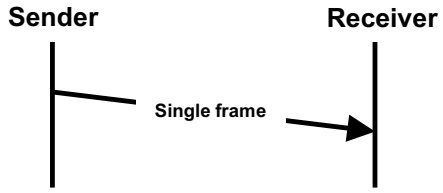


Figure4.1 Flow of Single Frame transmission

(2) Single Frame N_PCI byte and N_Data bytes

Table4.4 Overview of SF N_PCI byte and N_Data bytes

	N_PCI								N_Data
	Byte #1								Byte #2 - #8
	7	6	5	4	3	2	1	0	-
Single Frame	0	0	0	0	SF_DL				Message Data (1 - 7 Byte)

(a) Single Frame Data Length (SF_DL) parameter definition

This parameter is used to specify the number of Message data bytes in transmission data field (N_Data: Byte #2 - #8).

Table4.5 Definition of SF_DL values

Hex value	Description	Remarks
$0	Reserved	
$1 - $6	It shall be assigned the value of the valid message data length.	Extended or Mixed addressing
$1 - $7		Normal addressing
$8 - $F	Invalid	

4.4 Multiple Frame Transmission

In case that the length of data transmitted by the sender is over 7 bytes, the Multiple Frame that sends after segmenting the data into several frames shall be used.

(1) Transmission flow

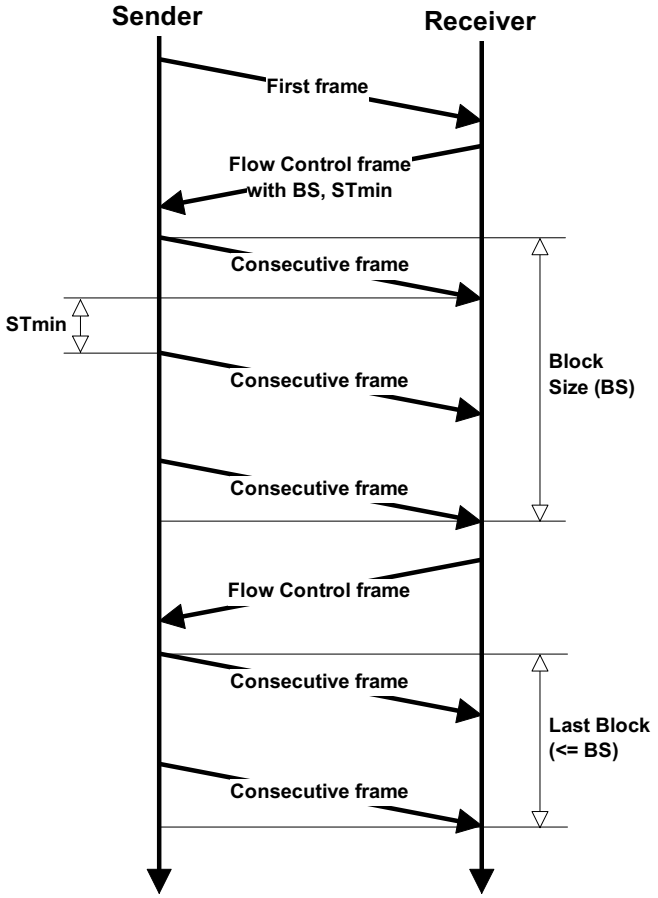


Figure4.2 Flow of Multiple Frame Transmission

(2) First Frame

The First Frame shall be used to inform the receiver that the sender will transmit the Multiple Frame, with information of data length that will be transmitted in the future.

(a) First Frame N_PCI bytes

Table4.6 Overview of First Frame N_PCI bytes

	N_PCI								
	Byte #1								Byte #2
	7	6	5	4	3	2	1	0	7 - 0
First Frame	0	0	0	1	FF_DL				

(b) First Frame Data Length (FF_DL) parameter definition

Table4.7 Definition of FF_DL values

Hex value	Description	Remarks
$0 - $6	Invalid	
$7 - $FFF	It shall be assigned the value of the valid message data length (maximum: 4095 bytes). Total is 12 Bit (The Bit3 of Byte #1 is MSB and the Bit0 of Byte #2 is LSB). It is amounted to 12 bits (The Bit 3 of Byte #1 is MSB, the Bit 0 of Byte #2 is LSB).	Extended or Mixed addressing
$8 - $FFF		Normal addressing

(3) Consecutive Frame

After sending a First Frame, all segmented data is sent with Consecutive Frame.

(a) Consecutive Frame N_PCI byte and N_Data bytes

Table4.8 Overview of Consecutive Frame N_PCI byte and N_Data bytes

	N_PCI								N_Data
	Byte #1								Byte #2 - #8
	7	6	5	4	3	2	1	0	-
Consecutive Frame	0	0	1	0	SN (Repeat $ 0 - $F)				Message Data (1 - 7 Byte)

(b) Sequence Number (SN) parameter definition

Table4.9 Definition of SN values

Hex value	Description
$0 - $F	It is a number set from "0 (= $0)" to "15 (= $F)" as identifier number of frames. The 1st Consecutive Frame is numbered in "1 (= $1)". This number counts up from "0 (= $0)" again when it reached "15 (= $F)". In addition, this number is incremented one by one without influencing a Flow Control Frame.

(4) Flow Control Frame

The Flow Control Frame shall be transmitted as a response of the following frame. When responding, the data processing status of the receiver is transmitted with this frame.

- First Frame
- Consecutive Frame

The sender shall transmit data corresponding to the Flow Control Frame.

(a) Flow Control Frame N_PCI bytes

Table4.10 Overview of Flow Control Frame N_PCI bytes

	N_PCI									
	Byte #1								Byte #2	Byte #3
	7	6	5	4	3	2	1	0	-	-
Flow Control Frame	0	0	1	1	FS				BS*1	STmin*1

*1) These bytes are only present when responding for the First Frame.

(b) Flow Status (FS) parameter definition

This parameter shall contain a value of Table4.11 according to a state of the receiver.

Table4.11 Definition of FS values

Hex value	Description
$0	**Continue To Send (CTS)** The meaning of this value is that the receiver is ready to receive a maximum of BS number of Consecutive frames.
$1	**Wait (WT)** The meaning of this value is that the receiver requests that the sender waits without sending a new Consecutive Frame. When the sender received this status, It shall wait a new Flow Control Frame sent within N_Bs (see section 4.5). The receiver shall not transmit this value in succession more than 4 times. When processing was not completed within 3 times, the 4th Flow Control Frame shall not transmit. And after time-out processing, execute a retry.
$2	**Overflow (OVFLW)** The meaning of this value is that the data length (FF_DL) in First Frame exceeds the buffer size of receiver. The sender shall abort the transmission of a segmented message.
$3 - $F	Reserved

(c) Block Size (BS) parameter definition

This parameter shall contain the number of Consecutive Frames that can be received at once. The sender shall transmit frames per block size, and wait for the Flow Control Frame from the receiver afterwards.

Because only the last block of Consecutive Frames may have less than the Block Size number of frames, the receiver shall decide the number of all frames by First Frame Data Length.

Table4.12 Definition of BS values

Hex value	Description
$00	This parameter shall be used to indicate to the sender that the receiver can receive all Consecutive frames without the Flow Control Frame.
$01 - $FF	These parameters shall be used to indicate to the sender the maximum number of Consecutive Frames that can be received without an intermediate Flow Control Frame.

Basically, when an ECU need not correspond to the Flash Reprogramming Session and regulations, the Block Size in a Flow Control Frame shall be fixed to 8 (= $8), and be used.

(d) Definition of Separation Time (STmin) parameter

This parameter shall contain the minimum time between Consecutive Frames when sending Consecutive Frames.

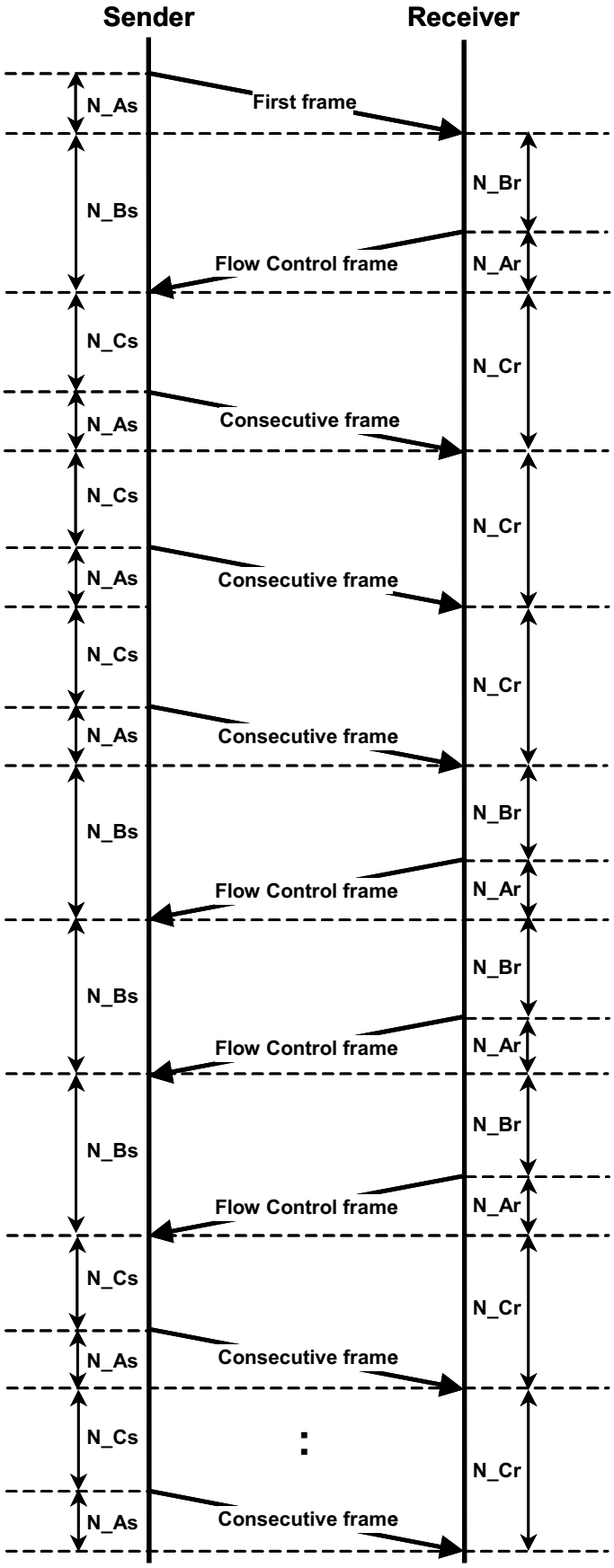
After sending the 1st Consecutive Frame, the sender shall wait for the minimum of Separation Time, and transmit next Consecutive Frame.

Table4.13 Definition of STmin values

Hex value	Description
$00 - $7F	0 [ms]-127 [ms]
$80 - $F0	Reserved
$F1 - $F9	100 [μs]-900 [μs]
$FA - $FF	Reserved

4.5 Network layer Timing

(1) Timing parameter Definition



Note) "s": sender, "r": receiver

Figure4.3 Placement of network layer timing parameters

Table4.14 Network layer timing parameter values

Timing Parameter	Description	Min	Max
N_Br	This parameter is the time until a necessary Flow Control Frame for ECU after reception of the First Frame or one Consecutive Frame is completed.	0 ms	5 ms
N_Cs	This parameter is the time untill an ECU transmits the 1st (or next) Consecutive Frame after reception of one Flow Control Frame is completed or transmission of one Consecutive Frame is completed.	Stmin,r	Stmin,r*
Stmin,r	This parameter is a timing parameter sent by a diagnostic tool to provide for the communication specification of the Consecutive Frame transmitted by an ECU.	Refer to ISO 15765-2	Refer to ISO 15765-2
Stmin,s	This parameter is a timing parameter sent by an ECU to provide for the communication specification of the Consecutive Frame transmitted by a diagnostic tool.	0 ms	20 ms

Note) N_Cs max timing parameter (Stmin,r*) shall be same value as Stmin,r. However if it is impossible, its value shall not exceed 2/3 of Cr max.

(2) Time-out Parameter Definition

When aborting communication between the diagnostic tool and the ECU, an appropriate time-out shall be executed.

Table4.15 Time-out parameter values

Timing Parameter	Description	Min	Max
N_As	This parameter is the time from an access to the network to transmission of a response message.	N/A	150 ms
N_Bs	This parameter is the time until the Flow Control Frame is received after transmission of the 1st (or next) Consecutive Frame is completed.	N/A	150 ms
N_Cr	This parameter is the ECU's waiting time for reception of the Consecutive Frame after transmission of the Flow Control Frame is completed or after reception of the last Consecutive Frame is completed.	N/A	150 ms

4.6 Error Handling

As a general rule, arrival of an unexpected data shall be ignored, with the exception of the Single Frame and the First Frame (physically addressed). In this case, the network layer shall not notify the upper layers of its arrival.

About error handling in each frame, refer to ISO 15765-2.