



**TODAY'S
TOPIC**

CONTENT

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INTRODUCTION TO UDS

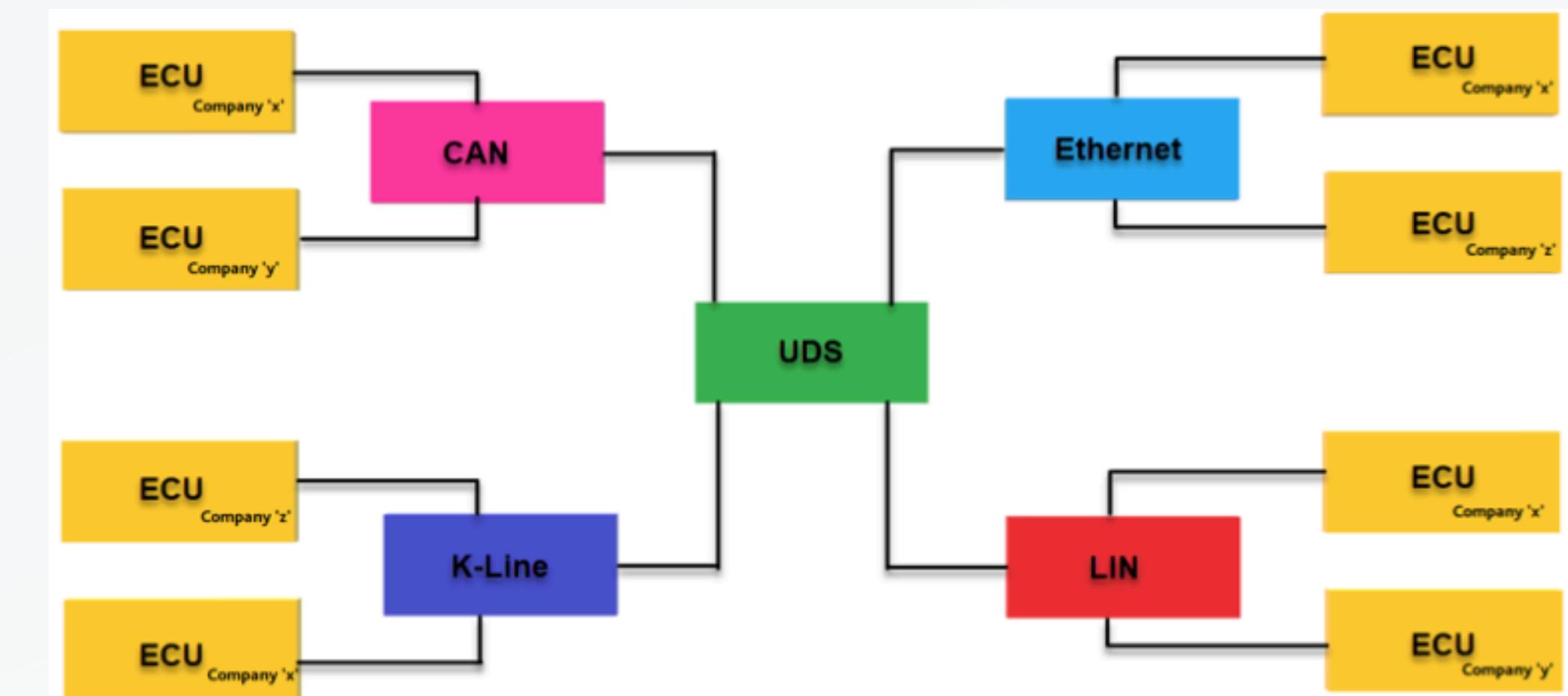
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OVERVIEW OF DIAGNOSTIC SERVICES

INTRODUCTION TO UDS

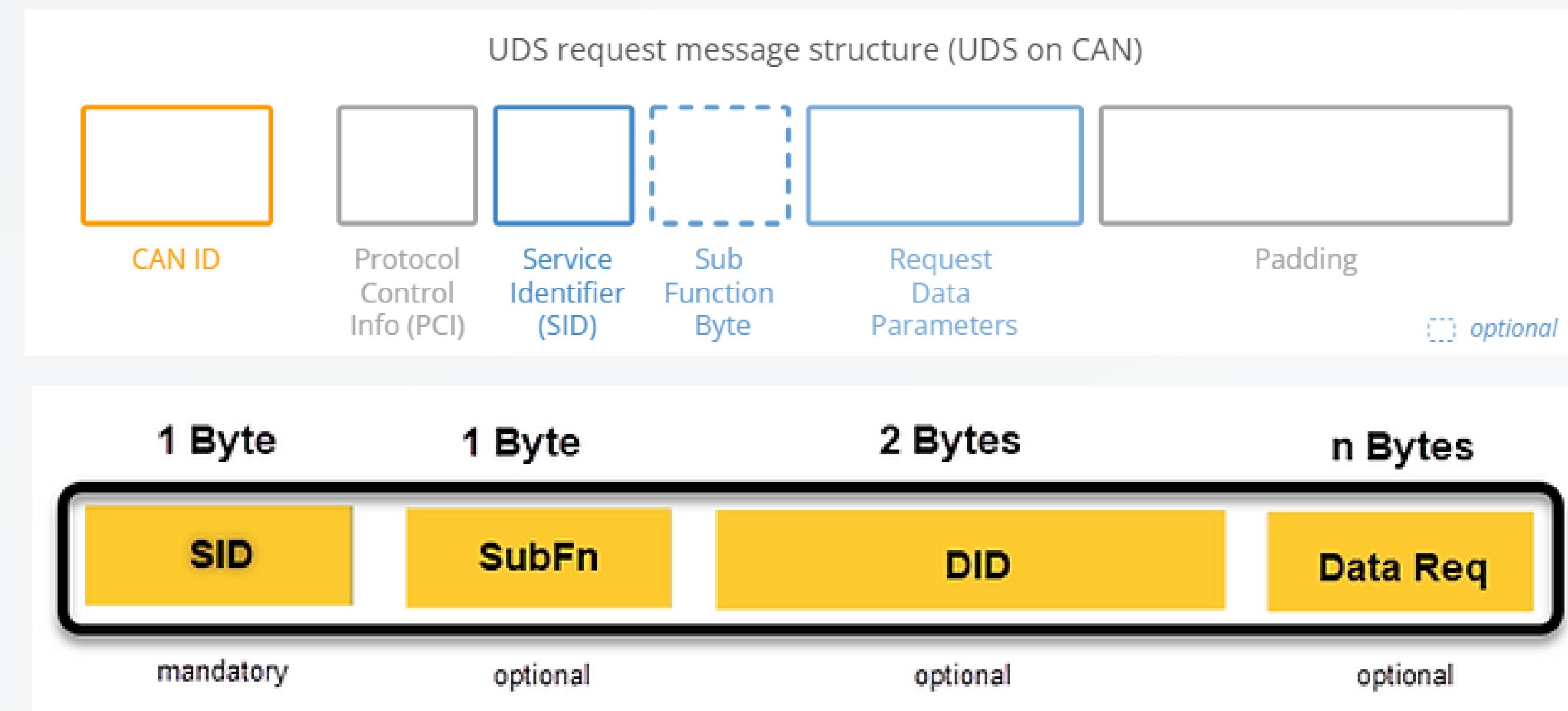
What is UDS?

Unified Diagnostic Services (UDS) is a communication protocol used in automotive Electronic Control Units (ECUs) to enable diagnostics, firmware updates, routine testing and more.



INTRODUCTION TO UDS

UDS Service Request: Format?



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UDS Service Request: PCI?

The PCI field is not per se related to the UDS request itself, but is required for diagnostic UDS requests made on CAN bus. In short, the PCI field can be 1–3 bytes long and contains information related to the transmission of messages that do not fit within a single CAN frame.

Role of PCI?

Message Segmentation and Reassembly:

Frame Type Identification:

Data Length Information:

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UDS Service Request: SID?

Positive response SID :
request SID + Ox40

Negative response SID:
always Ox7F

UDS service identifiers (SIDs)			
	UDS SID (request)	UDS SID (response)	Service
Diagnostic and Communications Management	0x10	0x50	Diagnostic Session Control
	0x11	0x51	ECU Reset
	0x27	0x67	Security Access
	0x28	0x68	Communication Control
	0x29	0x69	Authentication
	0x3E	0x7E	Tester Present
	0x83	0xC3	Access Timing Parameters
	0x84	0xC4	Secured Data Transmission
	0x85	0xC5	Control DTC Settings
	0x86	0xC6	Response On Event
Data Transmission	0x87	0xC7	Link Control
	0x22	0x62	Read Data By Identifier
	0x23	0x63	Read Memory By Address
	0x24	0x64	Read Scaling Data By Identifier
	0x2A	0x6A	Read Data By Identifier Periodic
	0x2C	0x6C	Dynamically Define Data Identifier
	0x2E	0x6E	Write Data By Identifier
	0x3D	0x7D	Write Memory By Address
	0x14	0x54	Clear Diagnostic Information
	0x19	0x59	Read DTC Information
DTCs	0x2F	0x6F	Input Output Control By Identifier
	0x31	0x71	Routine Control
	0x34	0x74	Request Download
	0x35	0x75	Request Upload
	0x36	0x76	Transfer Data
	0x37	0x77	Request Transfer Exit
	0x38	0x78	Request File Transfer
	0x7F		Negative Response
Sent with a Negative Response Code when a request cannot be handled			

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UDS Service Request: SFB?

UDS services - sub function types

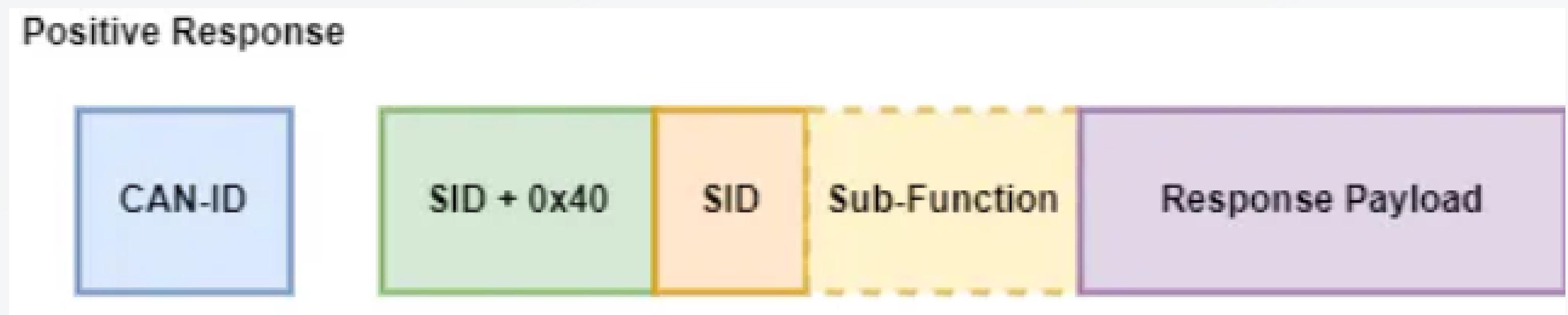
UDS SID (request)	UDS SID (response)	Service	Sub function types
0x10	0x50	Diagnostic Session Control	Diagnostic session type
0x11	0x51	ECU Reset	Reset type
0x27	0x67	Security Access	Security access type
0x28	0x68	Communication Control	Control type
0x3E	0x7E	Tester Present	"Zero sub function"
0x83	0xC3	Access Timing Parameters	Timing parameter access type
0x85	0xC5	Control DTC Settings	DTC setting type
0x86	0xC6	Response On Event	Event type
0x87	0xC7	Link Control	Link control type
0x2C	0x6C	Dynamically Define Data Identifier	Definition type
0x19	0x59	Read DTC Information	Report type
0x31	0x71	Routine Control	Routine control type

Bit 7 can be used to suppress positive response (if bit 7 is 1, ECU will not send the positive response to client)

But, negative response can't suppress

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UDS Service Response: Positive?



(Server to Client) Once the service request message is received by the server, it checks the request message. If everything is fine, the server performs the service requested and sends a positive response message.

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UDS Service Response: Negative?



(Server to Client) if a certain requested service cannot be performed by the server, it responds to the server with a negative response message.

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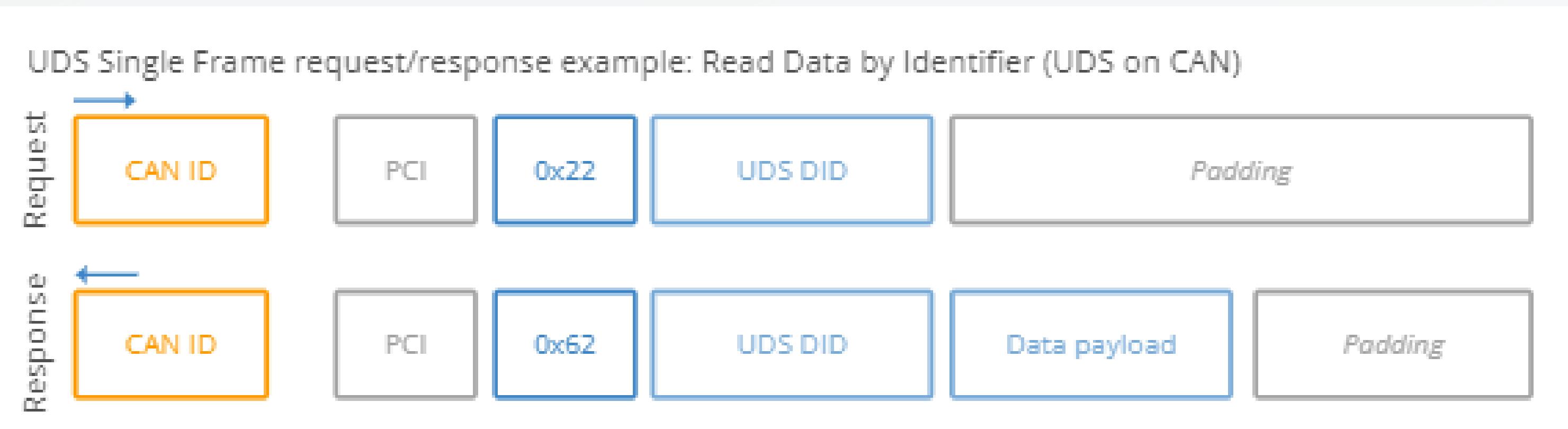
UDS Service Response: NRC?

UDS SID 0x7F - Negative Response Codes (NRC)

UDS NRC	Description
0x10	General reject
0x11	Service not supported
0x12	Sub-function not supported
0x13	Invalid message length/format
0x14	Response too long
0x21	Busy-repeat request
0x22	Conditions not correct
0x24	Request sequence error
0x25	No response from subnet component
0x26	Failure prevents execution of requested action
0x31	Request out of range
0x33	Security access denied
0x35	Invalid key
0x36	Exceeded number of attempts
0x37	Required time delay has not expired
0x70	Upload/download not accepted
0x71	Transfer data suspended
0x72	Programming failure
0x73	Wrong block sequence counter
0x78	Request received - response pending
0x7E	Sub function not supported in active session
0x7F	Service not supported in active session
0x81/0x82	RPM too high/low
0x83/0x84	Engine is running/not running

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Single-frame communication?



If payload can be included within 7 bytes, Simply send Single Frame.
Don't need to segmentation and there's no Flow Control.

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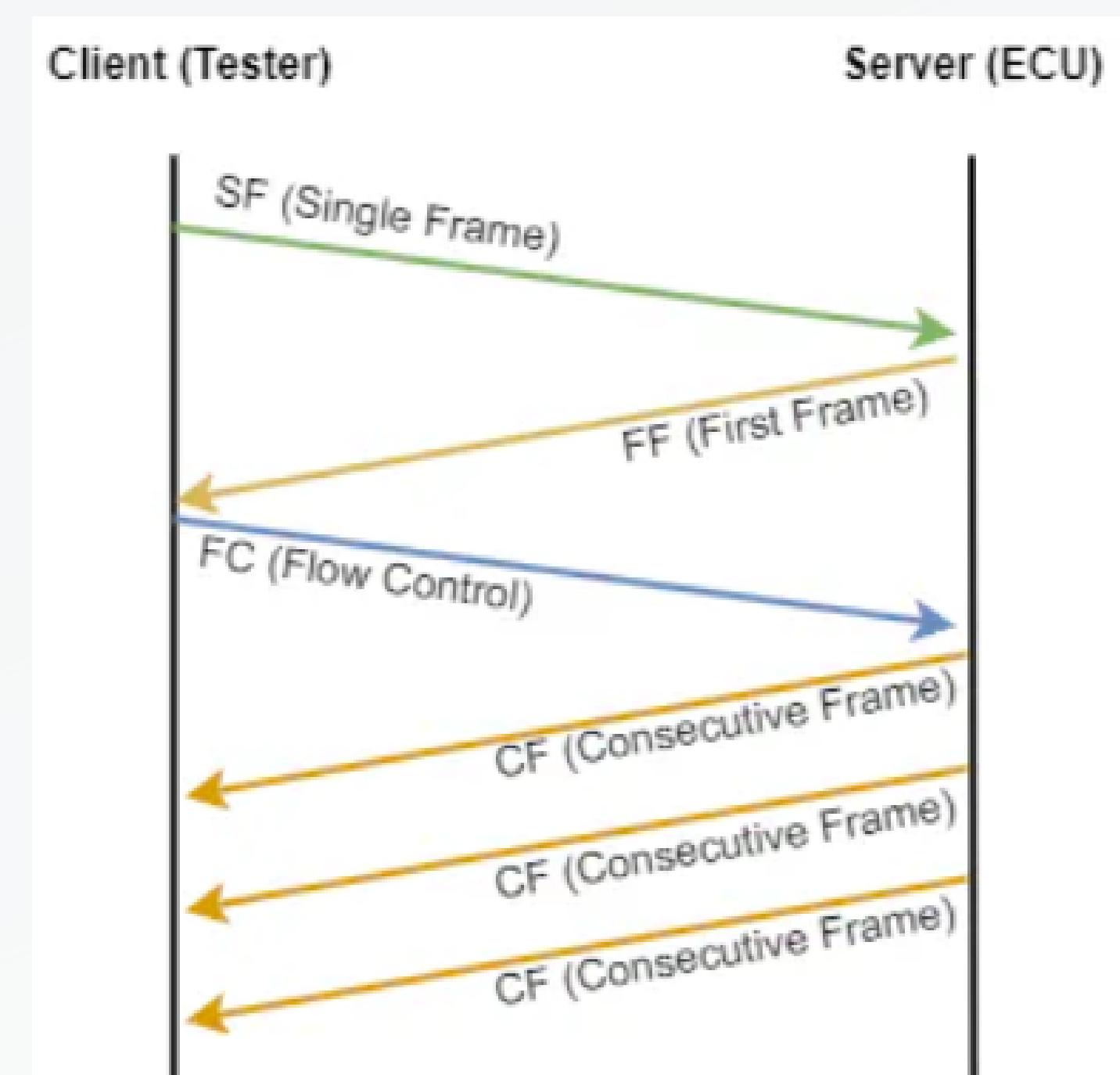
Multi-frame communication?

SF (Single Frame) - Contains the UDS request sent to the ECU.

FF (First Frame) - The ECU send this response with the initial part of the response and the total response length.

FC (Flow Control) - Gives the ECU some parameters that will define how the rest of the response will be sent to the tester. Most notably, there is the ST (Separation Time) Min parameter, which specifies the minimum time distance between each frame.

CF (Consecutive Frame) - Where the remainder of the response is sent by the ECU, according to the parameters specified in the FC frame.



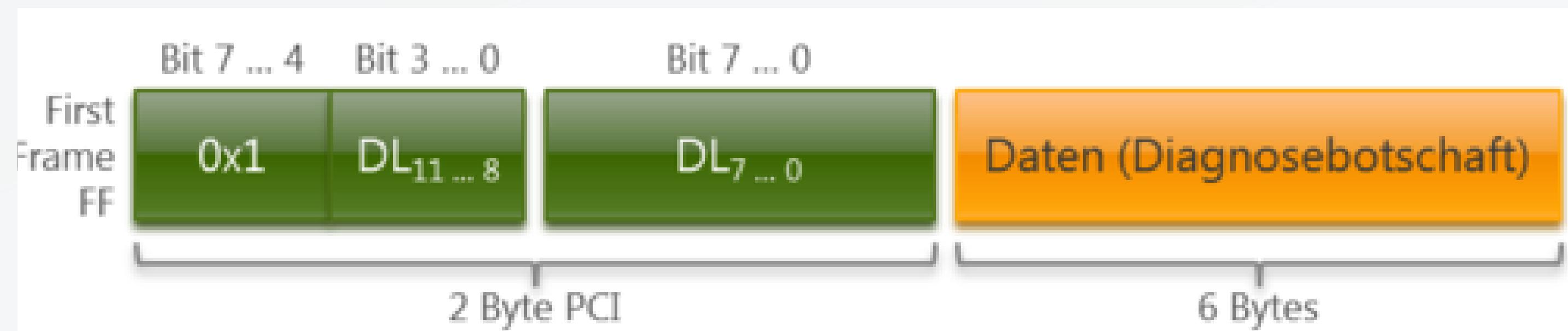
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Single Frame(SF)?



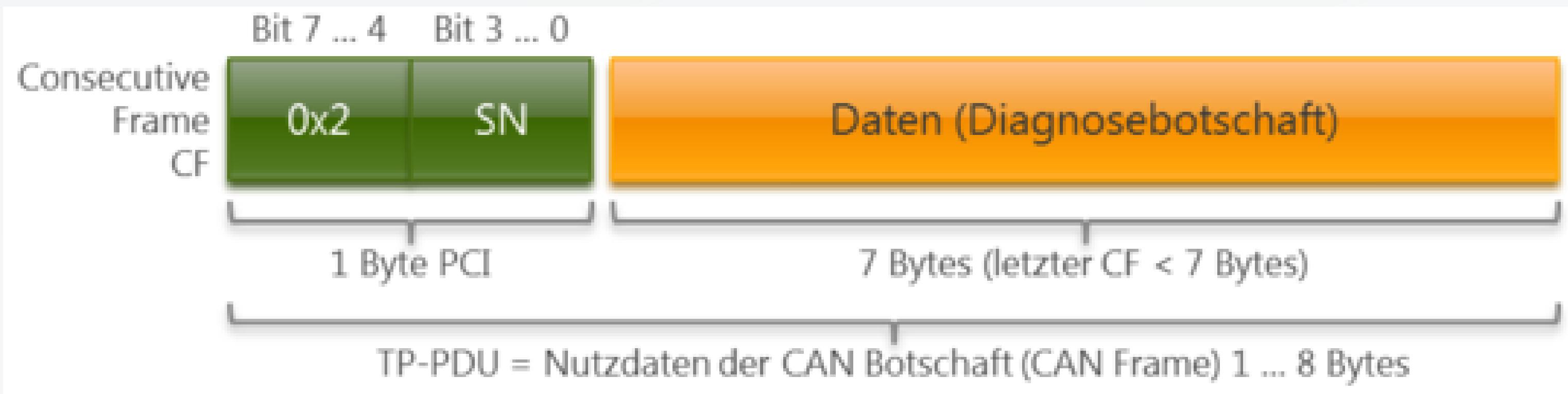
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First Frame(FF)?



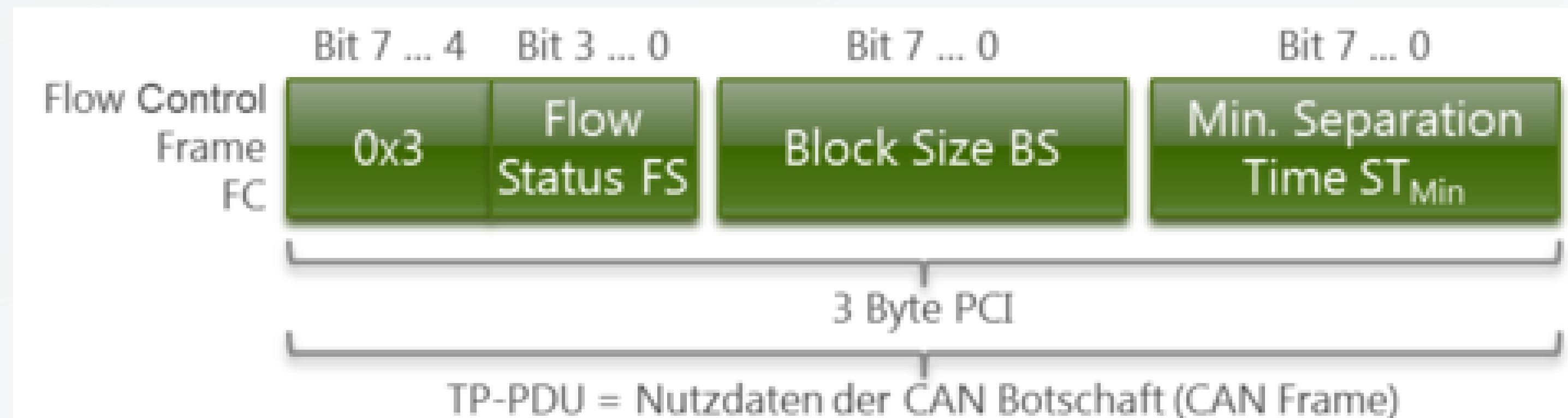
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Consecutive Frame(CF)?



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Flow Control Frame(FC)?



BIT 3...0 FLAG BOUNDARY : 0~2

FLAG 0X0 : CONTINUE TO SEND (CTS)

FLAG 0X1 : WAIT

FLAG 0X2 : OVERFLOW / ABORT

OVERVIEW OF DIAGNOSTIC SERVICES

What is Ox10?

Diagnostic Session Control

SBF ID	SBF NAME	Description
Ox01	Default Session	After power on, ECU will stay in this session
Ox02	ProgrammingSession	ECU boot mode for new software flashing
Ox03	Extended DiagnosticSession	A real diagnostic session where most of the diagnostic work is done
Ox04	System SafetyDiagnostic Session	Used to test all the safety-related ECUs. Ex: Airbag

OVERVIEW OF DIAGNOSTIC SERVICES

What is Ox11?

ECU Reset

The function of the ECU Reset Service Identifier (Ox11) is to reset the ECU/Server in a different format according to the problem requirement.

SBF	SBF Name	Description
Ox01	Hard Reset	This is Equivalent to power reset
Ox02	key Off On Reset	It is Equivalent to Ignition On-Off-on
Ox03	Soft Reset	It is Equivalent to watch-dog reset of a micro-controller

OVERVIEW OF DIAGNOSTIC SERVICES

What is Ox22?

Read Data By Identifier

Read Data by Identifier services allows the tester to request the server for recorded data. With this service, the tester can retrieve one or more data from the server.

SID (1 byte)

Data by Identifier (2 bytes)

Padding (5 bytes)

OVERVIEW OF DIAGNOSTIC SERVICES

What is Ox2E?

Write Data By Identifier

Write data by identifier service allows the client (diagnostic tool) to write the information on the ECU at the memory location with the help of a Data Identifier (DID).

Request Frame

SID (1 byte)

Data by Identifier (2 bytes)

Data parameter (n bytes)

Positive Response Frame

Response ID (SID+ 0X40)

Data Identifier

OVERVIEW OF DIAGNOSTIC SERVICES

What is Ox27?

Security Access Service

UDS Frame	D0	D1	D2	D3.....	Dn(Optional)
Seed –Request (Tool→ECU)	27	xx(Seed_Sunfunc)			Application specific Data
Seed –Response (Tool←ECU)	67	xx(Seed_Subfunc)			Seed_Value[n]
Key-Response (Tool→ECU)	27	zz (key_Subfunc)			Key_Value[n]
Response (If Key Verified) (Tool←ECU)	67	zz (key_Subfunc)			Application specific Data

OVERVIEW OF DIAGNOSTIC SERVICES

What is 0x28?

Communication Control

control byte

0x1	Normal Communication Messages
0x2	Network Management Communication Messages
0x3	Network Management Communication Messages and Normal Communication Messages

Sub Function	Description
0x00	Enable Rx and Tx
0x01	Enable Rx and Disable Tx
0x02	Disable Rx and Enable Tx
0x03	Disable Rx and Tx

OVERVIEW OF DIAGNOSTIC SERVICES

What is Ox19?

The Read DTC Information service is used in UDS protocol to read the DTC's from a vehicle or from a particular ECU or node.

Ox04 – Report DTC Snapshot Record By DTC Number

Ox06 – Report DTC Extended Data Record By DTC Number

OxOA – Report Supported DTCs

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What is DTC?

DTC: Diagnostic Trouble Code

A code stored by a vehicle's on-board diagnostic system when it detects a malfunction or issue.

DTC Frame?

DTC High Byte								DTC Middle Byte								DTC Low Byte							
\$9				\$2				\$3				\$4				\$0				\$0			
1	0	0	1	0	0	1	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0
B	1	1	2	2	3	3	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Add DTC status 1 byte. Total :4bytes

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What kind of DTC status?

statusOfDTC: bit field name	Bit #	Bit state	Description
testFailed	0	0	DTC is not failed at the time of the request
testFailedThisOperationCycle	1	0	DTC never failed on the current operation cycle
pendingDTC	2	0	DTC was not failed on the current or previous operation cycle
confirmedDTC	3	0	DTC is not confirmed at the time of the request
testNotCompletedSinceLastClear	4	0	DTC test were completed since the last code clear
testFailedSinceLastClear	5	0	DTC test never failed since last code clear
testNotCompletedThisOperationCycle	6	0	DTC test completed this operation cycle
warningIndicatorRequested	7	0	Server is not requesting warningIndicator to be active