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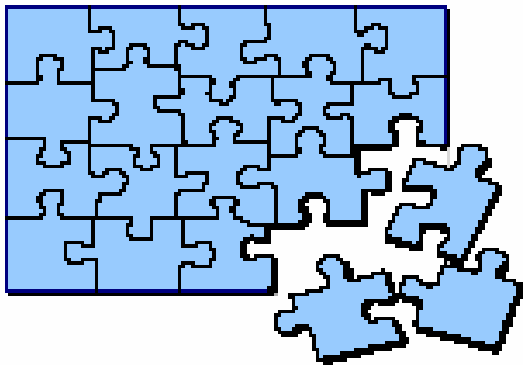

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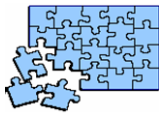
IM Solutions OBD Communication Update Webinar

Organizer and Introduction:
Nick Positano

Facilitator:
"G" Jerry Truglia

Speakers:
Bobby Gruszczynski
Fred Garza
Bernie Carr
Greg Potter



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On-Board-Diagnostics - OBDonUDS/J1979-2 - A Brave New World

Bob Gruszczynski
OBD Communication Expert
Retired

1

Rationale For UDS

- **Initial discussion time frame – Approximately 2012-2013**
- **Determination – SAE J2012 would use up all P-codes by 11/2020**
- **Internal discussion regarding solutions**
  - Dispense with P-B-C-U designators (see later slides)
  - Move to 3-byte DTCs only (2-byte + FTB)
  - Switch to UDS
  - Others…
- **Outcome – Switch to UDS**
  - Already in use by several OEMs
  - Allows/defines enhanced diagnostics
- **Also – Interim solution – dispense with "area of vehicle system" designator – beginning in 2017**

2

2

Rationale For UDS

- **Original J2012 intent to have separation of vehicle systems and subsystems**
- **Systems:**

System	Code Categories	Hex Value
Body	B0xxx - B3xxx	8xxx – Bxxx
Chassis	C0xxx - C3xxx	4xxx - 7xxx
Powertrain	P0xxx - P3xxx	0xxx - 3xxx
Network	U0xxx - U3xxx	Cxxx – Fxxx

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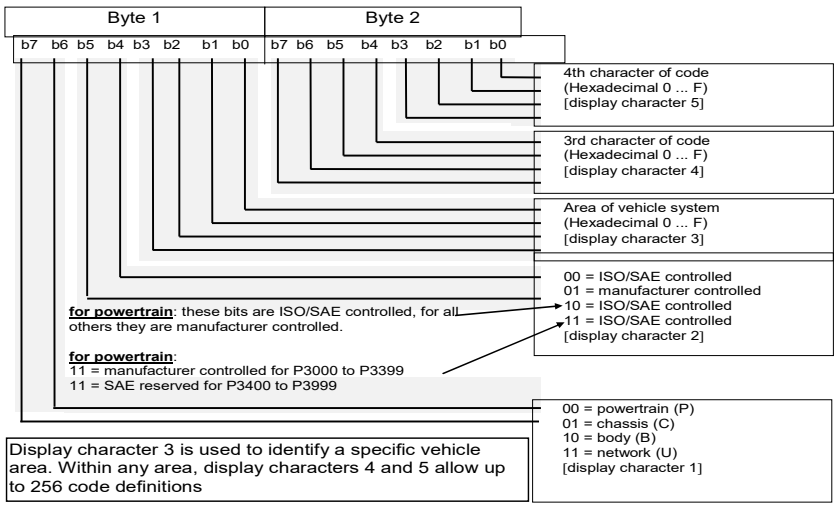
Rationale For UDS



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Rationale For UDS

- **Discussion moved to Alliance and Global Automakers groups and OEMs agreed (mostly)**
- **Once decided by Committee and the OEM groups, CARB buy-in was needed**
- **CARB initial discussion time frame – Approximately 2014**
- **Original discussion centered on remediation of DTC issue**
- **However, UDS encompasses more than just DTCs**
  - DIDs (Data identifiers), equivalent to J1979 PIDs
  - DTCs actually 4-bytes (FTB + status byte)
  - Enhanced data
  - Authentication, etc…

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Rationale For UDS

- **Original intent was to provide exactly the same information as available through J1979 (OBD-related PIDs, Vehicle information, etc…)**
- **However, CARB became interested in the enhanced features**
- **OEMs balked at providing extra data**
  - Enhanced data in UDS not standardized (only data areas and message formats)
  - OEMs differ in implementation/data definitions
- **Small group meetings have been taking place to discuss CARB requests and compromises to finish the transition.**
- **CARB regulation to feature UDS coming ~November 2020**
- **See CARB presentation covering new data requests**

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What is UDS?

- **Protocol which can be compared to SAE J1979**
- **Defined in ISO 14229 - Unified Diagnostic Services (UDS)**
  - ISO is the owner of this standard
  - SAE has worked out a “co-ownership” deal
  - J1979-2 will be the new SAE document defining “OBD on UDS”
- **Uses Services / Modes 0x10 to 0xFF**
- **Is already used by many OEMs**
- **Allows/defines enhanced diagnostics**

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Why move away from the status quo?

Arguments for Service Infrastructure

- OBD service data are the same as OBD data for enhanced diagnostic services.
- UDS allows for Authorization, Authentication, Secured Data Transmission (if needed) by using certificates handled by 3rd party.
- UDS is independent from CAN. It is can be used with other transport protocols, e.g. Ethernet.
- Advanced scan tools can easily deploy OBD as well as Enhanced diagnostics.
- UDS is the basis for ISO 27145, which is used for HD Euro VI.

8

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Why move away from the status quo?

Arguments for UDS:

- allows for 3 byte DTCs + additional info using status byte (instead of 2 byte DTCs)
- allows for expanded PID/MIDs/TIDs/INFOTYPE ranges.
- supports multiple Freeze Frames, e.g. 4 frames.
- is compatible with service info, e.g. ODX, OTX...
  - ODX = *Open Diagnostic Data Exchange,* ISO 22901
  - OTX = Open Test sequence eXchange, ISO 13209
- Is already in use by many of vehicle manufacturers.

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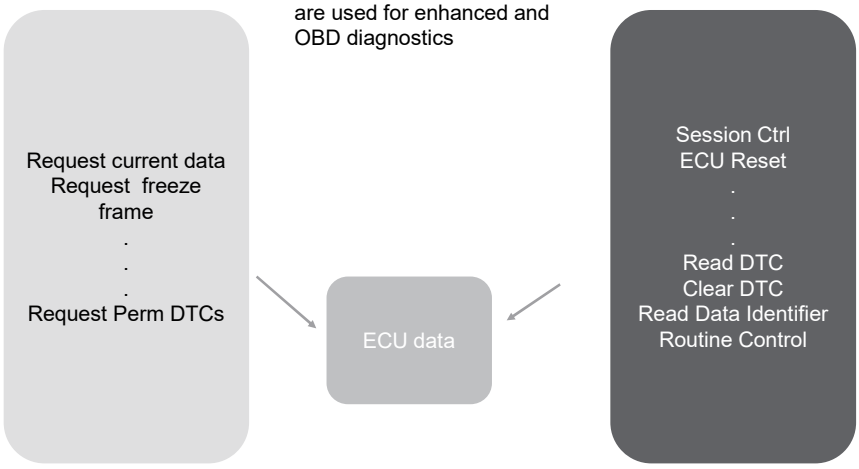
Today's solution

SAE J1979 Classic

ISO 14229-1

Different services/protocols are used for enhanced and OBD diagnostics



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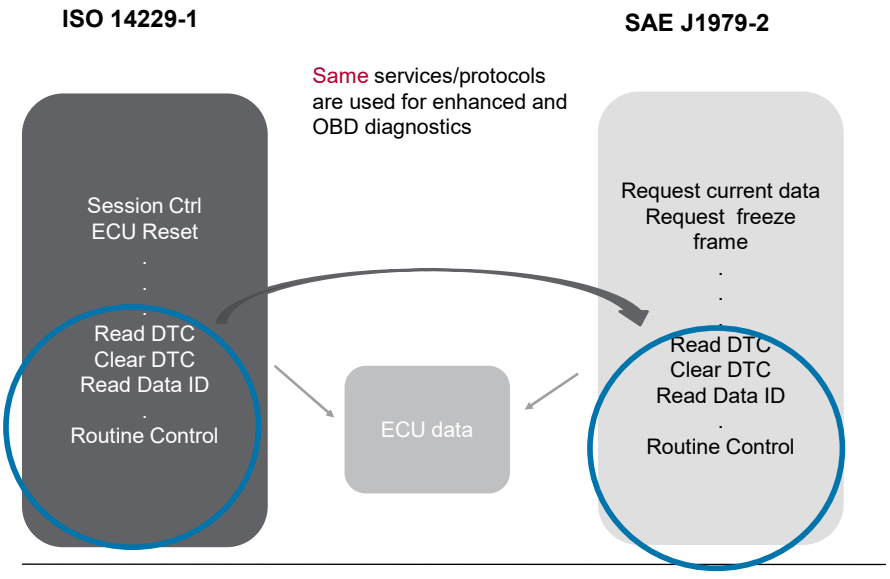
In Discussion



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Overview Service-Mapping (in Discussion)

SAE J1979		ISO 14229	
Service	**Name**	**Service**	**Name**
Read Out Data			
0x01	Request Current Powertrain Diagnostic Data	**0x22**	ReadDataByIdentifier, PID 0xF4/F5xx
0x09	Request Vehicle Information	**0x22**	ReadDataByIdentifier, PID 0xF8/F9xx
0x06	Request On-Board Monitoring Test Results for Specific Monitored Systems	**0x22**	ReadDataByIdentifier, PID 0xF6/F7xx
Fault Memory			
0x03	Request Emission-Related DTCs	**0x19 42 (08)**	reportWWHOBDDTCByMaskRecord (confirmed)
0x07	Request Emission-Related DTCs Detected During Current or Last Completed Driving Cycle	**0x19 42 (04)**	reportWWHOBDDTCByMaskRecord (pending)
0x0A	Request Emission-Related DTCs with Permanent Status	**0x19 55**	reportWWHOBDDTCWithPermanent Status
0x02	Request Powertrain Freeze Frame Data	**0x19 04**	reportDTCSnapshotRecordByDTCNumber
0x04	Clear/Reset Emission-Related Diagnostic Information	**0x14**	
Control OBD System			
0x08	Request Control of On-Board System, Test or Component	**0x31 01**	StartRoutine, RID 0xE000 - 0xE1FF[12]

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Data - Changes in J1979 DA

Data Identifier (DID): 2 byte identifier for a data item, e.g. PID, OBDMID, InfoType (see table)

Routine Identifier (RID): 2 byte identifier for a routine (e.g. ”EVAP leakage test”)

Type	Service	SAE J1979-Classic ID	SAE J1979-UDS ID
PID	0x01	0x00-0xFF	0xF400-0xF5FF
MID	0x06	0x00-0xFF	0xF600-0xF7FF
InfoType	0x09	0x00-0xFF	0xF800-0xF8FF

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Data - Changes in J2012 DA

2 Byte Definition		3 Byte Definition			
DTC	Name	DTC	Component / System Name	FTB	Fault
P0001	Fuel Volume Regulator Control Circuit/Open	P0001	Fuel Volume Regulator Control	13	Circuit Open
P0002	Fuel Volume Regulator Control Circuit Range/Performance	P0001	ISO/SAE Reserved - Previously Defined for 2-Byte DTCs	92	Performance or Incorrect Operation
P0003	Fuel Volume Regulator Control Circuit Low	P0001	ISO/SAE Reserved - Previously Defined for 2-Byte DTCs	11	Circuit Short To Ground
P0004	Fuel Volume Regulator Control Circuit High	P0001	ISO/SAE Reserved - Previously Defined for 2-Byte DTCs	12	Circuit Short To Battery

- (limited) backward compatibility
- Recycle „formerly used“ DTCs (70%)
- 3 byte = 2 byte DTC + Failure Type Byte (FTB)
- 3 byte DTC definition with FTBs allows more precise pin-pointing of different faults.
- additional byte (Status of DTC) is defined in UDS

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What effect will it have?

- **OEMs will need to:**
  - Update current UDS implementations or,
  - Implement UDS services via J1979-2
- **Tool vendors will be most affected**
  - Need to support new services and data
  - Need to be able to display information in a logical manner
  - J1978 (J1979 equivalent for tools) will be updated to reflect changes to J1979
- **Technicians will have new and different data for use in diagnosis**
  - More PIDs
  - More vehicle data
  - Updated readiness groups
  - Updated DTC information

15

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Thank you

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Andreas Scholl	Valeo Siemens	

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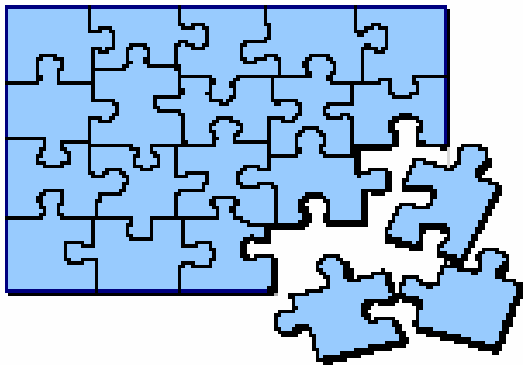

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UDS Services for OBD-II

Fred Garza
(Frederico.Garza@arb.ca.gov)
California Air Resources Board

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Agenda

- What is UDS?
- What is currently provided with OBD-II, i.e., SAE J1979?
- How will OBD-II change with UDS services, i.e., SAE J1979-2?
- How will this impact current I/M programs, i.e., Smog Check?

CARB

1

What is UDS?

- Unified Diagnostic Services (UDS)
  - Software in control modules that enable diagnostic services to be performed at the request of an external scantool
    - Can supply diagnostic info about a control module
      - Fault codes (i.e., diagnostic trouble codes (DTC)), live data, perform actions, run software routines, etc.
      - Not really standardized and not all vehicles use it
      - Documented in ISO 14229

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What is UDS? (con't)

- Proposal is to mandate and standardize some features of UDS for legislative OBD-II; now called J1979-2
  - Allow usage for 2022MY vehicles and require by 2026MY
  - Still use CAN communication (i.e., pins 6 + 14) on current OBD-II connector (J1962)
  - Vehicles will be required to use UDS for all OBD-II communications and won't respond to currently-used protocols

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What standardized data is currently provided with OBD-II, i.e., SAE J1979?

OBD Functionality	J1979 (OBD-II)
DTC Byte Size	2-byte
ECU Addressing	Functional (i.e., broadcast)
Current Powertrain Data	Mode $01
Freeze Frame Data	Mode $02 (single freeze frame)
Confirmed DTCs	Mode $03
Clear Emission Data	Mode $04
DTC Test Results	Mode $06
Pending DTCs	Mode $07
Bi-Directional Control	Mode $08
Vehicle Information	Mode $09
DTC IUMPR	Mode $09 Infotype 08/0B
Permanent DTCs	Mode $0A

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4

4

What standardized data is currently provided with OBD-II, i.e., SAE J1979? (con't)

Readiness Groups

Spark Ignition Readiness Groups	Compression Ignition Readiness Groups
Misfire	Misfire
Fuel system	Fuel system
Comprehensive component	Comprehensive component
Catalyst	NMHC catalyst
Heated catalyst	NOx after treatment
Evaporative system	Boost pressure system
Secondary air system	Exhaust gas sensor
Oxygen sensor	PM Filter
Oxygen sensor heater	EGR and/or VVT system
EGR and/or VVT system	

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5

5

How will standardized OBD-II data change with UDS services, i.e., SAE J1979-2?

- In keeping up with advances in communication technology, CARB will propose new regulation requirements to include the following features for SAE J1979-2; note some items are still in discussion with the auto industry
  - Update readiness group categories
  - Redefine readiness completion requirements for misfire, fuel system and comprehensive components
  - Tie readiness groups to DTC-specific readiness
    - DTC status byte will be used to provide DTC-specific readiness and other DTC-specific info (i.e., pending status, confirmed status, complete this drive cycle)

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How will OBD-II standardized data change with UDS services, i.e., SAE J1979-2? (con't)

New Readiness Groups

(e)(1)	Catalyst Monitoring
(e)(2)	Heated Catalyst Monitoring
(e)(3), (f)(3)	Misfire Monitoring
(e)(4)	Evaporative System Monitoring
(e)(5)	Secondary Air System Monitoring
(e)(6), (f)(4)	Fuel System Monitoring
(e)(7), (f)(5)	Exhaust Gas Sensor Monitoring
(e)(8), (f)(6)	Exhaust Gas Recirculation (EGR) System Monitoring
(e)(9), (f)(10)	Positive / Crankcase Ventilation (PCV) System Monitoring
(e)(10), (f)(11)	Engine Cooling System Monitoring

(e)(11), (f)(12)	Cold Start Emission Reduction Strategy Monitoring
(e)(13), (f)(15)	Variable Valve Timing, Lift, and/or Control (VVT) System Monitoring
(e)(14)	Direct Ozone Reduction (DOR) System Monitoring
(e)(15), (f)(15)	Comprehensive Component Monitoring
(e)(16), (f)(16)	Other Emission Control or Source System Monitoring
(f)(1)	Non-Methane Hydrocarbon (NMHC) Converting Catalyst Monitoring
(f)(2)	Oxides of Nitrogen (NOx) Converting Catalyst Monitoring
(f)(7)	Boost Pressure Control System Monitoring
(f)(8)	NOx Adsorber Monitoring
(f)(9)	Particulate Matter (PM) Filter Monitoring

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How will standardized OBD-II data change with UDS services, i.e., SAE J1979-2? (con't)

	Status Bits in Status Byte	Supported	Remark
0	TestFailed	OBD	
1	TestFailedThisOperationCycle	OBD	Used for trigger condition for Freeze frame (latest occurence)
2	PendingDTC	OBD	
3	ConfirmedDTC	OBD	
4	TestNotCompletedSinceLastClear	OBD	DTC based readiness since last clear
5	TestFailedSinceLastClear	Optional for OEM	Not required for OBD
6	TestNotCompletedThisOperationCycle	OBD	DTCbased readiness this operation cycle
7	WarningIndicatorRequested	Optional for OEM	Not required for OBD

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How will standardized OBD-II data change with UDS services, i.e., SAE J1979-2? (con't)

- DTC-specific IUMPR and test results service
- Freeze frame support for 5 DTCs where each DTC will have two allotted freeze frames (one for first occurrence and the second for most recent occurrence)
- Failure Type Byte (FTB) added to current DTC names (i.e., P0100-XX) to create more DTCs available for use
  - Standardized FTBs documented in SAE J2012
- Add EVAP system sealing and Diesel Particulate Filter (DPF) regeneration functionality

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SAE J1979 vs. SAE J1979-2

OBD Functionality	J1979 (OBD-II)	J1979-2 (OBD-II UDS)
DTC Byte Size	2-byte	3-byte (2-byte OBD + 1-byte Failure Type Byte)
ECU Addressing	Functional (i.e., broadcast)	Functional and Physical (i.e., broadcast and point-to-point)
DTC Status Byte	No support	Provides additional DTC info (i.e., pending, confirmed, complete, pass/fail)
Current Powertrain Data	Mode $01	Service $22
Freeze Frame Data	Mode $02 (single freeze frame)	Service $19 Subfunction $04 (two freeze frames for at least 5 DTCs)
Confirmed DTCs	Mode $03	Service $19 Subfunction $42 with status byte bit 3 mask
Clear Emission Data	Mode $04	Service $14
DTC Test Results	Mode $06	Service $19 Subfunction $06 (support test results for more DTCs)
Pending DTCs	Mode $07	Service $19 Subfunction $42 with status byte bit 2 mask
Bi-Directional Control	Mode $08	Service $31
Vehicle Information	Mode $09	Service $22

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SAE J1979 vs. SAE J1979-2 (con't)

OBD Functionality	J1979 (OBD-II)	J1979-2 (OBD-II UDS)
DTC IUMPR	Mode $09 Infotype 08/0B	Service $19 Subfunction $06 (support IUMPR for more DTCs)
Permanent DTCs	Mode $0A	Service $19 Subfunction $55
List of DTCs within each Readiness Group	No support	Service $19 Subfunction $56
List of DTCs that support IUMPR	No support	Service $19 Subfunction $1A $91
List of DTCs that support Test Results	No support	Service $19 Subfunction $1A $92

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How will this impact current I/M programs?

- Update of scantool or interface required
  - Either software and/or hardware updates
  - More memory to account for the new larger message responses
- Update of database storage
  - To account for new data (both size and format)
- New readiness categories can be used as additional failure criteria (more data to determine if vehicle ran it's emissions self checks prior to I/M test)

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Questions/Comments?

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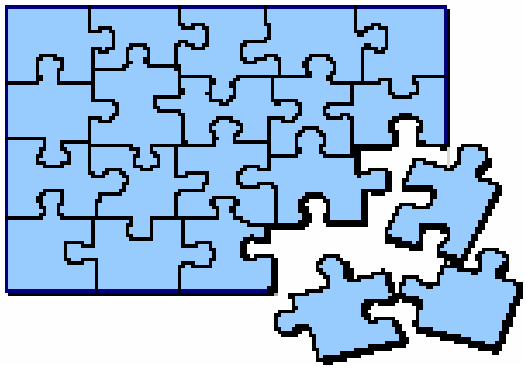

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Key Topic:
GST Implementation of J1979-2

BCarr – 2020-06-01

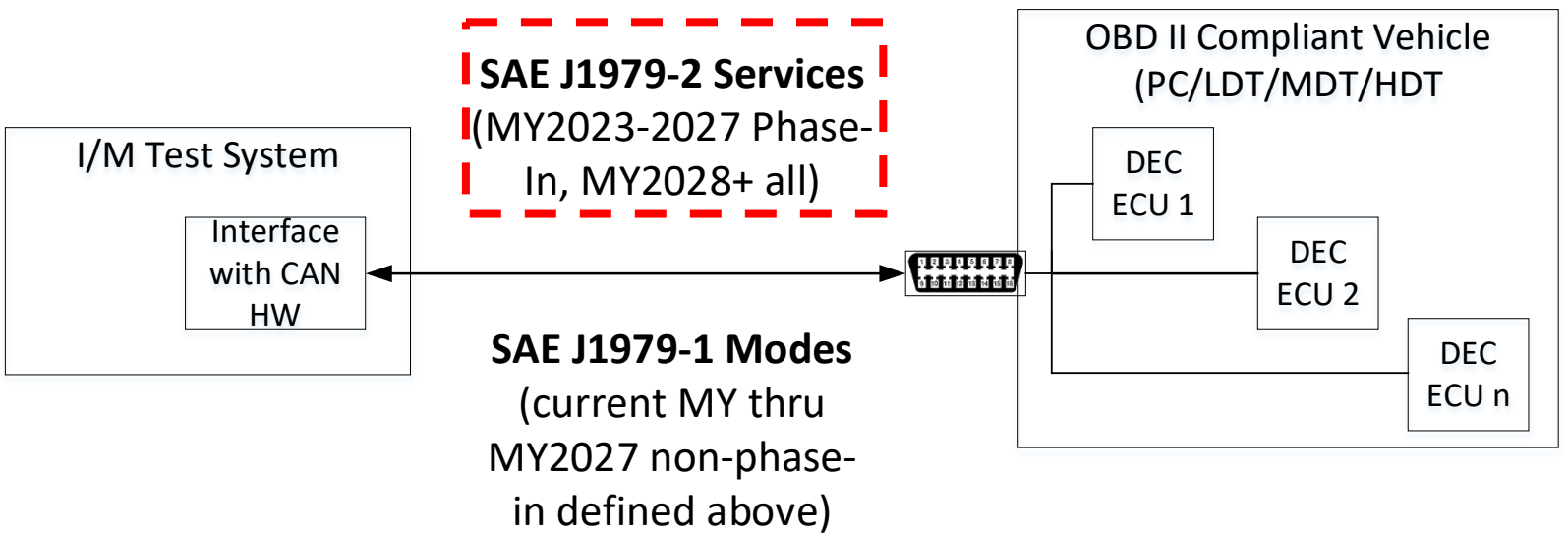
Key Topic: GST Implementation of J1979-2

- Presentation focus:
  - Generic Scan Tool (GST) portion of the I/M Test
  - Communication to vehicle diagnostic emission controllers (DEC ECU)
  - Bring forward a few functional differences
  - Pre-thinking to an Inspection and Maintenance Test System Update
  - Main points are highlighted RED

- Information as accurate as possible on 6/8/2020
  - Keep in mind: content is subject to change until SAE J1979-2 is published !!!

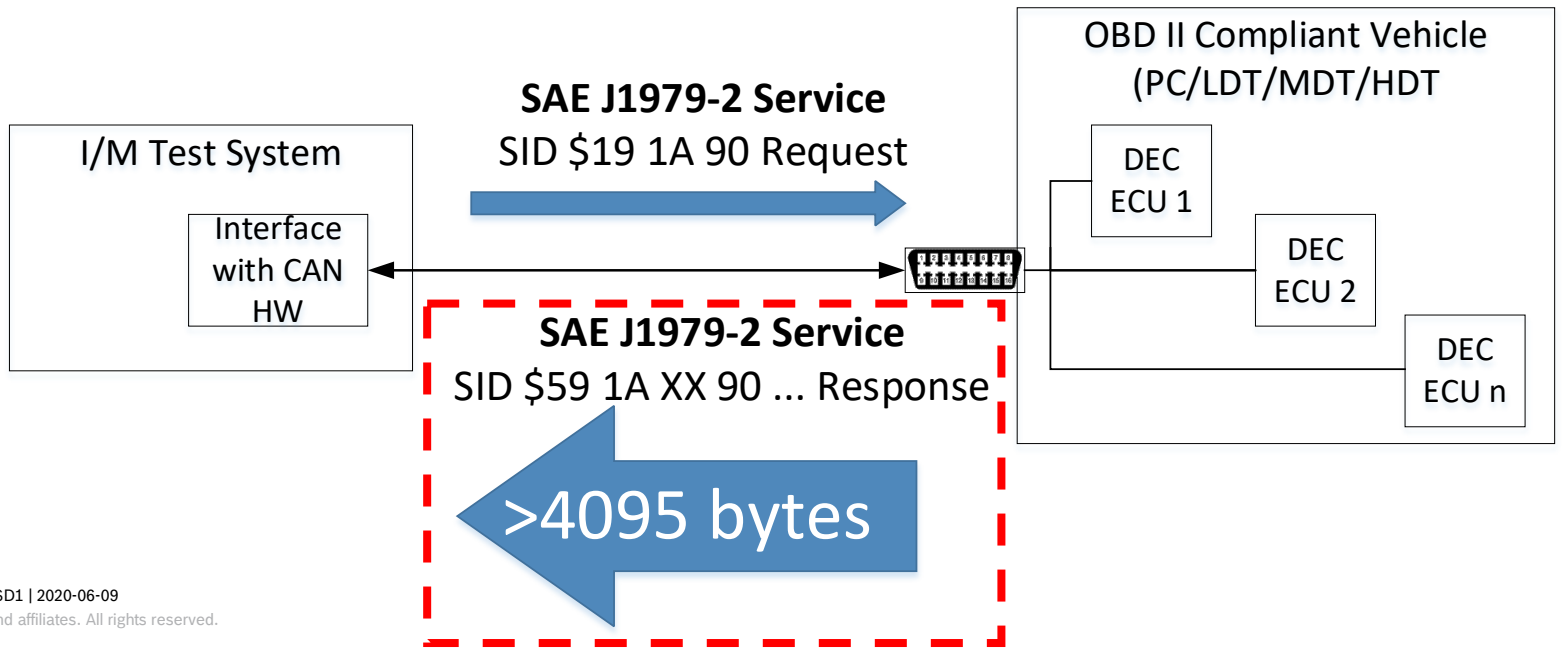
Key Topic: GST Implementation of J1979-2

- (new) Diagnostic Services recommended practice document -> SAE J1979-2
  - Messages per ISO 14229-1
- Diagnostic Test Modes recommended practice document -> SAE J1979-1
  - Messages per ISO 15765-4



Key Topic: GST Implementation of J1979-2

- Large response messages
  - Some response messages will have a message length greater than 4095 bytes
    - For reference: ISO 15765-2:2016 defines 32 bit msg length == 4096 bytes to 4.2GB
    - Initial message length estimation is ~5kb to 12kb (from on DEC ECU)
  - Requires Communication Interface to support First Frame Escape Sequence

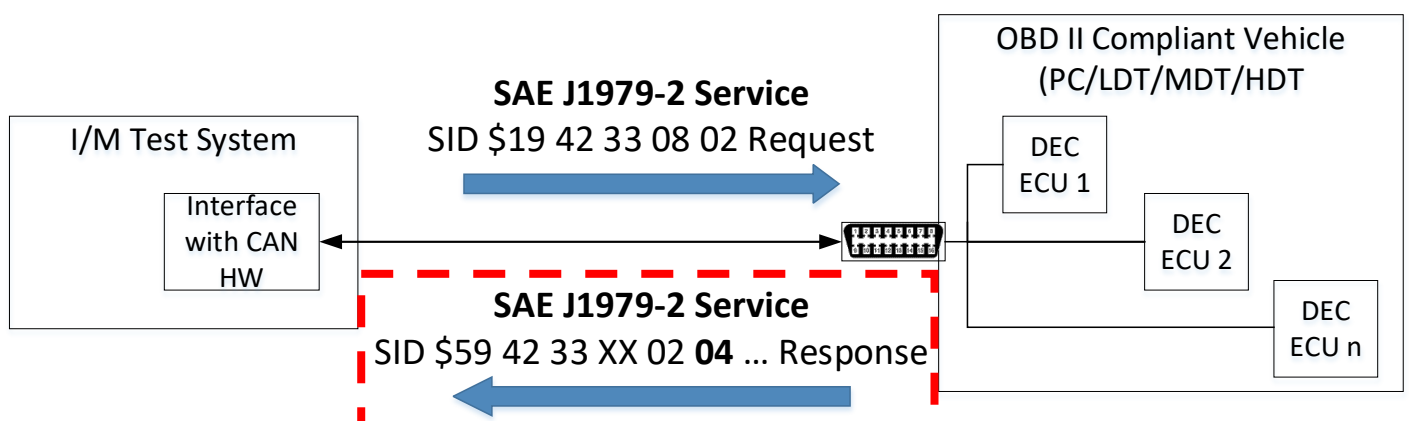


Key Topic: GST Implementation of J1979-2

- Decoding DTC Format in the response message
  - A one byte identifier which specifies the format of DTCs
  - DTC response message will have DTCFormatIdentifier in byte 6
    - PC/LDT vehicles will use SAE_J2012-DA_DTCFormat_04
    - MDT/HDT vehicles will use SAE_J1939-73_DTCFormat_02
  - A DEC ECU can only support one DTC Format

Data Byte	Parameter Name	Cvt	Value (hex)	Mnemonic
6	DTCFormatIdentifier=	M		
	SAE_J2012-DA_DTCFormat_04		04	J2012-DADTCF04
	SAE_J1939-73_DTCFormat_02		02	J1939-73_DADTCF02

Response Message



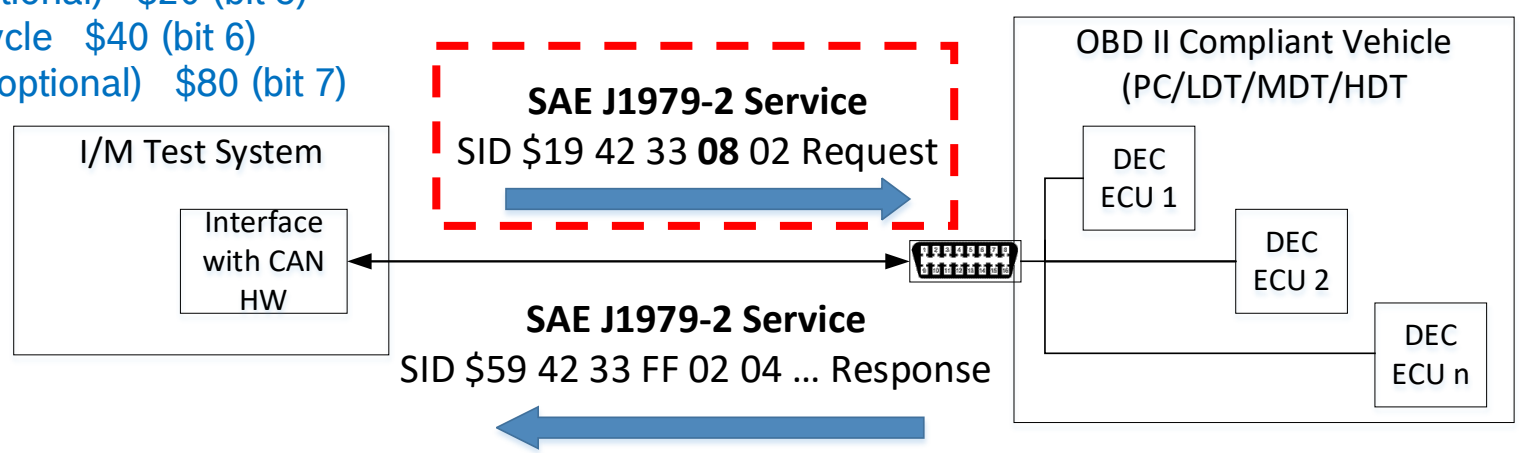
Key Topic: GST Implementation of J1979-2

- Multiple DTC Status Mask Formats can be defined:

TestFailed $00 (bit 0)
TestFailedThisOperationCycle $02 (bit 1)
PendingDTC $04 (bit 2)
ConfirmedDTC $08 (bit 3)
TestNotCompletedSinceLastClear $10 (bit 4)
TestFailedSinceLastClear (OEM optional) $20 (bit 5)
TestNotCompletedThisOperationCycle $40 (bit 6)
WarningIndicatorRequested (OEM optional) $80 (bit 7)

Data Byte	Parameter Name	Cvt	Value (hex)	Mnemonic
4	DTCStatusMask = confirmedDTC	M	**08**	DTCSM

Request Message



Key Topic: GST Implementation of J1979-2

- Four key topics with J1979-2 implementation were covered today…there likely will be more
- So here we are in June 2020
  - Content in SAE J1979-2 will be changing until the recommended practice passes ballot
  - Rough publication date is talked about by end of CY2020
- Meanwhile a lot of work is still yet to be done to complete SAE J1979-2 RP

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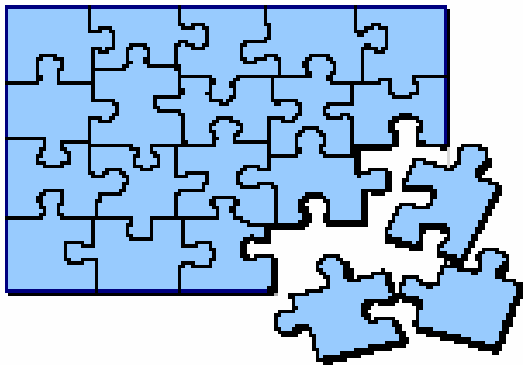

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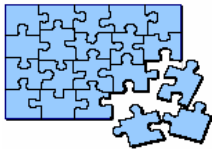

Thank You